# INTRODUCTION TO THE FACULTY OF ENGINEERING

## Historical Background

The Faculty of Engineering was established by a Royal Decree issued by His Majesty King Khaled Bin Abdulaziz on 6th Dhul Hijja 1394H (January 9th, 1975). Students started their studies in the academic year 1395/1396 (1975/1976) in six departments namely, Civil Engineering, Mechanical Engineering, Electrical Engineering, Industrial Engineering, Nuclear Engineering and Mining Engineering.

Starting from the academic year 1401/1402H (1981/1982G) several changes were introduced in the structure of the Faculty of Engineering. In that year the Department of Chemical Engineering was established as a separate Department which was working as a division of the Department of Mechanical Engineering from 1394H (1975G) until 1401/1402H (1981/1982G). The University Council, in 1402H (1982G), reorganized the Department of Mechanical Engineering into three separate departments: Production Engineering and Mechanical Systems Design, Thermal Engineering and Desalination Technology and Aeronautical Engineering. Also in the same year, Sanitary Engineering was introduced as one of the main specializations of the Department of Civil Engineering and Biomedical Engineering was introduced as one of the main specializations of the Department of Electrical Engineering. In the year 1407H (1987G), The University Council approved the change in the name of the Department of Electrical Engineering to the Department of Electrical and Computer Engineering. Finally in 1410H (1990G), the University Council decided to change the name of the Department of Chemical Engineering to the Department of Chemical and Materials Engineering.

The Faculty of Engineering at King Abdulaziz University is unique in certain respects. It is the only faculty in the Kingdom that has departments offering programs in Biomedical Engineering, Nuclear Engineering and Aeronautical Engineering.

## Vision and mission of the Faculty of Engineering

The **vision of the Faculty of Engineering** at King Abdulaziz University is as follows:

*"To pioneer and innovate in Engineering sciences and their applications"*.

The **mission of the Faculty of Engineering** is as follows:

*"To prepare distinguished engineers and to pioneer in conducting research and studies and in transferring knowledge and technology, all for ultimately serving and developing the society"*.

## Guiding Principles and Core Values

All the activities of the Faculty are guided by the following principles and core values which are deeply rooted in our Islamic and cultural heritage:

- Pioneering (innovation, creativity, distinction)
- Quality (continuous improvement and development toward perfection)
- Professional ethics
- Team work
- Belonging and loyalty.

## Qualities of Engineering Graduates

The Faculty of Engineering is fully aware of its responsibilities towards its graduates as depicted in the above mentioned mission statement. In order to support the mission of the faculty as well as the mission of the university the Faculty is preparing engineering graduates who possess the following career and professional capabilities which are implicitly included in the educational objectives of different Engineering Programs:

- **Perform professionally:** exhibit integrity, behave ethically, accept responsibility, take initiative, and provide leadership.
- **Demonstrate technical competence:** think creatively, search broadly and use state of the art engineering tools to identify and formulate safe innovative approaches.
- **Work efficiently:** act as an effective team member and use formal and informal communication skills as well as project management techniques to ensure timely and within-budget completion of work projects.
- **Keep commitment:** remain business focused, quality oriented, and committed to personal professional development as well as the sustainable development of the society.

## Outcomes of Students Learning Experience

The study programs in the Faculty of Engineering are designed to give the students a learning experience to progressively build up a set of skills that help them achieve educational objectives of their study programs. The Faculty of Engineering has adopted the following eleven ABET outcomes (i.e. a-k criteria) as general learning outcomes which are explicitly included in the learning outcomes of all engineering programs in addition to any other outcomes stipulated by the Department for the achievement of its educational objectives (stated as criteria l, m and n).

Learning outcomes are considered as statements that describe what students are expected to know and be able to do by the time of graduation and they relate to the skills, knowledge and behaviors that students acquire in their matriculation through the engineering program. It is the responsibility of each engineering program to have one or more processes that identify, collect, and prepare data to evaluate the achievement of these outcomes by the time of graduation. Each program must also have one or more processes to interpret the data and evidences accumulated through the assessment practices to determine the extent to which the eleven outcomes are being achieved, and to take decisions and actions to improve the program.

Engineering programs in the Faculty of Engineering provide the students with a learning experience that permits them to build up the following skills and abilities:

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

## Academic Accreditation of the Faculty of Engineering Programs

The 12 programs of the Faculty of Engineering at King Abdul Aziz University have gone over years through the international accreditation process of ABET Inc., previously known as the Accreditation Board for Engineering and Technology. ABET, Inc., which is the recognized accreditor for college and university programs in applied science, computing, engineering, and technology in the US, is a federation of 30 professional and technical societies representing these fields. Among the most respected accreditation organizations in the U.S., ABET has provided leadership and quality assurance in higher education for over 75 years. ABET currently accredits some 3,100 programs at more than 660 colleges and universities inside the US and worldwide.

## ABET Terminology Used By the Faculty of Engineering

The 12 programs of the faculty of Engineering adopt the following ABET terminology:

*Program Educational Objectives* (PEOs): broad statements that what graduates are expected to attain within a few years of graduation. The program must have published program educational objectives that are consistent with the mission of the institution, the needs of the program's various constituencies, and these criteria. There must be a documented and effective process, involving program constituencies, for the periodic review and revision of these program educational objectives.

*Student Outcomes* (SOs): Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program. Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program. The program must have documented student outcomes that prepare graduates to attain the program educational objectives.

*Course Learning Outcomes/Objectives* (CLOs): specific observable (measurable) actions that the students should be able to perform if they mastered the course materials. ABET requires specifying how these CLOs are related to the student outcomes and the degree to which the course will contribute to the achievement of the student outcomes.

*Assessment*: one or more processes that identify, collect, and prepare data to evaluate the attainment of student outcomes and program educational objectives. Effective assessment uses relevant direct, indirect, quantitative and qualitative measures as appropriate to the objective or outcome being measured. Appropriate sampling methods may be used as part of an assessment process.

*Evaluation*: one or more processes for interpreting the data and evidence accumulated through assessment processes. Evaluation determines the extent to which student outcomes and program educational objectives are being attained. Evaluation results in decisions and actions regarding program improvement.

## ABET Outcomes versus NCAAA Domains of Learning

The National Commission for Academic Accreditation and Assessment (NCAAA) has been established in the Kingdom of Saudi Arabia with responsibility for determining standards and criteria for academic accreditation and assessment, and accrediting post secondary institutions and the programs they offer. The Commission is committed to a strategy of encouraging, supporting, and evaluating the quality assurance processes of post secondary institutions to ensure that quality of learning and management of institutions are equivalent to highest international standards. These high standards and levels of achievement must be widely recognized both within the Kingdom, and elsewhere in the world.

The domains used in the higher education component of the National Qualifications Framework for Saudi Arabia are

- Knowledge, (the ability to recall and present information),
- Cognitive Skills (the ability to apply concepts and principles in thinking and problem solving),
- Interpersonal Skills and Responsibility, (the ability to work effectively in groups, exercise leadership, and take responsibility for their own independent learning, and the ethical and moral development that is associated with these abilities), and
- Communication, Information Technology and Numerical Skills (including basic mathematical and communication skills and ability to use communications technology).
- Psychomotor skills are very important in some fields of study and are considered as an additional domain where relevant to the program concerned.

Engineering programs in the Faculty of Engineering provide the students with a learning experience that permits them to build up the skills and abilities according to ABET criterion 3 as stated earlier. Student outcomes (a) through (k) plus any additional outcomes that may be articulated by the program must foster attainment of program educational objectives.The faculty administration has been developping an assessment and evaluation process that periodically documents and demonstrates the degree to which the student outcomes are attained. As compared to the 5 domains of learning stipulated by the National Commission for Academic Accreditation and Assessment (NCAAA), we notice the following:

1. NCAAA Psychomotor domain is not applicable for Engineering programs
2. All ABET outcomes require a level of learning in the engineering subjects that is higher than knowledge. A minimum level of learning of application (level 3) in the 6 levels of the cognitive domain of Bloom's taxonomy is required.
3. Only basic math and science courses are limited to a knowledge level of learning.
4. Knowledge of discipline-related industrial practices is also required and is normally satisfied through the summer training activity.

As a result of this discussion the 4 NCAAA domains of learning are mapped in the outcomes of Engineering Programs as follows:

i. Knowledge

Outcome (1): Knowledge of facts, concepts and theories of Math and basic sciences.

Outcome (2): Knowledge of discipline-related industrial practices and procedures.

ii. Cognitive Skills

Outcome (a): an ability to apply knowledge of mathematics, science, and engineering
Outcome (b): an ability to design and conduct experiments, as well as to analyze and interpret data
Outcome (c): an ability to design a system, component, or process to meet desired needs within realistic constraints such as ……..
Outcome (e): an ability to identify, formulate, and solve engineering problems
Outcome (h): the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
Outcome (j): a knowledge of contemporary issues
Outcomes (l- m): body of working knowledge specified in the program criteria.

iii. Interpersonal Skills and Responsibility

Outcome (d): an ability to function on multidisciplinary teams
Outcome (f): an understanding of professional and ethical responsibility
Outcome (i): a recognition of the need for, and an ability to engage in life-long learning.

iv. Communication, IT, and Numerical Skills

Outcome (g): an ability to communicate effectively
Outcome (k): an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
Outcome (a): an ability to apply knowledge of mathematics, science, and engineering.

To sum up the contribution of each course to the satisfaction of program learning outcomes is expressed using a table in the following format:

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | m | n | d | f | i | g | k | a | l |
| Maximum Attainable Level of Learning* | | | | | | | | | | | | | | | | | |

*1: Low level (Remembering & Understanding), 2: Medium (Applying & Analyzing), 3: High (Producing & Evaluating)

## Departments and Degree Programs of the Faculty of Engineering

The Faculty consists of the following nine Departments as indicated in the table:

| **DEPARTMENT** | **CODE** | |
|---|---|---|
| | **ARABIC** | **ENGLISH** |
| Aeronautical Engineering | هـ ط | AE |
| Chemical & Material Engineering | هـ كم | ChE |
| Civil Engineering | هـ مد | CE |
| Electrical & Computer Engineering | هـ ك | EE |
| Industrial Engineering | هـ ص | IE |

| | | |
|---|---|---|
| Nuclear Engineering | هـ ن | NE |
| Mining Engineering | هـ ت | MinE |
| Production Engineering & Mechanical Systems Design | هـ مك | MENG |
| Thermal Engineering & Desalination Technology | هـ مق | MEP |

The Faculty offers the Bachelor's Degree in the following 14 programs (in alphabetical order):

1. Chemical Engineering.
2. Civil Engineering.
3. Electrical Engineering (Biomedical).
4. Electrical Engineering (Computer).
5. Electrical Engineering (Electrical Power and Machines).
6. Electrical Engineering (Electronics and Communications).
7. Industrial Engineering.
8. Mechanical Engineering (Aeronautical).
9. Mechanical Engineering (Production Engineering and Mechanical Systems Design).
10. Mechanical Engineering (Thermal Engineering and Desalination Technology).
11. Mining Engineering.
12. Nuclear Engineering (Nuclear Power).
13. Nuclear Engineering (Radiation Protection).
14. Nuclear Engineering (Medical Physics).

*N.B.: The Chemical and Materials Engineering Department offers only one BS program, namely Chemical Engineering. In that department the Materials track is applicable only for the MS program. The Electrical Engineering Department, on the other hand, offers four BS programs while the Nuclear Engineering Department offers 3 programs.*

# STUDENT SERVICES

## Awards

The following awards are available to students in the Faculty of Engineering:

- **Monthly award**: An award of 1000 Saudi Riyal per month is given to every Saudi BS student and also to every non-Saudi BS student who is on a granted scholarship.
- **Distinction award**: An award of 1000 Saudi Riyal is granted to every student who secures an average grade of distinction (A or A+) in two consecutive semesters. This award serves as an incentive for advanced students to maintain their high level of achievement.
- **Books and References Allowance**: An amount of 3000 Saudi Riyal is given to every graduate student once during his regular period of study.
- **Thesis Allowance**: An amount of 3000 Saudi Riyals for the M.Sc. student and 4000 Saudi Riyals for the PhD student are given to the student to cover some of the costs incurred in preparation of the thesis.

## Housing, Nutrition, and Medical Care

### *Housing*

The University has constructed an ample number of student housing units within or at the outskirts of the University campus. Two types of housing are available:

- Married Student Housing: Available to all married students.
- Single Student Housing: Available to all students whose families reside outside Jeddah (including those who are on scholarships). This type of housing is also available if a student's family circumstances necessitate.

Supervision of the students in these housing units, and the general management of the units is the responsibility of well-trained and qualified personnel. These supervisors are helped by assistant supervisors who take over the supervision duty as well as the task of handling emergencies during evening and night periods. New students are to contact the Deanship of Students Affairs to obtain their free housing.

### *Nutrition*

The University has a central kitchen that prepares meals to be distributed to a certain number of dining halls within the housing units or inside the University campus. Meals are offered to all students at highly subsidized prices.

### *Medical Care*

The university provides free medical treatment for all students at the University Clinic which is conveniently located near the center of University campus, and has clinics covering all main medical specialties.

### *Student Activities*

The first article of the basic statutes of King Abdulaziz University has set five main goals amongst which is: *To Promote cultural, sporting, social, and scientific activities*. This goal is to be pursued for the well being of Saudi society in general and for the University in particular. The Deanship of Student Affairs in the University collaborates through various committees with the various Faculties in supervising the extra-curricular activities, which aim at achieving the following objectives:

- To participate in developing the integrity and balanced personality of the university students.
- To support Islamic education and to direct students to commit themselves to the Islamic code of conduct.
- To develop the talents of the students and improve their capabilities and assist them in acquiring useful knowledge and experience.
- To get the students accustomed to participating in social activities, to develop brotherly relations among them, and to develop a harmonious relationship based on mutual respect among themselves and their professors.
- To provide students with means of comfort, convenience and assurance.
- To educate the students about the roles they have to play in their society and to enforce in them the feelings of belonging to their country.

In recognition of the importance of student activities and their role in the bringing up of the youthful students, the university rules dictate that the university Rector should act as the General Chairperson of the Higher Committee for Student Activities, with the Dean of Student Affairs acting as his Deputy. The Faculty of Engineering takes care of, and supports, the student activities, through the following committees with specific purpose assigned to each of them:

### 1. Committee for Promotion of Islamic Awareness

This Committee strives to help develop students' understanding of Islamic theology and law, to enforce practical commitment to the Islamic code of conduct, to strengthen the association with the glorious Qur'an through memorization, recitation and mastering the rules for perfect recitation, to strengthen the Islamic brotherly relations, and to prepare students to face foreign ideologies. The Committee for Promotion of Islamic Awareness organizes lectures, meetings and trips, which are usually of an educational nature. The committee also participates in the activities organized by the General Committee for Promotion of Islamic Awareness and it also takes part in the central programs arranged by the Deanship of Student Affairs.

### 2. Committee for Cultural Activities

This Committee aims at the development and improvement of student talents and potentials in cultural, artistic and literary fields. It also tries to develop creativity and inventiveness within students, to enable them to acquire general knowledge, and to lead them to interact wisely with the different cultures of the world.

The committee organizes lectures, cultural, scientific and literary meetings, trips as well as scientific and cultural visits. It also takes part in the activities of the University Central Committee of Cultural Activity, and in the central activities of the Deanship of Student Affairs. These activities are numerous and diverse and include the following:

- Hobby Clubs (e.g. Photography, Theatre, Arabic Calligraphy, Drawing)
- Literary Clubs (Poetry, Novels, Short Stories and Plays)
- Cultural Competitions, Scientific Research Competitions and Technical hobbies.
- Cultural and Artistic Exhibitions
- Social Club.

### 3. Committee for Social Activities

This Committee tries to help students develop adaptation, strengthen the relationships between students and professors, realize proper social life for the youth in the light of Islamic ethics and principles, bring about a spirit of cooperation, friendship and intimacy, establish avenues for appropriate and useful entertainment and, finally, to train students to do and give their best with sincerity, self-denial and appreciation of the public interest.

The committee organizes lectures, meetings and social trips and visits. It participates in social competitions and arranges get-to-know-each-other parties. It also participates in the activities of its parent committee as well as in the programs of the Deanship of Student Affairs.

### 4. Committee for Athletic Activities

This Committee attempts to spread knowledge about various sports, promote physical fitness, and facilitate student training and participation in sport competitions. The aim is to develop perseverance, sport spirit and attitudes, spirit of positive competition, leadership, organization, and collectivism.

The student sporting activities in the Faculty of Engineering and in the University include, among others, soccer, basketball, volleyball, handball, tennis, table tennis, horsemanship, swimming, judo, karate.

The committee participates in sport competitions organized by the University. It also participates in the activities of its parent committee at the University level as well as in the activities of the Deanship of Student Affairs. The various teams representing the Faculty of Engineering normally win distinguished positions in these competitions.

### 5. Scouting Society

The students of the Faculty of Engineering can participate in the activities of the Scouting Society of the University. The objectives of this Society include training the students to get prepared for public service at any time, train them to the ethics of truthfulness, honesty, preferring others to oneself, obedience, and full adherence to the rulings of Islam. Further objectives include stressing the brotherly feeling and attitudes among the believers, establishing the good examples to be followed and strengthening the meaning of manhood, gallantry and both self-reliance and self-denial.

The society organizes trips, camps, and camping expeditions. It participates in all scouting activities and competitions organized within the Kingdom of Saudi Arabia and the Arabian Gulf States.

### 6. Equestrian Club

King Abdulaziz University distinguishes itself among all Saudi and Arab Universities in the great interest it takes in horsemanship and in the great care it directs toward recreating the Arab heritage associated with it. To serve these ends, the University established a special club for horsemanship in which all students of the university can take part so as to get ample training on this popular sport.

Participation in all activities of the committees for student activities is open to all students of the Faculty of Engineering who desire to do so. Every committee for student activity consists of one staff member acting as its head or facilitator beside six members including the activity supervisor within the Faculty of Engineering plus five student members who are elected by the general body of students under the supervision of the Deanship of Students Affairs. The committee selects one of its members to act as its secretary.

### Facilities for Sport Activities at the University

King Abdulaziz University provides several facilities where the students can participate in individual and team sports. These facilities include:

- The soccer (football) stadium: includes a soccer field, a running track, a jumping domain, and a hall for exertion sports.
- The physical-training tent: It includes playgrounds for basketball, volleyball, handball, table tennis and the flying feather beside facilities for judo, taykondo, and physical fitness.
- The swimming pool.
- The horsemanship club.
- Playgrounds in the housing units for basketball and tennis.

### The Ideal and Outstanding students

Every year the Faculty of Engineering honors one of its students as an ideal or exemplary student. Criteria of selecting this student include his scholastic achievement as evidenced by his GPA, which should be no less than 3.75/5.00 or "VERY GOOD". They also include the nature of student participation in the extra-curricular activities, and the rating given to him by his own department as regards his general behavior, conduct, and commitment. The University elects its own exemplary student from those of the various Faculties.

In addition to honoring an exemplary student, the Faculty of Engineering nominates four students as outstanding students. These should have superior or distinguished contributions in four types of activities: Promotion of Islamic awareness, Cultural, Social, and Athletic.

### Alumni Association

Engineers graduated from the Faculty of Engineering at KAU are members of the Alumni Association. This association is the parent body for keeping graduates in touch with each other and with the University. The benefits of being a member of the Alumni Association include newsletters, an alumni directory, ongoing alumni career services, library privileges and access to the alumni home page on the World Wide Web, invitation to special events and opportunity to participate in educational enrichment and continuing education.

The Faculty of Engineering Alumni Association is an umbrella organization encompassing the development of graduated Engineers, both professionally and personally. The Association promotes excellence in all aspects of its activities to promote communication among graduates and the community, and to develop a powerful professional network. The Alumni Association encourages alumni loyalty, involvement, and investment in advancing the Faculty of Engineering.

### Students Advisory Committee (SAC)

In accordance with the directives of the KAU Deans' Consultation Committee, a Students Advisory Committee (SAC) is formed from senior Faculty Administrators as well as representatives of students from all academic levels. The SAC aims at solving the students' educational problems and difficulties through mutual discussions between the Senior Faculty Administrators, and student representatives. To achieve this purpose, the

SAC is scheduled to hold monthly regular meetings.

The Students Advisory Committee has the following objectives:

- Promotion and development of the educational programs in the Faculty.
- Addressing students' problems and difficulties and helping finding solutions.
- Elevating learning capacities of students.
- Enhancing academic staff/students relationships.

*The SAC is formed of the following members:*

- The Dean of the Faculty of Engineering, Chairman
- Vice-Dean of the Faculty of Engineering Member
- Vice-Dean for Post-graduate Students and Research Member
- Vice-Dean for Development and Total Quality Management Member
- 22 students selected from various Departmental levels and different specialization programs in the Faculty, with one student acting as a coordinator to the Committee.

# ANCILLARY ACADEMIC UNITS

## English Language Unit

The ELC, English Language Center was established at King Abdulaziz University in 1975, when the university invited the British Council to setup a project to teach English to the students of the Faculties of Engineering and Medicine. Over the year project developed and matured and in 1984 the ELC became an independent entity linked to the Faculty of Arts and Humanities, for administrative and Financial purposes. After the ABET substantial equivalency for evaluation all the B.Sc. degree programs of the Faculty of Engineering in 2003, the ELC part dealing with teaching of English language to the Engineering students was transferred to administration of the Faculty of Engineering. It is now functioning as "English Language Unite" in the Faculty with special program for engineering students importing effective English language skills.

## Academic Affairs and Training Unit

The Academic Affairs and Summer Training Unit (AATU) guides and directs Faculty students in all affairs related to their educational progress, e.g., registration, addition, cancellation or determining the equivalence of courses in addition to appointing student advisors, etc. The AATU provides all necessary information concerning registration, addition or cancellation of courses to the respective academic advisors at the start of each semester. Furthermore, the AATU supplies student advisors with an updated record of student grades. In addition, the AATU acts in cooperation with the various Engineering Departments in all matters concerning academic or related student activities.

The AATU endeavors to utilize modern techniques to expedite its activities fairly accurately. Computer programs are developed to regulate various processes for student registration and student counseling. All information concerning every student in the Faculty is continually updated and student records are well documented. Computer programs have been designed to facilitate registration processes, setting time-tables and regulating student specialization at various Engineering Departments. The Administration has also designed computer programs to regulate and control student training in cooperation with external agencies in the country. The Academic Affairs Administration undertakes the following tasks:

### *Preparation, Follow-up and Updating Student Files*

As students enroll in the Faculty, files are established containing student personal data. Additional information, e.g., student grades, student attendance records or any other information concerning the student, is added up to the file during his stay at the Faculty.

### *Student Counseling and Registration*

The AATU handles all routine problems facing new students. Students are directed to ways and means of registering, deleting or adding courses according to their educational program. This goes on for about two semesters. Thereafter, students are distributed among Faculty members for purposes of counseling. The various Departments in the Faculty will then be totally responsible for the counseling of students until their graduation.

The Faculty and academic staff are guided by the following objectives for student counseling:

- Discovering a student's real potential and capabilities and directing him to a suitable specialization where he can be very efficient.
- Helping the student to understand the goals of university education and enabling

  him to select a program of study that suits his interests and to follow up that program.
- Ensuring, through close supervision of his academic records, that the student is continuing in the proper direction and is progressing efficiently towards graduation in his chosen specialization.
- Advising students on proper means of registration at the beginning of each semester and helping them to prepare their time-tables.
- Establishing a cordial relationship between the student and his advisor within the university tradition for purposes of creating a conducive atmosphere for the student to improve his productivity in education.

On the other hand, the student is also obliged to undertake the following:
- The student has to be aware of all academic programs in the University. He has also to be aware of University Statutes and Regulations.
- He has to set his own objectives in a convincing manner that suits his abilities and tendencies.
- He has to be aware of the ways and means of taking up his own decisions regarding his academic goals.
- He has to be responsible and must project a good impression to all.

- ***Registration, Dropping, Addition and Withdrawal***
  The Academic Advisor helps the student register in certain courses according to his program of study. The information is processed through the AATU and the student obtains his computerized time-table. In accordance with the university regulations and on approval of the Academic Advisor, a student may delete or add certain courses. The amended time-table will then be finally approved. Thereafter, the student commences his study for a specific semester.

- ***Major Areas in the Faculty Departments***
  Before the preregistration period, a student who has completed 40-50 credit hours of Faculty core program will consider opting for a specific major. A student looks for a department to join, the Departments recommend acceptance of students in their specializations according to availability of opportunities within the Department and the level of competition among students who want to join the Department. Results of acceptance are announced after approval by the Faculty Dean and Vice-Dean. Newly Accepted students in academic departments are assigned to different academic advisors.

- ***Course Equivalence of Transferred Students***
  The Faculty receives applications from students who wish to transfer from other Universities or from Faculties within the University or from Departments within the Faculty. The Academic and the concerned Affairs Department co-ordinate these activities of student transfer. Courses studied by those students are evaluated and if course equivalencies are established the corresponding requirements are waived in favor of the student.

- ***Examination Time-Table for Core Program***
  Faculty core program courses are generally taught in various sections. In accordance with University regulations, the mid-semester and final examinations for such courses must be held in common. Consequently, the Academic Affairs Administration prepares and organizes the respective core courses examination time-table and undertakes to avoid any conflict a student may be subjected to during the examination period. A student should not be required to take more than two examinations per day.

- ***Communications and Contacts***
  The Academic Affairs Administration acts as a coordinator between students and Faculty Departments. It represents the first entrance to the Faculty where all student affairs are facilitated and his valuable time is utilized constructively. Furthermore, the Administration liaises between the Faculty administration, Registration, and all Engineering Departments in all matters related to student enrollment, preparation of time-table, course registration, addition or omission of courses, opening new sections, closure of sections or enlargement of section capacities. The administration also specifies graduation requirements in cases of ambiguity and finalizes graduation procedures. The Administration coordinates with the Deanship of Admission and Records in all matters related to student interests, e.g., granting letters of introduction, coordinating student non-curricular activities and recommending outstanding students academically and those of good behavior.

- ***Announcements***
  The Academic Affairs Administration handles announcements to students in all matters related to the academic field as it is the sole channel to do so in the Faculty. The student is consequently advised to follow up all announcements displayed in the Faculty premises.

## Training Unit

The need for narrow specializations stems from the fact that a graduate from the Faculty is expected to be well equipped with theoretical and practical knowledge. This will avail the engineering graduate to a liaison between theoretical and practical solutions to production and construction problems facing the society.

In accordance with the major educational objectives, the Faculty of Engineering has adopted a mandatory policy regarding student training. Students will undergo a summer training period as a pre-requisite for obtaining the B.Sc. degree in any specialization. This period extend over two to three months duration during the summer vacations. The Training Unit attempts to avail students with suitable opportunities, otherwise it directs students to opportunities close to their specializations. The Faculty observes that there will be no conflict between summer training and course work.

The summer training commences when a student has completed 90 credit hours, grasped basic engineering fundamentals, and aquired a good background in the English Language. At the end of his training period, a student submits a training report to be evaluated by the respective academic departments. The Faculty through its Summer Training Department arranges summer training opportunities with various establishments (governmental and private) in the country. Steps taken for such arrangement are as follows:

- Submitting students' names ready to take up the training, their total GPA and specialization.
- Coordinating with various establishments in the country for training opportunities.
- Filing up training application forms with all relevant information, e.g., specialization, contact address during summer and telephone number in case of an emergency, etc. Students are also encouraged to seek training opportunities through personal contacts but these have to be approved by respective departments in the Faculty.
- Training opportunities are then classified, tabulated and distributed to suit the student's training needs in view of their prospective specialization.

## The Cooperative Program Stream

The new study plan entitles a student to obtain the BS degree in Engineering either by the regular stream or by the co-operative program stream.

The requirements of the two streams are exactly the same, with the sole exception that the cooperative stream allocates eight units of credit to cooperative work.

To follow the cooperative stream, the student secures the approval of his department to spend a period of engineering work/ apprenticeship/ practical training within an institution performing engineering work that is closely related to the student's specialty. This period of cooperative work extends over a summer session and one main semester. It takes place under the supervision of a faculty member so as to ensure that the student is effectively combining the academic and the practical real-life aspects of his work study.

The cooperative stream allows the student to acquire practical skill and experience within his specialty. Moreover, it enjoys the following additional merits:

- Combining the academic or theoretical interests with the practical or real-life experience for the student.
- Bringing about more interactions between the university and the external organizations, and strengthening the relations between the engineering departments within and outside the university.
- Improving the student's chances for appropriate employment after graduation, since it is quite likely for him to get a job offer at the place of his cooperative work.

## Engineering Consulting and Professional Development Office

The Engineering Consulting and Professional Development Office (ECPDO) mission is to build the most effective partnership between the industry and the Faculty of Engineering at King Abdulaziz University. It is meant to develop research and innovation that benefits society as a whole and foster regional and national industrial and economic development. ECPDO will help to develop innovative programs that provide students with hands-on, real world experience in industry, provide industry with excellent opportunities to advance research, enhance the university's state-of-the-art technology, and recruit the engineering talent of the future. ECPDO's primary objectives are intended to be as follows:

- Prepare the engineering students to become young professionals.
- Prepare a comprehensive training program to improve the communication skills of the engineering students.
- Prepare engineers sensitive to the environment and the society needs.
- Focus on engineering ethics using available economic resources and applying available regulations.
- Expose the students to real-life situations and orient their mentality towards the needs of the industrial society.
- Initiate applied research programs suitable for the undergraduate level to ignite the creativity and competition between the students.
- Initiate an award program to encourage outstanding students to share and implement their ideas.
- Initiate the link between KAU and the industry.
- Emphasize the need of applied research programs to solve industrial problems.
- Focus on community services and solve community problems at the local and national levels.
- Enhance the chances of KAU graduates finding suitable jobs at respectable national and international ventures.

- Establish consulting services for private and government sectors where faculty members and graduate and undergraduate students work together in professional teams.
- Establish a bank of ideas.
- Establish a reward system for participants.

In achieving the above objectives, it is believed that the Faculty of Engineering will be able to transfer the results of University research to the public by bringing scientists and the business community together in a relationship of mutual advantage.

## Faculty Library

The Faculty Library was established in 1976 with 1000 reference books and 9500 textbooks. Since then, the library has expanded continually and now contains more than 24000 reference books and 80000 textbooks. The library also contains encyclopedias, government reports, scientific manuals and copies of B.Sc. projects and M.Sc. and Doctoral theses.

A checkout system is available according to the following rules:

- Professors can check out a maximum of 10 books for a four-month period.
- Other academic staff can borrow up to five books for a one- month period.
- Undergraduate and graduate students can check out 3 and 5 books for a one-month period respectively.

The library is open from 7:30 a.m. till 2:30 p.m. Information about all technical literature is documented in the University Computer System.

## Technical Arabization Program

In 1979, the Faculty established a Technical Arabization Program to enhance the educational process. The program includes preparing technical and scientific dictionaries to help students in their education. So far, 50 projects have been completed and others are under preparation as follows:

- 24 projects have been published and distributed.
- 18 projects are at the press.
- 8 projects are being reviewed.
- 6 projects are still under preparation.

List of finished translated or authored books in Arabic

1. Introduction to Engineering
2. Material Science Dictionary
3. Soil Engineering Properties
4. Introduction to Fluid Mechanics
5. Introduction to Production Engineering
6. Engineering Graphics
7. Probabilities and Statistics
8. Engineering Systems for Desalination
9. Dictionary of Production Engineering
10. Islamic Architecture
11. Fundamentals of Heat Transfer
12. Reliability Analysis of Nuclear Desalination Plants
13. Fundamentals of Industrial Engineering
14. Strength of Materials

15. Computer Applications in Civil Engineering
16. Energy Sources and Conversion
17. Basics of Material Science
18. Fundamentals of Casting
19. Air Conditioning and Refrigeration
20. Engineering Economics
21. Mining Engineering
22. Numerical Models for Solar Systems
23. Introduction to Nuclear Physics
24. Calculus
25. Basics of Mining Engineering

Books in the publication process

1. Introduction to Nuclear Engineering
2. Energy in Environmental Design of Dry Provices
3. Basic Electrical Engineering
4. Basic Analysis of Geotechnical Engineering
5. Dictionary of Aeronautical Engineering
6. Rock Explosions
7. Electronics of Power Systems
8. Fundamentals of Engineering Metrology
9. Applied Finite Element Analysis
10. Aerodynamic Propulsion
11. Internal Combustion Engines
12. Dictionary of Engineering Transportation
13. Analysis of Electrical Power Systems
14. Modern Automatic Control
15. Fundamentals of Machine Elements Design
16. Nuclear Power
17. Introduction to Chemical Engineering Thermodynamics
18. Construction Analysis
19. Basics of Modern Chemistry

Books being reviewed

1. Structural Analysis
2. Introduction to Computer
3. Introduction to Electrical Communications
4. Basics of Engineering Instrumentation
5. Dictionary of Civil Engineering
6. Dictionary of Environmental Design

Books Under Preparation

1. Fundamentals of Chemical Engineering
2. Dictionary of Industrial Engineering Terminology
3. Dictionary of Electrical Engineering
4. Operations Research
5. Problem Solving Methods and Algorithms
6. Dictionary of Geotechnical Engineering

## The Educational Computer Unit

The Educational Computer Unit at the Faculty of Engineering provides computational facilities for the purpose of training students and aiding them in their project and homework assignments.

The Unit supports five Personal Computer labs with more than 90 PCs connected together through a modern network. Central network services are provided by many servers, two dedicated file servers using Windows 2000 operating environment, one dedicated print server and one CD-ROM server with a capacity of 14 CDs (it provides on-line access to archived libraries and reference materials). Three more servers use Linux and Windows 2000 operating systems to provide automatic configuration of networked workstations via DHCP, and intranet services like Web, FTP, DNS and connection to the Internet. In addition, the Faculty provides other computing facilities under the direct supervision of individual departments.

The Faculty of Engineering recognizes the importance of having a backbone network, with access to the Internet for advancing the educational and research activities of its staff members and their students. A modern network was built in the Faculty recently, under the supervision and management of the Educational Computer Unit. There are several distribution switches, where each one covers a whole floor. Each switch has a speed of 100 Mbps on each port using the Fast Ethernet technology. Each building has a backbone switch that aids in connecting the building to the other buildings through fiber optics cables.

The number of rooms and offices, in the Faculty, that have a network connection is 219 rooms including those that are not in use at present. Adding at least 214 more nodes, which is the total number of networked PCs in the different labs in the Faculty gives a grand total of 433 user nodes on the network.

The Faculty of Engineering has a permanent connection to the Internet through a fiber optic line to the University Computer Center, for a speed up to (10Gbps). This will give every one, on the Faculty network, access to the web, email and other Internet services.

The Unit provides its computational services 24 hours a day, and maintains 32 lines of remote access available after office hours, so academic staff can use them to connect to local servers, the intranet, and the Internet at any time.

## Academic Accreditation Unit (AAU)

A Coordination Committee was formed before Accreditation Board of Engineering and Technology evaluation visit in year 2002. It was chaired by the Dean of the Faculty of Engineering. The Committee held weekly meetings to coordinate and define policies and to review progress of the preparation for the ABET visit. A sub-committee was formed and assigned the task of preparing Volume I of the self-study questionnaire for the whole engineering Faculty. Individual departmental committees and sub-committees worked on the preparation of Volume II of the study questionnaire for individual programs. For instructional purposes, other committees were formed for review the progress of the Faculty and Department activities.

In September 2003, Faculty of Engineering at KAU earned the substantial equivalency for its 12 Programs from the ABET organization. The Faculty received full accreditation in September 2009 based on the new ABET criteria EC 2000. This required substantial work from Faculty members, administrative leaders, and students. So, as a continuous improvement, all the previous committees either on the Faculty level or Department level were reformed. In addition, new committees/units are constituted. One of these units is the Academic Accreditation Unit (AAU) which was constituted to work closely with Faculty

ABET Committee. The main duties and responsibilities of AAU are:

- Set all necessary activities at the program and Faculty level.
- Identify the deadlines of all necessary activities at the program and Faculty level.
- Schedule and organize regular seminars and/or workshops for Faculty members, administration staff, and students.
- Design the common assessment forms.
- Assist scientific departments in designing the required assessment forms either the program or course level
- Assist scientific departments in preparing program self-study questionnaire and other materials required by ABET
- Coordinate and follow up the implementation of EC 2000 requirements for Academic departments and administration units in the College.
- Construct an archiving system for Volume I and Volume II for all programs and any other necessary materials.

## Industrial Advisory Board

In order to enhance and regularize the University-Industry cooperation, the Faculty of Engineering has constituted an Industrial Advisory Board in the year 1423H (2003G). The board consists of leading personalities from public and private organizations besides senior faculty members. It is certain that the decisions of the Committee will have positive and lasting influence on the overall role of the Faculty of Engineering towards the service of local industry in particular and the community in general. The following objectives are envisaged for the Committee.

- Consolidating the relationship between the Faculty of Engineering and the Public and Private Sector organizations.
- Providing to the Public and Private Sectors an opportunity to recommend changes and contribute to the development of Faculty's educational programs to suit market manpower needs and professional requirements.
- Synchronizing development in academic programs and the number of engineering graduates according to specialization and market needs.
- Assessing and fulfilling the needs of the private sector for training seminars for their employees, through short courses and seminars.
- Increasing cooperation with the private sector in all engineering disciplines for purposes of promoting scientific research within the Faculty, addressing and solving real-life problems of the local industry and community.
- Increasing cooperation with the Private Sector organizations for all engineering disciplines for participation in summer training programs for the students as well as to providing an opportunity for the faculty members to professionalize their experience.

## Students' Consultation Unit

The Faculty of Engineering established the Students' Consultation Unit as a result of the study conducted among some of the students who faced hardships during their course of study in the faculty. Some of those students could not cope with the situation and had to drop from the faculty. Through dialogue with some of such students, the necessity to establish such a unit was eminent. It is evident that students undergo difficult circumstances and need some advice to help them find solutions for the challenges they face.

Through the experience of some of our faculty members with such cases, it was found that individual meetings of the student with the faculty member may well contribute positively paving the way to successful strategies. This may be explained in light of the privacy the student gets in such an atmosphere, and due to the parental concern the faculty member displays. This is particularly demonstrated when the faculty member is a senior one such that he can employ his expertise in dealing with such circumstances. However, it should be emphasized that this Unit does not interfere nor create a conflict with the role of the academic advisors, since the role of the Unit is not registration issues nor course study plans.

With this background, the idea of establishing this unit came about to be a stage available to each student for consultation during almost any hour of the day. Thus the vision of the Unit is: Towards a Successful Student Community who can overcome hardships. The mission of the Unit is: to help the Faculty of Engineering students to excel scientifically by developing their personal capabilities and by recognizing the appropriate solutions for the problems their encounter. A group of distinguished senior faculty members were employed to be in the consulting team of the Unit. These members were deliberately chosen from various disciplines to represent most departments in the Faculty of Engineering. Each of those members devote couple of hours in a fixed weekly schedule to be available to students for consultation. The most distinguished characteristic of this Unit is that the personal information about the student will be quite respected in the sense that nobody has the right to access such information other than the advisor. Therefore, the advising sessions will be held in the adviser's office.

It remains to be emphasized that this Unit is not dedicated directly to academic difficulties. Its role is to address personal and social aspects. Its goals are:

- Developing students' personal capabilities.
- Helping students in overcoming academic, social and personal difficulties.
- Strengthening the relationship between the students and the faculty members.

## GENERAL REQUIREMENTS APPLIED TO ALL ENGINEERING PROGRAMS

### Undergraduate Programs

The study in the Faculty of Engineering follows a ten-semester system. This system of studies caters for;

- Concentrating on the courses that must be completed in scheduled time and on the student's ability to understand the courses and interact with his colleagues.
- Taking into account the aptitude differences among students. More capable students can complete their studies earlier.
- Giving the student self-confidence by selecting courses that suit his interests within the program constraints.
- Variation of assessment methods, such as homework, quizzes, major exams, midterm, final test, projects, and various types of assignments.
- Maintaining a strong relationship between students and instructors by appointing an academic advisor upon admission to an engineering department.

### ADMISSION

General conditions for admitting a student to the Faculty of Engineering for a bachelor's degree are as follows:

- The student must have obtained a recent Secondary School Certificate, or its equivalent, (not earlier than five years). The University has the right to waive off this condition for an otherwise acceptable applicant.
- The student must be of Saudi nationality. Non-Saudis are treated in accordance with King Abdulaziz University regulations.
- The student must have good behavior and conduct.
- The student must be of good health.
- Only full-time students are enrolled. An employed prospective student should have a written permission from his employer allowing him to attend classes on a full-time basis.
- The student must pass the "Exam of the "National Center for Assessment in Higher Education" (QIYAS) as well as the "Competencies Exam of King Abdulaziz University."
- The student should not be registered for another academic degree at KAU or any another university.

### Admission to King Abdulaziz University

Admission is based on a combination of the student score in the General Certificate of Secondary Education (GCSE), known as THANAWIA, and scores in two standard national exams organized and administered by the "National Center for Assessment in Higher Education" (QIYAS). These two Exams are:

1. General Aptitude Test, known as QUDRAT.
2. Scientific Track Admission Test, known as TAHSEEL.

QUDRAT is designed, similar to the American SAT Reasoning Test, to measure critical thinking skills that the student needs for academic success in college. TAHSEEL, on the other hand, is a three-hour MCQ exam that covers the basic concepts of Math, Physics, Chemistry, Biology, and English Language at the secondary school level.

For the time being, the acceptance of the students into KAU Faculty of Engineering is based on a weighed sore composed of the three above mentioned Exams as follows:

*Weighted Score = 0.6*THANAWIA + 0.15*QUDRAT + 0.25*TAHSEEL*

Students admitted to the university are considered as "Students of the General Program" and they attend a prep school for two semesters.

### Faculty Engineering Admission Requirements

Admission to the Faculty of Engineering is competitive and selective. Only the top 10% of the Secondary school graduates have a chance of being admitted into the Faculty each year. The students are admitted to the Faculty of Engineering after completing successfully all the requirements of the scientific track of the prep year. The Faculty of Engineering Council fixes each year the maximum number of the students to be admitted. The Faculty accepts the highest GPA students on condition that:

1. They obtain at least 80% in Math, Physics and English language courses of the prep year
2. They accumulate a GPA of 3.5 or better.

### Admission to Academic Programs

It is the responsibility of Academic Affairs and Training Unit (AATU) to distribute students among the programs (specialization majors), taking into consideration their favored selection, their GPA, and the requirements of each engineering program. Conditions of specialization for a student are:

- Completing at least two semesters.
- Complete a minimum of 30 hours at the end of the semester during which he applies for specialization.
- Passing the first and second levels of the English language courses ELCE 101 and ELCE 102.
- Not being a transfer student to the Faculty in the semester during which he applies for specialization.

Students are allowed to change their specialization majors within the Faculty of Engineering only once during the whole study period provided that they should not have completed 50% or more of credit hours in the original specialization the semester during which they apply for changing specialization.

### Transfer from Other Universities

A student may transfer from another university or educational institution to the Faculty of Engineering, KAU, provided that an academic degree granted by that institution is equivalent to a KAU degree. Also, the following criteria apply:

- The student should have a general grade of 70% or a minimum GPA level of 3.0 out of 5.0, and should not have been dismissed, for disciplinary reasons, from the institution that he has transferred from.
- The student must complete 50% of the credit hours of study required for graduation at KAU.
- A transferred student will be exempted from certain courses required for the BS degree at KAU, if he has already taken their equivalents at his previous institution. However, a course taken at the original institution will be considered equivalent to a course offered at KAU provided (a) the student has passed the former course with a grade of C or better, (b) the credit hours of the former course are no less than those of the latter course, and (c) the detailed contents of the two courses are ascertained to be essentially equivalent by the concerned KAU Department. Courses from which a transferred student is exempted can be listed in his transcript but will not contribute to his cumulative GPA at KAU.

## Transfer of students within KAU

- A student may transfer from one faculty to another within the University only once, if a chance is available. He may do this in accordance with the following admission terms and conditions:
  - The student must have a GPA average of not less than 3.0 out of 5.0
  - The student must complete one academic year before transferring to the Faculty of Engineering. He must also complete a minimum of 12 technical credit hours with a cumulative average of not less than C +.
  - The student must pass at least one course in Mathematics with a grade of not less than C.
  - The student must pass at least one course in Physics or Chemistry with a grade of not less than C.
  - The intake of transferred applicants depends on the available capacity.
- The grades of the courses taken by a student in his previous faculty will be accepted and considered in his new specialization according to the degree requirements. Courses that are not transferred will remain in the student's record, but will not count in the cumulative average.

# STUDY LOAD AND DURATION

## Study Load and Courses

(a) The maximum study load is 18 credit hours per regular semester and 9 credit hours in the summer session.

(b) The minimum allowable load is 12 credit hours per regular semester.

(c) The registered credit hours are decided according to the following:
  - A student having a cumulative average of 2.75 or more may register for up to 18 credit hours.
  - A student who has a cumulative average of less than 2.75 may register for up to 16 credit hours.
  - As an exception, a student who is expected to graduate may register for up to 24 credit hours, if his cumulative average is equal to or more than 3.75.

## Add and Drop

- A student, on the approval of his academic advisor, may add one course or more up to the end of the first week of the semester.
- A student, on the approval of his academic advisor, may drop one course or more up to the end of the fourth week of the semester.
- A student can withdraw from the whole semester up to the tenth week of each semester.
- In some exceptional cases and upon recommendation of the Academic Advisor and approval of the Vice Dean of the Faculty of Engineering, a student may withdraw from one or more courses. Approval for withdrawal may be granted on condition that the student has a minimum number of 12 registered credit hours after withdrawal.

## Study Postponement and Discontinuation

- A student, during his university study, may apply for a postponement of his studies (for a reason acceptable to the pertinent Faculty Committee) for a period of not more than two continuous main semesters (or three separated semesters) and only after finishing one main semester or more with a cumulative average of not less than (2.0). If his cumulative average is less than 2.0, his request will be submitted to the University Admission and Registration Committee.

- If the student ceases his studies for one semester without submitting an application for a postponement, his registration will be canceled. The following rules will be taken into consideration;
  - If the period of the discontinuation is more than two main semesters and is for reasons unacceptable to the Admission and Registration Committee, the student's registration will be canceled. However, he may apply to rejoin the university as a freshman.
  - The discontinuation period will not be counted as a part of the period fixed for the completion of an academic degree.
  - A freshman who withdraws during his first semester may apply to rejoin the university as a freshman.

## Evaluation

- The student evaluation procedure should be in conformity with the teaching policies of the University, and in line with the nature of the course. The instructor of the course should hold periodic tests. In addition, a mid-term test is usually given in the $7^{th}$ week of the main semester and the $4^{th}$ week of the summer semester during the class periods. A final test should also be held during the last week of each semester in accordance with the schedule issued by the Admission and Registration Deanship.
- Any student who fails to attend the final test without an acceptable excuse is assigned a grade of "Fail". However, any student who is absent from the test for a valid reason may submit his case to the Department Council to decide whether or not he would be given the grade of “Incomplete” (IC). The student who is given an IC has to complete the requirements of the course during the following semester; otherwise his grade is automatically changed into the grade of “Fail” (F).
- An honors degree is granted to the student who attains a cumulative average of (4.5) or more, at the time of graduation, provided that he has not failed in any course taken at the University.

## Grade Distribution

The full marks for every course are100, which are typically distributed as follows:

| | |
|---|---|
| 20 | Midterm. |
| 40 | Final Exam that covers the entire course contents. |
| 40 | Semester work such as: verbal and written tests, reports or research work or additional studies, experimental lab, and weekly or monthly homework. |

Instructors could alter this distribution given that the grade of the Final Exam does not exceed 70% of the total course grades.

## Numerical and Symbolic Notation for Grades

- The Marks obtained by the student in the course can be recorded as follows:

| Range of Marks | Symbol | Points |
|---|---|---|
| From 95 to 100 | $A^+$ | 5 |
| From 90 to 94 | A | 4.75 |
| From 85 to 89 | $B^+$ | 4.5 |
| From 80 to 84 | B | 4.0 |
| From 75 to 79 | $C^+$ | 3.5 |

| | | |
|---|---|---|
| From 70 to 74 | C | 3.0 |
| From 65 to 69 | $D^+$ | 2.5 |
| From 60 to 64 | D | 2.0 |
| Less than 60 | F | 1.0 |

- The grade of "Incomplete" (IC): It is permitted to delay the grade of a course due to non-completion of its requirements with the permission of the instructor and the approval of the Department Council. But this delay should be for no more than one main semester. If this delay lasts for more than one semester, grade will automatically change into a "Fail" (F) grade.
- The grade of "In Progress" (IP): Some courses need more than one semester to complete their requirements particularly those including senior design project work or training. For these courses, the student can postpone his grade for no more than two further semesters. In this case, the student grade is IP (In Progress).
- The grade of "Failure" (F): The student is permitted to repeat a course in which he earned an F. The new grade does not cancel the old one. The old grade is kept in the student's transcript and is counted in his GPA.

## Continuation of Study

- The basis for the continuation of study in the university for the student is to maintain the grade of "Pass," the equivalent to a cumulative average of 2.0.
- The student will be dismissed from the university in the following cases:
  - If he receives a maximum of three consequent warnings due to his lower cumulative average (less than 2 out of 5). Upon a recommendation, from the Faculty Council, the University Council can give a fourth opportunity to the student who can raise his cumulative average by taking the available courses.
  - If he does not fulfill the graduation requirements within a maximum period of one and a half of the program period (i.e. 15 semesters), the University Council can give an exceptional opportunity to the student to fulfill the graduation requirements with a maximum period of twice the program period (i.e. 20 semester)..

## Regular Attendance

- The student must attend at least 75% of the total number of classes. If the student is absent for more than 25% in any course without an acceptable reason he will be denied attendance in the remaining classes of this course and its final exam and will be given the grade of "Denial" (DN). The student can submit a request to the Academic Affairs of the Faculty to attend the final exam only if he can supply documented excuses, given that his absence does not exceed 50% of the course.
- Sick leave is only accepted on the basis of a medical report issued by the Medical Center of the University or one endorsed by it.

# GENERAL OUTLINE of B.Sc. DEGREE

## Development Aspects of the Study Plan

Following the introduction of the prep year in King Abdulaziz University, the Faculty of Engineering was required to readjust its curriculum to comply with this fundamental modification. The updated curriculum presented in this document is the result of this readjustment. It consists of 155 credit units similar to the previous curriculum in spite of the additional 14 credit units introduced in the prep year as follows:

1. Two additional credit units allocated to the two English language courses (6 credit units instead of 4 in the previous curriculum)
2. Twelve additional credit units allocated to the following four new courses:

| | | |
|---|---|---|
| CPIT 100 | Computer Skills | 3 |
| COMM 101 | Communication Skills | 3 |
| BIO 110 | General Biology I | 3 |
| STAT 110 | General Statistics I | 3 |

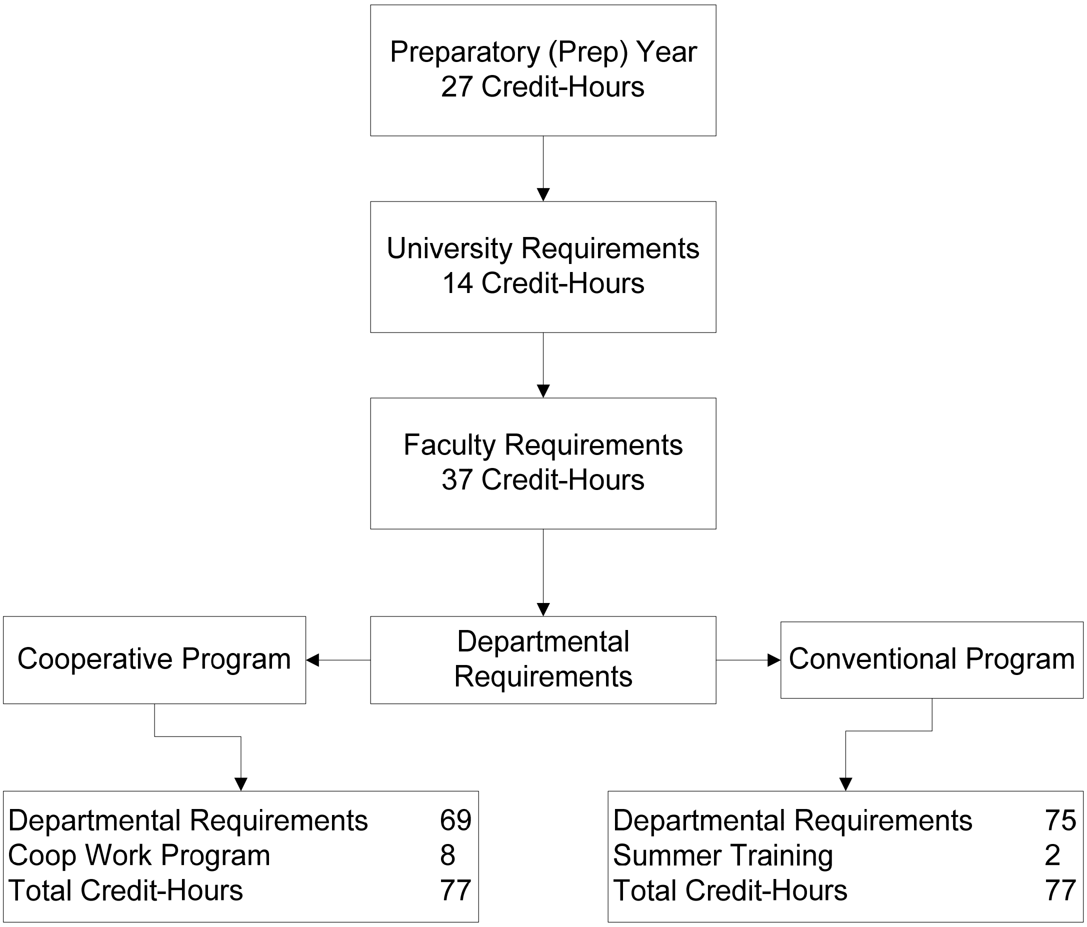
In order to qualify for a B.Sc. degree in Engineering, a student must successfully complete 155 credit units with an overall GPA of 2.75 out of 5 or better while satisfying the curricular requirements of his program of specialization. Regular track students are also required to complete one summer training of 10 weeks or in industry under the supervision of a faculty member. This summer training and 6 credit units of the departmental electives are replaced by the coop work program of 25 weeks for coop track students. The typical study period is five years (10 semesters).

## Study Plan Framework

The program of study for the Bachelor of Science Degree in Engineering is designed to provide a strong background in Science, Mathematics, Islamic Studies and Humanities besides the Engineering courses. The main objective of the program is to develop the professional proficiency of high caliber associated with personal and cultural maturity of the students and consistent with the Islamic values and the social ethics of the society.

Industrial training for students is an integral part of the graduation requirements, which is imparted either as a short spell of summer training program with ten weeks duration (2 credit units) in the regular track or as a single long spell of training under the co-operative work program of 26 weeks duration (8 credit units) in the coop track (if applicable). The industrial training is supervised/evaluated jointly by the Faculty members as well as by the personnel assigned by the industrial organization. The 8 credit units of the coop program replace the 2 credit units of the summer training and 6 credit units out of the departmental electives.

The 155 credit units required for the B.Sc. degree in each Engineering Program in regular or coop track are distributed as indicated in following tables illustrated in the figure.




## Study Plan Framework (Regular Track)

| **REQUIREMENTS** | | **CREDIT UNITS** |
|---|---|---|
| 1. Preparatory year | | 27 |
| 2. University Requirements | | 14 |
| 3. Faculty requirements | Compulsory | 37 |
| | Elective | - |
| 4. Department requirements | Compulsory (Maximum) | 69 |
| | Elective (Minimum) | 6 |
| 5. Summer training | | 2 |
| TOTAL | | 155 |

## Study Plan Framework (Cooperative Track – if applicable)

| **REQUIREMENTS** | | **CREDIT UNITS** |
|---|---|---|
| 1. Preparatory year | | 27 |
| 2. University requirements | | 14 |
| 3. Faculty requirements | Compulsory | 37 |
| | Elective | - |
| 4. Department requirements | Compulsory (Maximum) | 69 |
| | Elective (Minimum) | - |
| 5. Cooperative training for 6 months | | 8 |
| TOTAL | | 155 |

## University Requirements

The university requirements consist of the prep year science track requirements and the general university requirement in Arabic language and Islamic studies as indicated in the following tables:

### Preparatory Year Requirements

| Course No | | Course Title | Credit Hours | Prerequisites |
|---|---|---|---|---|
| 1 | CPIT 100 | Computer Skills | 3 | - |
| 2 | COMM 101 | Communication Skills | 3 | - |
| 3 | ELCS 101 | English Language I (for Science) | 0 | - |
| 4 | ELCS 102 | English Language II (for Science) | 2 | - |
| 5 | ELCS 103 | English Language III (for Science) | 2 | - |
| 6 | ELCS 104 | English Language IV (for Science) | 2 | - |
| 7 | MATH 110 | Calculus I | 3 | - |
| 8 | PHYS 110 | General Physics I | 3 | - |
| 9 | CHEM 110 | General Chemistry I | 3 | - |
| 10 | BIO 110 | General Biology (1) | 3 | - |
| 11 | STAT 110 | General Statistics (1) | 3 | - |
| | | Total | 27 | |

### University Requirements

| Course No | | Course Title | Credit Hours | Prerequisites |
|---|---|---|---|---|
| 1 | ISLS 101 | Islamic Culture (1) | 2 | --- |
| 2 | ISLS 201 | Islamic Culture (2) | 2 | ISLS 101 |
| 3 | ISLS 301 | Islamic Culture (3) | 2 | ISLS 201 |
| 4 | ISLS 401 | Islamic Culture (4) | 2 | ISLS 301 |
| 5 | ARAB 101 | Arabic Language (1) | 3 | --- |
| 6 | ARAB 201 | Arabic Language (2) | 3 | ARAB 101 |
| | | Total | 14 | |

## Faculty Requirements

Faculty requirements consist of 14 courses of a total of 37 credit units distributed as shown in the table.

### Faculty of Engineering Compulsory Courses

| Course No | | Course Title | Credit Hours | Prerequisites |
|---|---|---|---|---|
| 1 | MENG 102 | Engineering Graphics | 3 | - |
| 2 | IE 200 | Technical Communication Skills | 2 | ELCS 102 |

| | | | | |
|---|---|---|---|---|
| 3 | EE 201 | Structured Computer Programming | 2 | CPIT 100, MATH 110 |
| 4 | IE 201 | Introduction to Engineering Design I | 3 | ELCS 102, COMM 101 |
| 5 | IE 202 | Introduction to Engineering Design II | 2 | IE 200, IE 201 |
| 6 | PHYS 202 | General Physics II | 4 | PHYS 110, MATH 110 |
| 7 | MATH 202 | Calculus II | 3 | MATH 110 |
| 8 | MATH 203 | Calculus III | 3 | MATH 110 |
| 9 | MATH 204 | Differential Equations I | 3 | MATH 202 |
| 10 | MATH 205 | Series and Vector Calculus | 3 | MATH 202, MATH 203 |
| 11 | EE 251 or EE 250 | Basic Electrical Engineering or Basic Electrical Circuits | 4 | PHYS 202 |
| 12 | IE 255 | Engineering Economy | 3 | MATH 110 |
| 13 | CHEM 281 | General Chemistry Laboratory | 1 | CHEM 110 |
| 14 | PHYS 281 | General Physics Laboratory | 1 | PHYS 110 |
| | | Total | 37 | |

## Departmental Requirements (80 Cr. Hrs.)

Each department has its own special requirements which are given elsewhere in Bulletin. Students can refer to their respective Department for detailed course requirements.

## Guide Lines for First 4 Semesters for All Engineering Programs

In addition to the common first (Prep.) year, the curriculum assumes a common second year in which the students cover a large part of the Faculty of Engineering requirements. The students are assumed to apply for specialization during the second semester of this second year and join their departments starting from the third year (fifth semester). A plan prescribed by the faculty council for the first 4 semesters of study as guideline is outlined in the following tables:

**1st Year (Preparatory Year)**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| ELCS 101 | English Language I (For Science) | 0 | ELCS 103 | English Language III (For Science) | 2 |
| ELCS 102 | English Language II (For Science) | 2 | ELCS 104 | English Language IV (For Science) | 2 |
| PHYS 110 | General Physics I | 3 | CHEM 110 | General Chemistry I | 3 |
| MATH 110 | Calculus I | 3 | STAT 110 | General Statistics I | 3 |
| CPIT 100 | Computer Skills | 3 | BIO 110 | General Biology I | 3 |
| | | | COMM 101 | Communication Skills | 3 |
| | Total | 11 | | Total | 16 |

## 2nd Year

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| ARAB 101 | Arabic Language (1) | 3 | ISLS 101 | Islamic Culture (1) | 2 |
| MENG 102 | Engineering Graphics | 3 | IE 201 | Introduction to Engineering Design I | 3 |
| IE 200 | Technical Communication Skills | 2 | PHYS 202 | General Physics II | 4 |
| EE 201 | Structured Computer Programming | 2 | MATH 203 | Calculus III | 3 |
| MATH 202 | Calculus II | 3 | IE 255 | Engineering Economy | 3 |
| PHYS 281 | General Physics Lab | 1 | CHEM 281 | General Chemistry Lab | 1 |
| | Total | 14 | | Total | 16 |

### Designations of Departments

Each course is given 3 numerals preceded by the code of the department offering it. The following tables provide a key to these codes and numerals, used in the bulletin.

### Designations of Codes for Engineering Departments and Courses

| Department | Code |
|---|---|
| Aeronautical Engineering | AE |
| Chemical and Materials Engineering | ChE |
| Civil Engineering | CE |
| Electrical and Computer Engineering | EE |
| Industrial Engineering | IE |
| Mining Engineering | MinE |
| Production Engineering and Mechanical Systems | MENG |
| Thermal Engineering and Desalination Technology | MEP |
| Nuclear Engineering | NE |

### Designations of Departments from other KAU Faculties*

| Department | Code |
|---|---|
| Accounting | ACCT |
| Arabic Language | ARAB |
| Biochemistry | BIOC |
| Chemistry | CHEM |
| Economics | ECON |
| English Language Unite (Faculty of Engineering) | ELC |
| Environmental Science | ENS |
| Islamic Studies | ISLS |
| Mathematics | MATH |
| Medicine | MED |
| Mineral Resources and Rocks | EMR |
| Physics | PHYS |

| | |
|---|---|
| Psychology | PSY |

* The course description of courses offered by other faculties for the engineering students are given in the bulletin under a separate section after the course description of engineering faculty courses.

## Course Numerals

Hundreds Numerals: signify the level of course offering in the program.

| | |
|---|---|
| First level | 100 |
| Second level | 200 |
| Third level | 300 |
| Fourth level | 400 |

*Tens Numerals:*

Signify a specific specialization inside the Department.

*Unit Numerals:*

Signify the relative order of the course within a specialization.

# ACADEMIC PROGRAMS

**DEPARTMENT OF**
**AERONAUTICAL ENGINEERING**

## FACULTY

**Chairman:**
Al-Juhany, Khalid A.

**Professors:**
Al-Bahi, Ali M.

**Associate Professors:**
Habib, Sami S.
Megahed, Ibrahim E.
Olwi, Ibrahim A.

**Assistant Professors:**
Al-Juhany , Khalid A.
Al-Qadi, Ibrahim
Bajouda, Abdulrahman
Bourchak, Mostefa
Hafez, Salah M.
Harasani, Wail I.
Kada, Belkacem

**Lecturers:**
Alharbi, Mohammad
Aly, Maher S.

**Engineers**
Al-Gahmdi, Khalid S.
Al-Zhrani, Seraj O.

**Contact information:**
Mail address: P.O. Box 80204 Jeddah, Kingdom of Saudi Arabia
Chairman:

# INTRODUCTION

The Aeronautical Engineering Department at King Abdulaziz University was established in 1980 as a branch of the Mechanical Engineering Department to satisfy the needs of the development plans in the Kingdom in the field of Aviation and Space Technology. The University Council, in 1982 restructured the Department of Mechanical Engineering into three separate departments: Production Engineering & Mechanical Systems Design, Thermal Engineering & Desalination Technology, and Aeronautical Engineering.

The goal of the Aeronautical Engineering Department is to prepare Aeronautical Engineers capable of assuming their responsibilities in this vital field.

# VISION AND MISSION STATEMENTS

## The Vision of the Department

Leadership in aerospace education and research

## The Mission of the Department

To provide an environment that promotes creativity, stimulates innovation, enhances life-long learning skills, and professionally serves the society within the Islamic ethical and context.

This mission is the way to achieve the vision giving rise to a set of core values which are:

1. Dedication to student-centered, outcome-based teaching and learning.
2. Valuing innovation and creative thinking in teaching and assessment
3. Professional integrity and ethical behavior
4. Commitment to quality assurance and continuous improvement
5. Openness with all program constituencies and stakeholders.
6. Acceptance that the aforementioned values are part of the Islamic ethical standards

# EDUCATIONAL OBJECTIVES

The educational program of the Aeronautical Engineering Department at King Abdulaziz University is preparing its graduates to:

1. Engage in productive career in industry, military, academia, or research, enabled by their technical competence in mechanical and aeronautical engineering,
2. Advance in responsibility and leadership in public, private, or military sectors in Saudi Arabia and the Gulf Area, and
3. Demonstrate commitment to personal professional development as well as the sustainable development of the society.

## Aspects of Development

The department of the Aeronautical Engineering has most of the necessary resources needed to implement the new plan, however, some improvements and extra resources are needed to increase the ability of the department to accommodate more students considering the increase in demand for Aeronautical engineers for the expanding industries in the Kingdom. Future plans should consider the followings:-

1. Modernization and upgrading of existing aerodynamics Labs
2. Modernization and upgrading of existing aerospace structures Lab
3. Modernization and upgrading of existing flight dynamics and control Lab

4. Establishment of a new composite materials lab
5. Establishment of a new propulsion lab
6. Recruiting high professionals to operate and maintain laboratory equipment.
    - One engineers holding master degree specialized in experimental aerodynamics
    - One engineer holding master degree specialized in structural mechanics
    - One engineer holding master degree specialized in flight dynamics and control
7. Recruiting one additional faculty member specialized in aerospace materials
8. Recruiting one additional faculty member specialized in flight dynamics and control.

## ADMISSION AND GRADUATION REQUIREMENTS

### Students Admissions into the Aeronautical Engineering Program

The actual policy of the Aeronautical Engineering department is to accept, each semester, a fixed number of students (normally between 10 and 20) of the highest GPA from those expressing their interest to join the department.

### Graduation Requirements

In order to qualify for a BS degree in Mechanical Engineering (Aeronautical), students must successfully complete 155 semester credit units with an overall GPA of 2.٧٥ out of 5 or better. The student has to complete 49 required courses and two elective courses with a grade of D or better including 10 weeks of Industrial Summer Training and a Capstone B.Sc. design project as detailed in the AE curriculum requirements described here after.

### Graduates' Employment Opportunities

Although a considerable percentage of the graduates join aeronautical entities in the Kingdom, some of the graduates work as mechanical engineers, as researchers, or join military and academic fields.

# PROGRAM REQUIREMENTS AND CURRICULUM

## Key to Course Numbers and Department Code

Each course is referred to by an alphabetical code and a three digits number as follows:

1. Aeronautical Engineering Department is referred to by the code "AE"
2. The hundredth digit refers to the school year
3. The tenth digit refers to specialty within the department as indicated in the table.
4. The ones digit refers to course serial within the same specialty

Key of tenth digit in the codes of AE courses

| Tens Digit | Specialty |
|---|---|
| 0 | Foundation Courses |
| 1 | Aerodynamics |
| 2 | |
| 3 | Aerospace Structures and Materials |
| 4 | |
| 5 | Systems and Instruments |
| 6 | Flight Mechanics and Control |
| 7 | Propulsion |
| 8 | Aviation |
| 9 | Training, Research, and Special Topics |

## Units Required for the B.Sc. Degree

Units required for the B.Sc. degree in the Department of Aeronautical Engineering.

### Conventional Program

| **Requirements** | **Cr. Hrs** |
|---|---|
| University Requirements (including the prep year) | 41 |
| Faculty Requirements | 37 |
| Departmental Requirements (Compulsory) | 69 |
| Departmental Requirements (Electives) | 6 |
| Summer Training | 2 |
| **Total** | **155** |

### Cooperative Program

| **Requirements** | **Cr. Hrs** |
|---|---|
| University Requirements (including the prep year) | 41 |
| Faculty Requirements | 37 |
| Departmental Requirements (Compulsory) | 69 |
| Coop Program | 8 |
| **Total** | **155** |

## Department Compulsory Courses

Regular students are required to take 71 credits (2٥ courses) as indicated in the table.

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| MENG 130 | Basic Workshop | 2 | MENG 102 |
| CE 201 | Engineering Mechanics (Statics) | 3 | PHYS 281, IE 200 |
| MENG 204 | Mechanical Engineering Drawings | 3 | MENG 130 |
| MENG 262 | Engineering Mechanics (Dynamics) | 3 | CE 201 |
| MENG 270 | Mechanics of Materials | 3 | CE 201 |
| AE 300 | Engineering Thermo Fluids I | 3 | MATH 203, PHYS 281 |
| EE 300 | Analytical Methods in Engineering | 3 | MATH 203 |
| AE 302 | Engineering Thermo Fluids II | 2 | AE 300, MATH 205 |
| AE 303 | Fundamentals of Aerospace Design | 3 | AE 300, IE 202, IE 255 |
| MENG 310 | Machine Elements Design | 3 | IE 202, MENG 270 |
| AE 311 | Incompressible Flow | 3 | EE 201, EE 300, AE 303 |
| AE 331 | Aerospace Structures I | 3 | MENG 270, AE 303 |
| AE 333 | Flight Vehicle Materials | 3 | MENG 270, AE 303 |
| AE 362 | Flight Dynamics | 3 | AE 311, MENG 262 |
| AE 371 | Propulsion I | 3 | CHEM 281, AE 302, AE 303 |
| AE 390 | Summer Training | 2 | AE 331, AE 362 |
| MENG 410 | Mechanical Design | 3 | MENG 204, MENG ٣10 |
| AE 412 | Compressible Flow | 3 | MATH 204, AE 302, AE 311 |
| AE 414 | Experimental Aerodynamics | 2 | STAT 110, AE 412 |
| AE 432 | Aerospace Structures II | 3 | AE 331, AE 333 |
| AE 434 | Experimental Structural Mechanics | 2 | STAT 110, AE 432 |
| AE 436 | Aircraft Structural Design | 3 | AE 432, AE 333 |
| AE 463 | Aerospace Control Systems | 3 | AE 362, EE 251 |
| AE 472 | Propulsion II | 3 | AE371, AE 412 |
| AE 499 | Senior Project | 4 | AE 412, AE 432 |
| Total | | 71 | |

AE 390 – the summer training, 400 hours of on-job training distributed over 10 weeks that is included in the counting of training units.

Coop students are required to take all of the above mentioned 25 courses except AE 390 which is replaced by the following course:

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| AE 400 | Coop Work Program | 8 | AE 331, AE 362 |

## Department Elective Courses

Regular students select 2 courses (6 credit units) out of those in the table. For coop students no elective courses are required.

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| AE 402 | Thermo fluids Systems Design | 3 | AE 302 |
| AE 413 | Viscous Flow | 3 | AE 311 |
| AE 415 | Hypersonic Aerodynamics | 3 | AE 412 |
| AE 419 | Computational Fluid Dynamics | 3 | AE 412 |
| AE 437 | Aircraft Structural Integrity | 3 | AE 432, AE 333 |
| AE 451 | Avionic Systems | 3 | AE 362, EE 251 |
| AE 452 | Basic Aircraft Systems | 3 | AE 362 |
| AE 457 | Data Acquisition & Signal Processing | 3 | AE 362 |
| AE 461 | Performance of Aerospace Vehicles | 3 | AE 311 |
| AE 465 | Aircraft Design | 3 | AE 362 |
| AE 473 | Space Vehicle Propulsion | 3 | AE 472 |
| AE 481 | Air Transport Engineering | 3 | AE 362 |
| AE 482 | Aircraft Maintenance systems | 3 | STAT 110, AE 362 |
| AE 497 | Aeronautical Engineering seminar | 1 | AE 412, AE 432 |
| AE 498 | Special Topics in Aeronautical Eng. | 3 | AE 412, AE 432 |
| E … | Any Other Engineering Course | 2, 3, or 4 | - |
| UN xxx | Any Other University Course | 2, 3, or 4 | - |

- Each one theoretical hour calculated as one credit unit
- Each two or three practical hour calculated as one credit unit
- There is no circumstance for training hour (not counted in credit calculations)

# A TYPICAL PROGRAM FOR AERONAUTICAL ENGINEERING

## 3rd Year (Regular & Cooperative)

**5th Semester** / **6th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| MATH 205 | Series & Vector Calculus | 3 | MATH 204 | Differential Equations I | 3 |
| EE 251 | Basic Electrical Engineering | 4 | EE 300 | Analytical Methods in Eng. | 3 |
| AE 300 | Engineering Thermo Fluids I | 3 | MENG 204 | Mechanical Engineering Drawings | 3 |
| CE 201 | Engineering Mechanics (Statics) | 3 | AE 303 | Fundamentals of Aerospace Design | 3 |
| MENG 130 | Basic Workshop | 2 | MENG 262 | Engineering Mechanics (Dynamics) | 3 |
| IE 202 | Introduction to Engineering Design II | 2 | MENG 270 | Mechanics of Materials | 3 |
| | Total | 17 | | Total | 18 |

## 4th Year (Regular and Cooperative)

**7th Semester** / **8th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| ISLS 201 | Islamic Culture (2) | 2 | ISLS 301 | Islamic Culture (3) | 2 |
| AE 311 | Incompressible Flow | 3 | AE 362 | Flight Dynamics | 4 |
| AE 333 | Flight Vehicle Materials | 3 | AE 371 | Propulsion I | 3 |
| MENG 310 | Machine Elements Design | 3 | MENG 410 | Mechanical Design | 3 |
| AE 331 | Aerospace Structures I | 3 | AE 412 | Compressible Flow | 3 |
| AE 302 | Eng. Thermo Fluids II | 2 | AE 432 | Aerospace Structures II | 3 |
| | Total | 16 | | Total | 18 |

The student must select Regular or Cooperative track immediately after the eights semester.

### 4th Year Summer – Training (Regular)

| | | |
|---|---|---|
| AE 390 | Summer Training | 2 Cr. Hr. |

### 4th Year Summer – Training (Cooperative)

| | | |
|---|---|---|
| AE 400 | Coop Work Program | 8 Cr. Hr. |

## 5th Year (Regular)

**9th Semester** | **10th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| ISLS 401 | Islamic Culture (4) | 2 | ARAB 201 | Arabic Language (2) | 3 |
| AE 472 | Propulsion II | 3 | AE 414 | Experimental Aerodynamics | 2 |
| AE 434 | Experimental Structural Mechanics | 2 | AE 436 | Aircraft Structural Design | 3 |
| AE 463 | Aerospace Control Systems | 3 | ……. | Elective I | 3 |
| AE 499 | Senior Project | 4 | ……. | Elective II | 3 |
| | Total | 14 | | Total | 14 |

## 5th Year (Cooperative)

**9th Semester** | **10th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| AE 499 | Senior Project | 4 | ISLS 401 | Islamic Culture (4) | 2 |
| | | | AE 472 | Propulsion II | 3 |
| | | | AE 434 | Experimental Structural Mechanics | 2 |
| | | | AE 463 | Aerospace Control Systems | 3 |
| | | | ARAB 201 | Arabic Language (2) | 3 |
| | | | AE 414 | Experimental Aerodynamics | 2 |
| | | | AE 436 | Aircraft Structural Design | 3 |
| | Total | 4 | | Total | 18 |

## COURSE DESCRIPTION

**AE 300 Engineering Thermo Fluids I (3:3,1)**

Introduction. Pressure and fluid statics. Conservation of mass. Momentum equation. Properties of pure substances and mixtures. First law of thermodynamics. Specific heats and enthalpy. Energy equation. Second law of thermodynamics and irreversibility. Thermodynamics and Fluid Mechanics applications.

**Prerequisite: MATH 203, PHYS 281**

**AE 302 Engineering Thermo Fluids II (2:2,1)**

Conservation of energy. Modes of heat transfer. Generalized 1-D heat conduction, thermal resistance, and unsteady heat conduction. Convection, hydrodynamic and thermal boundary layers. Convective heat transfer coefficient and dimensionless groups. Correlations for predicting convective heat transfer coefficient. Heat exchangers. Radiation, black body radiation, Stefan-Boltzmann law, Grey body radiation, Kirchoff's law for black and grey bodies, and Radiant interchange between surfaces.

**Prerequisite: AE 300, MATH 205**

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Fundamentals of Aerospace Design** | **AE 303** | **هـط ٣٠٣** | **2** | **3** | **-** | **3** |
| **Pre-requisites** | | AE 300, IE 202, IE 255 | | | | |

Fundamentals of aerospace engineering are introduced through hands on design project. Topics are treated when required in the design process including: history and configurations of aircraft, design philosophy, mission specifications, weight estimation, aerodynamics, propulsion, performance, stability and control, structures, design implementation, and cost estimation. By the end of the course the design teams should build and test their prototypes and communicate the details of their designs both orally and in writing.

Faculties and departments requiring this course (if any): None

***Textbook:***

- Steven A. Brandt, Randall J. Stiles, and John J. Bertin, *Introduction to Aeronautics: A design Perspective*, AIAA Education Series, AIAA Inc., 2nd edition, Virginia, 2003.

***Reference:***

- Shevell, R. S., *Fundamentals of Flight*, Prentice – Hall, Inc, 2nd edition, 1988.

## ***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Correctly describe the aerospace design problem with clear objectives that are complete, specific, and concise including identification of customer needs and transforming them into design requirements.
2. Plan an effective design strategy including a plan of attack, decomposition of work into subtasks, development of a timetable.
3. Develop several potential solutions and compares them to find the best baseline.
4. Develop solutions that include economic, safety, environmental and other realistic constraints.
5. Integrate fundamental knowledge of aerospace topics and principles into aerospace design problems.
6. Define practical measures of effectiveness and use economic and other constraints to correctly optimize a baseline design.
7. Evaluate the solution by comparing the performance of the final design to customer demands and existing products if any.
8. Manage teamwork effectively by integrating different skills and abilities of team members.
9. Write high quality design reports using correct language and terminology, correct technical information, and professionally prepared graphs and tables.
10. Give clear, informative, and technically correct oral presentations using professionally prepared visual aids.

## ***Topic Covered During Class:***

| Course Topics | Duration in weeks |
|---|---|
| 1. History and configurations of aerospace vehicles | 1 |
| 2. Operating environment and the standard atmosphere | 1 |
| 3. Aerospace Design Methodology and introduction of term project | 1 |
| 4. Mission analysis, baseline configuration, and seizing | 1 |
| 5. Introduction to aerodynamics, airfoils and wing design | 2 |
| 6. Drag estimation | 1 |
| 7. Introduction to propulsion and engine selection | 1 |
| 8. Performance and constraint analysis | 1 |
| 9. Stability and control | 1 |
| 10. Parametric studies, sensitivity analysis, and baseline optimization | 1 |
| 11. Introduction to structures and structural design | 1 |
| 12. Design implementation, cost estimation, and analysis of the final product | 1 |
| 13. Design documentations and communications | 1 |

## ***Class Schedule:***

- **Lectures:** two one-hour sessions per week
- **Design lab:** one session of 3 hours per week

## ***Course Contribution to professional Component:***

- Engineering science: None
- Engineering design: 100%

## ***Course Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | | | 2 | 2 | | | 2 | 3 | | 3 | | |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Incompressible Flow** | **AE 311** | هـط ٣١١ | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | EE 201, EE 300, AE 303 | | | | |
| Two-dimensional inviscid fluid flow. Stream function and velocity potential. Superposition of elementary flows. Source panel methods. Thin airfoil theory. Vortex panel methods and finite wings. Vortex lattice method. Incompressible boundary layer. Aerodynamic Design. | | | | | | |

Faculties and departments requiring this course (if any)

None

***Textbook:***

- Class Notes

***Reference:***

- Anderson, John D., *Fundamentals of Aerodynamics,* McGraw-Hill, $4^{th}$ Edition, 2005.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Derive the general governing equations from the fundamental principles.
2. State the assumptions for incompressible potential flow and use them to simplify the general equations.
3. Define vorticity and circulation and distinguish between rotational and irrotational flows.
4. Define and compute stream function, streamlines, potential function, and equipotential lines for a flow and calculate each, if they exist.
5. State and implement the general approach for the solution of incompressible potential flow.
6. Analyze (i.e., calculate velocities, pressures, stream function, potential function, stagnation points, streamlines, equipotential lines, circulation around bodies, etc.) the elementary flows (uniform, source/sink, doublet, vortex) as well as any combination of them (lifting/non-lifting flow over a circular cylinder, Rankin oval, etc.)
7. Implement the source panel method to compute pressure and velocity on non-lifting surfaces.
8. State Kutta-Joukowski Theorem and use it to compute lift.
9. Explain and apply the Kutta Condition for any sharp edge of a wing (i.e., what it means physically and how it is enforced mathematically.)
10. State Kelvin's theorem and explain how it is implemented to setup the vortex system of an airfoil.
11. Derive the fundamental equation of Thin Airfoil Theory.
12. Use thin airfoil theory to compute aerodynamic characteristics of airfoils (lift and drag at various angles of attack, pitching moment about various points, a.c. location, c.p. location, etc.).
13. Describe and implement the vortex panel method to compute aerodynamic characteristics for thick airfoils.
14. Describe qualitatively and quantitatively both laminar and turbulent boundary layers in terms of their thickness, velocity profiles and shear stress variation along a surface.
15. Use the Boundary Layer Theory to calculate the skin friction drag, estimate the pressure drag of bodies, and predict location on the surface where boundary layer separation is likely to occur.
16. Describe the aerodynamic characteristics of airfoils and their impact on airfoil design.
17. Use software packages (JavaFoil) to investigate the effects of thickness and camber on the aerodynamic characteristics (lift slope, aerodynamic center) of airfoils.
18. Use software packages (JavaFoil) to investigate the effects of airfoil geometrical characteristics and the angle of attack on the boundary layer behavior and how it is related to changes in lift and drag.
19. Describe the flow field around wings of finite span and explain the generation of induced drag.
20. Describe Prandtl's lifting-line theory and state its limitations.
21. Apply the results from Prandtl's lifting-line theory to calculate the aerodynamic characteristics of airplane wings.
22. Identify wing aerodynamic parameters and recognize their impact on wing design.

23. Describe and implement (through the software package TORNADO) the Vortex Lattice Method to compute aerodynamic characteristics of wings and wing-tail-canard configurations (including high-lift device and control surfaces).
24. List several examples of regional, national, and/or global contemporary problems related to aerodynamics (ex. environmental issues, natural resources and energy conservation, etc.) articulate a problem/position statement for each, and explain what makes these issues particularly relevant to the present time.
    Identify possible solutions to these problems, as well as any limitations of these solutions.

***<u>Topic Covered During Class:</u>***

| Course Topics | Duration in weeks |
|---|---|
| 1. Basic laws | 1 |
| 2. Potential Flow Theory | 4 |
| 3. Airfoil and Boundary Layer Theories | 4 |
| 4. Finite Wing Theory | 4 |
| 5. Global/Social/Contemporary Problems Related to Aerodynamics | 1 |

***<u>Course Schedule:</u>***

- **Lectures:** three one-hour sessions per week
- **Tutorials:** one 50 minutes session per week

***<u>Course Contribution to Professional Component:</u>***

- Engineering science: 75%
- Engineering design: 25 %

***<u>Course Relationship to Program Outcomes:</u>***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | | 2 | 2 | | 2 | | | | 2 | 2 | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Aerospace Structures I** | **AE 331** | **هـط ٣٣١** | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | MENG 270, AE 303 | | | | |
| Aircraft structural details. Review of statics and strength of materials. Properties of sections (centroids, moments of inertia, etc). Equilibrium of force systems (truss, beam and frame structures and landing dear). Normal force, Shear force and bending moment diagrams. General loads on aircraft. Torsion stresses and deflections. Bending stresses and deflections. Bending stresses. Bending shear stresses (solid and open sections). Shear flow in closed thin-walled sections. MATLAB & GUI development of structural analysis tools. Lab experiments. Aircraft wing design and build project. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:***

- Bruhn, E.F., *Analysis and Design of flight vehicle structure*, Jacobs Publishing, 3rd edition, 1975

***References:***

- Curtis, H.D., *Fundamentals of Aircraft Structural Analysis*, McGraw-Hill, 1996.
- Donaldson, B.C., *Analysis of Aircraft Structures,* Cambridge University Press, 2nd edition, 2008.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Identify the nature and the composition of aircraft structures in order to know the type of loads acting on the aircraft.
2. Define the equilibrium of the force systems in different structures (truss, beam, and frame). Analyse the forces in the landing gear
3. Identify and distinguish between unstable and stable and between determinate and indeterminate structures
4. Find the internal forces in trusses and reactions by applying equilibrium force systems.
5. Sketch the free body diagrams to find the bending moments and shear forces in beams, frames, wing and aircraft.
6. Calculate the centroid and second moment of area, find the principle axis and use the parallel axes theorem.
7. Define the type of loads on aircraft and calculate the inertia loads and load factors
8. Calculate the shear stresses due to torsion for circular , open and thin walled closed sections
9. Calculate the bending stresses due to bending, find normal stress and neutral axis.
10. Calculate the bending shear stresses for closed, open sections and find the shear center.
11. Calculate the shear flow for thin-walled closed sections
12. Formulate the equilibrium equations and find the strain-displacement, stress-strain relationships.
13. Outline the aircraft material and its behavior under different loading.

## ***Course Topics and their Duration***

| Course Topics | Duration in weeks |
|---|---|
| 1. Aircraft materials | 0.5 |
| 2. Review of MENG 270 | 0.5 |
| 3. Equilibrium forces system , landing gear | 1 |
| 4. Properties of section: centroid, second moment of area…etc | 1 |
| 5. General load on aircraft | 1 |
| 6. Moments and shear in beams, frames, wing and Fuselage | 1 |
| 7. Bending stresses: normal stress and neutral axis | 1 |
| 8. Torsion: stress and deflections | |
| a. Circular sections | 1 |
| b. Open thin walled sections | 1 |
| c. Closed thin walled sections | 1 |
| 9. Bending shear stress | |
| a. Solid sections | 1 |
| b. Open sections | 1 |
| c. Shear center | 1 |
| 10. Shear flow in closed thin walled sections | 1 |
| 11. Principle of Theory of Elasticity | 1 |

## ***Course Schedule:***

- **Lectures:** three one-hour sessions per week
- **Tutorials:** one 50 minutes session per week

## ***Course Contribution to Professional Component:***

- Engineering Science: 75 %
- Design : 25 %

## ***Course Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | | | 2 | 2 | | | | | | | |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Flight Vehicle Materials** | **AE 333** | **هـ ط ٣٣٣** | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | MENG 270, AE 303 | | | | |
| Crystal structures. Imperfections in solids. Requirements from aerospace structural materials. Design philosophy (safe-life and damage-tolerant design). Aerospace applications of fracture mechanics. Airframe fatigue. Creep. Oxidation. Composite materials. Computer applications. | | | | | | |

Faculties and departments requiring this course (if any): None.

***Textbook:***

- Dieter, G.E., Engineering Design: A Materials and Processing Approach, McGraw-Hill, 3rd edition, 2000.

***Reference:***

- Bruhn, E.F., Analysis and Design of flight vehicle structure, Jacobs Publishing, 3rd edition, 1975.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Describe the behavior of engineering materials, particularly alloys of iron, aluminum, ceramics, plastics, and composites.
2. Describe criteria for material selection (Ashby chart).
3. Analyze the stress strain curves
4. Explain types of fracture modes.
5. Define airframe design philosophy (i.e. safe life & damage tolerant design philosophies)
6. Classify imperfections and explain their effects on the properties of materials. Define the different Non Distractive methods.
7. Calculate the expected life of a material with a given creep rate.
8. Calculate fracture toughness.
9. Apply materials selection and processing for aerospace related design project.
10. Communicate effectively in a team environment, negotiate and resolve conflict, motivate and coach other team members, organize meetings, delegate work tasks, develop a team vision, set team goals, and manage resources.
11. Write high quality design reports using correct language and terminology, correct technical information, and professionally prepared graphs and tables.

***Topic Covered During Class:***

| Course Topics | Duration in weeks |
|---|---|
| 1. Introduction to aircraft materials. | 1 |
| 2. Class of solid materials alloys, ceramics, plastics, and composite. | 1 |
| 3. Material selection criteria (Ashby chart). | 1 |
| 4. Stress strain curves | 1 |
| 5. Types of fracture modes. | |
| 6. Airframe design philosophy (i.e. safe life & damage tolerant | 1 |
| design philosophies) | 1 |
| 7. Imperfections and their effect on the properties of materials. | |
| 8. Methods of Non Destructive Testing. | |
| 9. Creep and Creep rate | 1 |
| 10. Fracture toughness. | 1 |
| 11. Materials selection and processing for aerospace related design | 2 |
| project. | 2 |
| | 2 |

***Course Schedule:***

- **Lectures:** three one-hour sessions per week
- **Tutorials:** one 50 minutes session per week

***Course Contribution to professional Component***

- Engineering Science: 75%
- Engineering Design: 25 %

***Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | **Th.** | **Pr.** | **Tr.** | **TCH** |
| **Flight Dynamics** | **AE 362** | **هـط ٣٦٢** | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | AE 311, MENG 262 | | | | |
| Aircraft static longitudinal stability. Neutral point. Longitudinal control. Center of gravity limits. Hinge moments. Stick free stability. Stick force. Speed stability. Directional static stability. Directional control. Roll static stability. Roll control. Unsteady equations of motion. Small disturbance theory. Stability derivatives. Linearized equations of motion. Dynamic stability. Reduced-order models. Longitudinal and lateral stability modes. Flying qualities. Introduction to state feedback and pole placement. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:***

- Nelson, Robert C., *Flight Stability and Automatic Control,* 2nd edition, 1998, McGraw-Hill Science.

***Reference:***

None

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Define the concepts of static and dynamic stability and distinguish between different modes of stability.
2. Define the concepts of degrees of freedom for a dynamical system, and classify aircraft motion variables, forces, moments,
3. Classify control surfaces (primary and secondary surfaces) and define their functions.
4. Derive the contributions of different aircraft components to longitudinal stability and derive the elevator control power.
5. Determine the stick fixed neutral point and describe the effect of changing the center of gravity location on the aircraft longitudinal static stability.
6. Compute the stick free lift curve slope, longitudinal static stability derivative, neutral point & static margin.
7. Define the stick force gradient, state the condition for aircraft speed stability, and explain the use of trim tabs on the elevator.
8. Estimate the contributions of aircraft components for the directional static stability and derive the rudder control power.
9. State and describe the conditions of roll static stability and trim, discuss the dihedral, the wing-fuselage interaction effect, and the sweep effects, and derive expressions for the wing dihedral derivative and the aileron control power.
10. Define axes systems and transformations, Euler's angles of rotation, orientation matrices and wind reference frame.
11. Derive aircraft kinematical equations of motion and illustrate longitudinal and lateral-directional modes
12. Employ Taylor series expansion for multivariable functions to Linearize functions about equilibrium points and steady reference conditions,
13. State assumptions of the small disturbance theory and the longitudinal/lateral motion decoupling assumptions.
14. Study the dynamic longitudinal and lateral stabilities and derive their response characteristics.
15. Define the effect of the effect of stability derivatives, the centre of gravity and mass distribution on the dynamic stability
16. Define the longitudinal, lateral and directional flying quality requirements
17. Define the characteristics of flight control systems and clarify the relations between flying quality requirements and design

18. State and obtain first and second order linear system characteristics, and infer stability and transient response from the complex plane root representation.
19. Derive state space models for linear multivariable systems, and reproduce the linear system characteristic equation from its state space model.
20. Study the controllability and observability of flight control system
21. Construct state space models for longitudinal and lateral dynamics and perform modal analysis on state space models.
22. Construct reduced state space models for Phugoid mode and short period mode approximations
23. Construct reduced state space models for Dutch roll mode, spiral mode, and roll mode approximations and estimate the motion characteristics of each mode
24. Apply linear optimal control theory to aircraft control
25. Design and apply different linear regulators

***Topic Covered During Class:***

| Course Topics | Duration in weeks |
|---|---|
| 1. Introduction to Aircraft Stability and Control | 1 |
| 2. Longitudinal Static Stability | 2.5 |
| 3. Longitudinal Static Control | 1 |
| 4. Lateral-Directional Static Stability and Control | 2 |
| 5. Equation of Motion and Stability Derivatives | 2.5 |
| 6. Dynamic Stability and Response Characteristics | 1 |
| 7. Classical Design techniques and Flying Qualities | 2 |
| 8. Introduction to Modern Control Theory | 2 |

***Course Schedule:***

- **Lectures:** three one-hour sessions per week
- **Tutorials:** one 50 minutes session per week

***Course Contribution to professional Component:***

Engineering science: 60%
Engineering design: 40%

***Course Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | | 2 | 2 | | | 2 | | 2 | | 2 | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Propulsion I** | **AE 371** | هـ ط ٣٧١ | 3 | 1 | - | 3 |
| **Pre-requisites** | | CHEM 281, AE 302, AE 303 | | | | |
| Aircraft engine types. Cycle analysis and performance parameters of jet and gas turbine engines (ramjet, turbojet, turbofan, and turboshaft). Rocket engines; classification and performance parameters. Ideal chemical rocket. Cycle analysis and performance parameters of piston engines. Application to the design of a thermodynamic cycle for an aircraft engine. | | | | | | |

Faculties and departments requiring this course (if any)

***Text Book:***

- Notes supplied by the instructor.

***Reference:***

- Hill, G.H, and Peterson, C.R, *Mechanics and Thermodynamics of Propulsion,* Prentice Hall, 2nd edition 1991

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Apply basic laws of fluid mechanics and thermodynamics on separate different components of aircraft engines (turbine, compressor, and combustors).
2. Apply the compressible flow laws relevant to turbojet and rocket engines (diffusers and nozzles)
3. Evaluate the effects of losses in different engine components (viscous, shocks, incomplete combustion)
4. Calculate the GTE performance parameters (specific thrust and thrust specific fuel consumption Tsfc) as function of the main design parameters( maximum temperature T04, engine pressure ratio EPR, flight M and ambient conditions)
5. Appreciate the rationale for development of specific engine configurations, e.g. turbofans and afterburning.
6. Identify common design constraints and practices for GTE.
7. Explain the performance and design characteristics of rocket engines and predict their effects on the rocket trajectory.
8. Calculate the major design parameters of solid rocket motors thrust chambers, grains and nozzles.
9. Recognize the use of piston engines in aircraft propulsion.
10. Explain the performance and design characteristics of piston engines.
11. Calculate the major design parameters of piston engines.

***Topics Covered During the Course:***

| Course Topics | Duration in weeks |
|---|---|
| 1. Introduction,: | |
| a. Basic laws | 1 |
| b. Chemical Reactions | 1 |
| c. Engine Types | 0.5 |
| 2. Thermodynamics of gas flow. | 1.5 |
| 3. Thermodynamics and performance of jet engines. | 5.5 |
| 4. Thermodynamics and performance of rocket engines. | 1.5 |
| 5. Thermodynamics and performance of piston engines. | 1.5 |
| 6. Design project | 1.5 |

***Class Schedule:***

- **Lectures:** three one-hour sessions per week
- **Tutorials:** one 50 minutes session per week

***Course Contribution to professional Component:***

- Engineering Science: 67 %
- Engineering Design: 33 %

***Course Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 1 | | 3 | | | | | 3 | | | | 1 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><td rowspan="2">COURSE TITLE</td><td rowspan="2">ENGLISH CODE /NO</td><td rowspan="2">ARABIC CODE/NO.</td><td colspan="4">CREDITS</td></tr>
<tr><td>Th.</td><td>Pr.</td><td>Tr.</td><td>TCH</td></tr>
<tr><td>Summer Training</td><td>AE 390</td><td>هـط ٣٩٠</td><td>-</td><td>-</td><td>400</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisites</td><td colspan="5">AE 331, AE 362</td></tr>
<tr><td colspan="7">10 weeks of supervised hands-on work experience at a recognized firm in a capacity which ensures that the student applies his engineering knowledge and acquires professional experience in his field of study at KAU. The student is required to communicate, clearly and concisely, training details and gained experience both orally and in writing. The student is evaluated based on his abilities to perform professionally, demonstrate technical competence, work efficiently, and to remain business focused, quality oriented, and committed to personal professional development.</td></tr>
</table>

Faculties and departments requiring this course (if any)

***Textbook:*** None
***Reference:*** None

## ***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Formulate an objective or mission statement that identify the real problem and describe the expected outcomes of the training activity.
2. Break-down a work environment into its units and work functions, and describe how these units are assembled into a whole entity.
3. Describe a professional organizational structure, its size and how it is related to its main products and to market issues.
4. Exhibit integrity, punctuality, and ethical behavior in engineering practice and relationships.
5. Demonstrate enthusiasm and business focusing.
6. Establish successful relationships with team members, advisors, and clients to understand their needs and to achieve or exceed agreed-upon quality standards.
7. Maintain focus to complete important tasks on time and with high quality, amidst multiple demands
8. Relate practical work to previous knowledge from basic sciences, engineering fundamentals, and discipline related courses.
9. Collect and review related data such as technical information, regulations, standards, and operational experiences from credible literature resources
10. Utilize prior knowledge, independent research, published information, and original ideas in addressing problems and generating solutions
11. Monitor achievement, identify causes of problems, and revise processes to enhance satisfaction
12. Communicate, clearly and concisely, training details and gained experience, both orally and in writing, using necessary supporting material, to achieve desired understanding and impact.

## ***Topic Covered During Class:***

| Course Topics: | Duration in weeks |
|---|---|
| 1. Acquainting the trainee by the company, its work environment, organizational structure, products, costumers, engineering units, and quality system. | 2 |
| 2. Familiarizing the trainee of one production or design unit with deep understanding of the work environment, regulations, standards, etc... | 1 |
| 3. Allocating the trainee to a project team and allowing him to study and collect necessary data about the project using internal and external data sources. | 1 |
| 4. Working as a team member to execute assigned tasks with the following objectives:<br>• Apply engineering practices related to his specialization.<br>• Enhance team work skills.<br>• Relate practical work to his engineering knowledge.<br>• Use modern engineering tools such as equipment and computer software.<br>• Use project management techniques.<br>• Complete assigned tasks on time with high quality.<br>• Develop personal communication skills. | 6 |

***Class Schedule***:

- Oral Presentation after submitting a written training report; both evaluated by at least 2 faculty members

***Course Contribution to professional Component:***

- Engineering science: 0%
- Engineering design: 0%
- Others: 100%

***Course Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | 1 | | | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Cooperative Work Program** | **AE 400** | **هـ ط 400** | **-** | **-** | **١٠٠٠** | **8** |
| **Pre-requisites** | | AE 331, AE 362 | | | | |

Extensive 26 weeks of supervised hands-on work experience at a recognized firm in a capacity which ensures that the student applies his engineering knowledge and acquires professional experience in his field of study at KAU. The student is required to communicate, clearly and concisely, training details and gained experience both orally and in writing. The student is evaluated based on his abilities to perform professionally, demonstrate technical competence, work efficiently, and to remain business focused, quality oriented, and committed to personal professional development.

Faculties and departments requiring this course (if any)

***Textbook:*** None

***Reference:*** None

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Formulate an objective or mission statement that identify the real problem and describe the expected outcomes of the training activity.
2. Break-down a work environment into its units and work functions, and describe how these units are assembled into a whole entity.
3. Describe a professional organizational structure, its size and how it is related to its main products and to market issues.
4. Exhibit integrity, punctuality, and ethical behavior in engineering practice and relationships.
5. Demonstrate enthusiasm and business focusing.
6. Establish successful relationships with team members, advisors, and clients to understand their needs and to achieve or exceed agreed-upon quality standards.
7. Maintain focus to complete important tasks on time and with high quality, amidst multiple demands
8. Relate practical work to previous knowledge from basic sciences, engineering fundamentals, and discipline related courses.
9. Collect and review related data such as technical information, regulations, standards, and operational experiences from credible literature resources
10. Utilize prior knowledge, independent research, published information, and original ideas in addressing problems and generating solutions
11. Monitor achievement, identify causes of problems, and revise processes to enhance satisfaction
12. Communicate, clearly and concisely, training details and gained experience, both orally and in writing, using necessary supporting material, to achieve desired understanding and impact.

***Topics Covered:***

| Course Topics: | Duration in weeks |
|---|---|
| 1. Acquainting the trainee by the company, its work environment, organizational structure, products, costumers, engineering units and quality system. | 2 |
| 2. Familiarizing the trainee of one production or design unit with deep understanding of the work environment, regulations, standards, etc... | 2 |
| 3. Allocating the trainee to a project team and allowing him to study and collect necessary data about the project using internal and external data sources. | 2 |
| 4. Working as a team member to execute assigned tasks with the following objectives:<br>• Apply engineering practices related to his specialization.<br>• Enhance team work skills.<br>• Relate practical work to his engineering knowledge.<br>• Use modern engineering tools such as equipment and computer software.<br>• Use project management techniques.<br>• Complete assigned tasks on time with high quality.<br>• Develop personal communication skills.<br><br>N.B.: If the assigned project is to be completed in less than 20 weeks, the student should complete his training period working on several successive projects | 20 |
| 5. Submitting first Progress Report to his academic supervisor | End of week #6 |
| 6. Submitting second Progress Report to his academic supervisor | End of week #12 |
| 7. Submitting third Progress Report to his academic supervisor | End of week #18 |

***Class Schedule:***

- Oral Presentation after submitting a written training report; both evaluated by at least 2 faculty members

***Course Contribution to professional Component:***

- Engineering science: None
- Others: 100%

***Course Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | 1 | | | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH | ARABIC | CREDITS |
|---|---|---|---|

| | CODE /NO | CODE/NO. | Th. | Pr. | Tr. | TCH |
|---|---|---|---|---|---|---|
| **Thermo fluids Systems Design** | **AE 402** | **402 هـ ط** | **2** | **3** | **-** | **3** |
| **Pre-requisites** | | **AE 302** | | | | |
| Analysis, design and optimization of thermo-fluid systems, heating and ventilating equipments, load calculations, system design, piping networks, heat exchanger analysis and design, computer-aided design projects. | | | | | | |

Faculties and departments requiring this course (if any)    None

***Textbook*:**
Mcquiston, Parker and Spitler, *Heating Ventilating and Air conditioning*, John Wiley & Sons, 6th Ed., NY, 2005

***Reference*:** ASHRAE Fundamentals Handbook, 2005 Edition

## ***Course Learning Objectives*:**

By the completion of this course the students will be able to:

1. Identify the basic properties of fluids and the various types of fluid flow configurations encountered in practice.
2. Determine the variation of pressure in a fluid at rest.
3. Apply the mass conservation equation in a flow system.
4. Determine the various types of forces and moments acting on a fluid flow field.
5. Identify pure substance, phases, ideal gas, ideal gas relations, and gas mixtures.
6. Identify intensive/extensive properties and explain the Zeroth law of thermodynamics.
7. Apply the first law of thermodynamics on closed systems and on control volumes undergoing steady state flow processes.
8. Define and calculate internal energy, enthalpy, specific heat at constant pressure and specific heat at constant volume.
9. Use the energy equation and the modified Bernoulli equation to determine turbine power output and pumping power requirements.
10. Explain Kelvin-Planck and Clausius statements of the second law of thermodynamics.
11. Define thermal efficiency, coefficient of performance, entropy, and reversible and irreversible processes.
12. Apply the second law of thermodynamics on closed systems and on control volumes undergoing steady state flow processes.
13. Analyze ideal cycles; e.g. Carnot, Rankine, Otto, Diesel, Brayton, and vapor compression cycles.
14. Calculate the forces exerted by a fluid at rest on plane and curved submerged surfaces.
15. Calculate major and minor losses associated with pipe flow systems and determine the pumping power requirements.

***Topic Covered During Class*:**    ***Duration in Weeks***

1. Properties of Air/Water Mixtures……………………………………………….1
2. Basic Processes …………………………………………………………………1
3. Energy Estimation Methods ……………………………………………………1
    a. Heating Loads………………………………………………………………….1
    b. Cooling Loads ……………………………………………………………..…. 1
4. Comfort and Health (Indoor Air Quality) …………………………………….. 1
5. Energy Conservation Methods………………………………………………. 1
6. System Design……………………………………………………………….. 1
    a. Air System Design…………………………………………………….. 1
    b. Water System Design ……………………………………………………. 1
    c. Fan/Pump Sizing ………………………………………………………… 1

d. Boilers …………………………………………………………………… 1
e. Refrigeration/Cooling Systems ………………………………………….. 1
f. Energy Recovery (heat wheels, heat pipes, air to air heat exchangers ) … 1

***Course Schedule:***

- **Lectures:** two one-hour sessions per week
- **Tutorials:** 3-hour session per week

***Course Contribution to professional Component:***

- Engineering science: 25%
- Engineering design: 75%

***Course Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | | 3 | 3 | | | 2 | 2 | | | | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><td rowspan="2">COURSE TITLE</td><td rowspan="2">ENGLISH CODE /NO</td><td rowspan="2">ARABIC CODE/NO.</td><td colspan="4">CREDITS</td></tr>
<tr><td>Th.</td><td>Pr.</td><td>Tr.</td><td>TCH</td></tr>
<tr><td>Compressible Flow</td><td>AE 412</td><td>هـ ط ٤١٢</td><td>3</td><td>1</td><td>-</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisites</td><td colspan="5">MATH 204, AE 302, AE 311</td></tr>
<tr><td colspan="7">Principles from Thermodynamics. Conservation laws governing compressible flow. Generalized flow in nozzles. Isentropic flow. Normal shock relations. Nozzle flow with shock waves. Oblique shock waves and expansion waves. Normal and Mach reflection. Airfoils in supersonic flow. Shock expansion method. Thin airfoil theory. Nonsteady gas dynamics. Moving shock waves and expansion waves. Shock tube theory. Aerodynamic facilities. Design of wind tunnels</td></tr>
</table>

Faculties and departments requiring this course (if any): None

***Textbook***:

- John D. Anderson Jr., *Modern Compressible Flow with Historical Perspective*, 3rd edition, McGraw-Hill, 2004.

***References:***

- H. W. Liepmann and A. Roshko, *Elements of Gasdynamics*, Dover Publications, 2002.
- Saad, M. A., *Compressible Fluid Flow*, Prentice Hall, 2nd edition, 1993.
- Anderson, John D., *Fundamentals of Aerodynamics*, McGraw-Hill, 4th edition, 2005.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. To establish the knowledge and understand the need of fluid properties and thermodynamic properties required to describe ideal compressible fluid flow.
2. Demonstrate the difference between compressible and incompressible flow.
3. Demonstrate the ability to apply conservative laws to fluid mechanics problems including one dimensional equation for conservative laws in differential form.
4. Illustrate the implication of compressibility to the area-velocity relationship and the need for a convergent divergent nozzle to obtain supersonic flow
5. Apply isentropic relations to isentropic flow in nozzles.
6. Apply the conservation equations to produce the normal shock wave relations and apply to flows with shock waves
7. Identify the location of a standing shock in a nozzle and select the conditions required to obtain a shock free nozzle
8. Explain the formation of a moving shock wave and oblique shock wave
9. Derive the equations of a moving shock wave, a reflected shock wave, and a moving expansion waves
10. Describe the shock tube, identify the conditions of the shock tube to manipulate the strength of the shock wave
11. Describe the wall deflection to shock angle relationship and the influence of Mach number change.
12. Describe the flow and the waves' pattern over simple 2-dimensional airfoils under variable Mach number conditions.
13. Describe fully the flow field produced by normal reflection and qualitatively by Mach reflection.

14. Explain the occurrence of shock bowing (bow shock wave) and shock detachment (detached shock wave) and describe how they are related.
15. Apply the oblique shock relations, small angle approximation and Prandtl-Meyer function to obtain approximate and exact solutions to flows with waves.
16. Obtain the lift and the drag coefficient of a simple airfoils in supersonic flow using shock expansion method and approximate methods of Prandtle-Meyer function and thin airfoil theory.
17. Describe shock-shock intersection shock-expansion interaction.
18. Design a supersonic nozzle
19. Use modern engineering tools necessary for engineering practice by solving problems using CFD (FLUENT) and software packages such as KASIMIR.
20. Study an example of regional, national, and / or global contemporary problems related to aerodynamics (ex. environmental issues, natural resources and energy conservation, etc.) articulate a problem / position statement for each, and explain what makes these issues particularly relevant to the present time. Identify possible solutions to these problems, as well as any limitations of these solutions.
21. Demonstrate the ability to engage as a team member in a course capstone design

***Topics Covered during training***

| Course Topics | Duration in weeks |
|---|---|
| 1. Introduction to Compressible Flow | 1 |
| 2. Review of Thermodynamics | 1 |
| 3. Integral form of the Conservation Equations | 0.5 |
| 4. One-Dimensional Flow (Normal Shock Wave) | 1 |
| 5. Oblique Shocks and Isentropic Waves | 1.5 |
| 6. Lift and Drag in Supersonic Flow | 2.5 |
| 7. Flow Through Nozzles | 2 |
| 8. Unsteady One-Dimensional Compressible Flow | 1.5 |
| 9. Supersonic Wind Tunnels | 3 |

***Class Schedule:***

- **Lectures:** three one-hour sessions per week
- **Tutorials:** one 50 minutes session per week

***Course Contribution to professional Component***:

- Engineering science: 75%
- Engineering design: 25%

***Course Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 3 | | 2 | 3 | 2 | 2 | 2 | | 2 | 2 | 2 | 3 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Viscous Flow** | **AE 413** | **413هـط** | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | AE 311 | | | | |

Review of conservation equations. Simple problems of viscous flow, Flow at high Reynolds number, Laminar boundary layer, Classical and numerical solutions of laminar boundary layer, Laminar separation, Transition from laminar to turbulent, Turbulent boundary layer, Viscous aerodynamic drag, Turbulent shear flows, Wakes and jets, Computer applications.

***Textbooks:***

- Lecture Notes.

***Reference:***

- White, F.M.; *Viscous Fluid Flow . 2nd edition, 1991, McGraw –Hill Inc.*

Faculties and departments requiring this course (if any): None.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

22. Derive governing equation for fluid flow problems.
23. Develop mathematical model for fluid flow problems.
24. Develop exact solution for range of practical engineering problems.
25. Carry out of magnitude analysis to identify major parameters.
26. Calculate boundary layers and shear stress development under the effect pressure gradient.
27. Identify factors affecting boundary layers transitions, means to identify transition and techniques to enhance or delay transition
28. Use statistical techniques to develop time-averaged Navier _Stokes equation relevant to turbulent flows
29. Relate Reynolds stresses with mean velocity gradient, mixing length hypothesis etc.
30. Differentiate between free and wall-bounded shear flows
31. Derive mean flow velocity profile and how to use to
32. Develop formulae between skin friction coefficient and local Reynolds s number with applications to internal and external flows.

***Topic Covered During Class:***

| Course Topics | Duration in weeks |
|---|---|
| 1. Basic laws | 1 |
| 2. Internal flow, exact and numerical solutions. | 4 |
| 3. Laminar boundary layer | 3 |
| 4. Boundary layer transition | 1 |
| 5. Turbulence , fundamentals | 1 |
| 6. Structure of Turbulent Boundary layer | 2 |
| 7. Applications | 2 |

***Course Schedule*:**

- **Lecture:** three one-hour sessions per week
- **Tutorials:** one hour session per week

***Course Contribution to professional Component:***

- Engineering science: 75 %
- Engineering design: 25%

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | | 2 | 3 | | | 2 | 2 | 2 | 2 | 2 | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><td rowspan="2">COURSE TITLE</td><td rowspan="2">ENGLISH CODE /NO</td><td rowspan="2">ARABIC CODE/NO.</td><td colspan="4">CREDITS</td></tr>
<tr><td>Th.</td><td>Pr.</td><td>Tr.</td><td>TCH</td></tr>
<tr><td>Experimental Aerodynamics</td><td>AE 414</td><td>هـط ٤١٤</td><td>1</td><td>3</td><td>-</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisites</td><td colspan="5">STAT 110, AE 412</td></tr>
<tr><td colspan="7">Experiments that accentuate instruments and experimental procedures. Wind tunnel types. Wind tunnel calibration. External and internal balance measurements. Pressure distribution measurement in shear layers. Measurement of laminar and turbulent boundary layers on a flat plate. Hot wire anemometry. Mach number measurement in supersonic flow.</td></tr>
</table>

Faculties and departments requiring this course (if any): None.

***Textbook:***

1. Holman, J.P., *Experimental Methods for Engineers*, 7th Edition, McGraw Hill, 2001.

***Reference***:

2. Rae, W.H., Jr. and Pope, A., *Low-Speed Wind Tunnel Testing*, John Wiley and Sons, 3rd edition, 1999.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Define the technical terms used in the course
2. Communicate the details of an experimental procedure clearly and completely
3. Identify different types of wind tunnels and recognize their characteristics
4. Design and select main components of wind tunnels such as contractions, diffusers, screens etc
5. Design an experiment to study or investigate technical fluid dynamic problem, propose a solution taking into account safety measures
6. Conduct or simulate an experiment to validate/check the feasibility of the proposed solution
7. Develop a mathematical model or computer simulation to correlate or interpret experimental results that may be real data from a laboratory experiment or simulated data given to students by their lecturer
8. List and discuss several possible reasons for deviations between predicted and measured results from an experiment, choose the most likely reason and justify the choice
9. Demonstrate knowledge of contemporary issues in experimental aerodynamics
10. Work effectively in a team

***Course Topics and their Duration :***

| Course Topics: | Duration in weeks |
|---|---|
| **Flow properties and basic principles**<br>Forces, stresses and the continuum hypothesis, Measurable properties, Flow velocity and velocity fields, Analytical description of flows, The choice of analytical approach, Similarity, Patterns of fluid motion | 1 |
| **Towards a sound experiment**<br>Planning the experiment, Safety, Qualitative assessment, Record keeping, Scientific ethics | 1 |
| **Fluid mechanical apparatus**<br>Producing the desired flow, Changing the flow area, Flow management, Wind tunnels, Turbulence and shear generation, Model testing | 1 |
| **Measurement of flow pressure**<br>What exactly is pressure, Pressure measuring instrumentation, Wall pressure measurements, In-flow pressure measurements | 1 |
| **Flow Visualization techniques**<br>Overview, Marker techniques, Optical techniques | 1 |
| **Measurements of local flow velocity**<br>Pressure impact devices, Thermal anemometer, Measurements of wind velocity | 1 |
| **Analysis of Experimental Data**<br>Measurements errors, Accuracy and precision, Resolution, sensitivity and Dynamic range, Accuracy /Systemic errors of measuring systems | 1 |
| **Selected Aerodynamic Experiments**<br>Flow visualization using smoke tunnel, Flow around circular cylinder, Flow around airfoil, High lift airfoils, Smooth and rough-wall turbulent boundary layer, Calibration of a normal hot-wire anemometer, Design an experiment to study or investigate technical fluid, dynamic problem, proposed by team of students and approved by their lecturer | 7 |

***Class Schedule:***

- **Lectures:** 1 hour per week.
- **Tutorials:** 1 hour per week.
- **Lab:** 2 hours per week

***Course Contribution to Professional Component:***

- Engineering science: 80%
- Engineering design: 20%

***Course Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 3 | 3 | 2 | 3 | 2 | 2 | | | 2 | 2 | 3 | 3 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><th rowspan="2">COURSE TITLE</th><th rowspan="2">ENGLISH CODE /NO</th><th rowspan="2">ARABIC CODE/NO.</th><th colspan="4">CREDITS</th></tr>
<tr><th>Th.</th><th>Pr.</th><th>Tr.</th><th>TCH</th></tr>
<tr><td>Hypersonic Aerodynamics</td><td>AE 415</td><td>هـط٤١٥</td><td>3</td><td>1</td><td>-</td><td>3</td></tr>
<tr><td colspan="3">Pre-requisites</td><td colspan="4">AE 412</td></tr>
<tr><td colspan="7">Hypersonic shock and expansion wave theories. Local surface inclination methods. Hypersonic inviscid flow fields. Approximate and exact methods. Hypersonic boundary layer theory. Hypersonic aerodynamic heating. Entry and heating problems. Hypersonic viscous interactions. High temperature gas dynamic. Equilibrium and non-equilibrium flows. Viscous high temperature flows.</td></tr>
</table>

***Textbooks:***

J. D. Anderson, Jr., *Hypersonic and High Temperature Gas Dynamics*, McGraw Hill, 1989.

***Reference:***

Class Handout

Faculties and departments requiring this course (if any): None.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

Students who successfully complete the course will demonstrate the following outcomes by tests, homework, and written reports:

1. An ability to solve problems involving inviscid hypersonic flows
2. An ability to solve problems involving viscous hypersonic flows.
3. An understanding high temperature effects in hypersonic aerodynamics.
4. An understanding of the design issues for hypersonic vehicles.
5. An ability to use computational tools to evaluate hypersonic flows.
6. A knowledge of hypersonic flow facilities.
7. A knowledge of recent developments in hypersonic aerodynamics with application to aerospace systems.

***Topic Covered During Class:***

| **Course Topics** | **Duration in weeks** |
|---|---|
| Introduction Characterization of hypersonic flow | 1 |
| Hypersonic shock and expansion wave theories | 2 |
| Local surface inclination methods | 2 |
| Hypersonic boundary layer theory | 2 |
| Hypersonic aerodynamic heating | 2 |
| Hypersonic viscous interactions | 2 |
| Equilibrium and nonequilibrium flows | 2 |
| Experimental facilities | 1 |

***Course Schedule*:**

- **Lecture:** three one-hour sessions per week
- **Tutorials:** one hour session per week

***Course Contribution to professional Component:***

- Engineering science: 75%
- Engineering design: 25%

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 3 | | 2 | 3 | 2 | 2 | 2 | | 2 | 2 | 2 | 3 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Computational Fluid Dynamics** | **AE 419** | **هـط ٤١٩** | **2** | **3** | **-** | **3** |
| **Pre-requisites** | | AE 412 | | | | |
| Introduction to CFD, Navier Stokes Equations, Partial Differential Equations (PDE's) Basics Of numerical methods for solving PDE's, Finite difference Methods for Hyperbolic, Parabolic, and Elliptic PDE's, Finite Volume Methods, Numerical Grid Generation, Applied CFD using Fluent commercial Package. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook***

- Kalus Hoffmann & Steve T. Chiang, *Computational Fluid Dynamics for Engineers* – Volume I, EES Publications, 2000..

***Reference:***

None

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. State the basics steps in a CFD analysis.
2. Derive Navier-Stokes equations from the fundamental principles.
3. State the basics steps in a CFD analysis.
4. Classify partial differential equations (PDE's)
5. Formulate Finite Difference approximations for different types of PDE's
6. Analyze the stability of finite difference approximation.
7. Assess the accuracy of finite difference approximation using benchmark problems.
8. Solve fluid dynamics and heat transfer problems in one and two dimensions for simple domains.
9. Formulate Finite Volume approximations for different types of PDE's.
10. Use the CFD package FLUENT to study and analyze fluid engineering problems.

***Topic Covered During Class:***

| | Course Topics | Duration in weeks |
|---|---|---|
| 1. | Introduction | 1 |
| 2. | Navier-Stokes Equations | 1 |
| 3. | Finite Difference Methods | 5 |
| 4. | Finite Volume Methods | 1 |
| 5. | Fluent | 6 |

***Class Schedule:***

- **Lecture:** two one-hour sessions per week
- **Tutorial/practical**: one 3-hour session per week

***Course Contribution to Professional Component:***

- Engineering Science: 100 %
- Engineering Design: 0 %

***Course Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | 1 | | 2 | | | | | | 2 | 2 | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Aerospace Structures II** | **AE 432** | هط ٤٣٢ | **3** | **1** | | **3** |
| **Pre-requisites** | | AE 331, AE 333 | | | | |
| Introduction to the Theory of Elasticity. Structural instability of columns and thin plates. Analysis methods (Virtual work and energy and matrix methods including FEM) for stress and deflection calculations in determinant and indeterminate structures. Thin plate theory. Composite materials analysis and design. FEA using APAQUS. Lab experiments. Light aircraft design and build project. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:***

- Bruhn, E.F., *Analysis and Design of flight vehicle structure*, Jacobs Publishing, 3rd edition, 1975

***References:***

- Curtis, H.D., *Fundamentals of Aircraft Structural Analysis*, McGraw-Hill, 1996.
- Donaldson, B.C., *Analysis of Aircraft Structures*, Cambridge University Press, 2nd edition, 2008.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Calculate the deflections of statically determinate structures.
2. Analyze the statically indeterminate structures to find their internal loads
3. Calculate the deflections of statically indeterminate structures.
4. Derive the stiffness equations of spring structures.
5. Derive the stiffness equations of a structural element.
6. Use the stiffness method to calculate the deflections and internal loads of truss structures
7. Apply the matrix method to find the deflections and internal loads of beams
8. Use the matrix method for structural analysis of frames.
9. Apply the stiffness method to find the deflections and internal loads of thin-walled structures
10. Calculate the primary buckling loads of columns.
11. Find the buckling loads of thin plates in compression , shear , bending and under combined systems of loading
12. Predict the local buckling load of a thin-walled column and compare it with the primary buckling load of the column
13. Calculate the crippling strength of thin-walled columns.
14. Design the stiffened panels to avoid buckling and crippling.
15. Design the tension-filled web beams.
16. Use MATLAB & GUI development of structural analysis tools.
17. Design, build and test structural project to satisfy required needs under realistic constraints.

***Topics Covered during Class***

| Course Topics | Duration in weeks |
|---|---|
| **Deflection of aircraft structures:** | 4 |
| 1. Deflections of statically determinate structures. | |

2. Load analysis of statically indeterminate structures
3. Deflections of statically indeterminate structures.

**Matrix Method of structures analysis** 4

4. Stiffness equations of spring structures.
5. General Stiffness equations of a structural element.
6. Matrix analysis of truss structures
7. Matrix analysis of beams
8. Matrix analysis of frames.
9. Matrix analysis of thin-walled structures.

**Structural stability** 4

10. Column primary buckling.
11. Thin plates Buckling
12. Local buckling load of a thin-walled column.
13. Crippling strength of thin-walled columns.
14. Stiffened panels in compression.
15. Tension-field web beams.

**Structural Experiments** 2

***Class Schedule:***

- **Lectures:** three one-hour sessions per week
- **Tutorials:** one 50 minutes session per week

***Course Contribution to professional Component:***

- Engineering Science: 80 %
- Engineering Design: 20 %

***Course Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 3 | 2 | | 3 | | 2 | | | | 2 | | 3 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | **Th.** | **Pr.** | **Tr.** | **TCH** |
| **Experimental Structural Mechanics** | **AE 434** | **هـ ط ٤٣٤** | ١ | **3** | **-** | **2** |
| **Pre-requisites** | | STAT 110, AE 432 | | | | |
| Basic methods in the experimental analysis of aerospace structures. Computerized data acquisition and analysis. Measurement of stresses, strains, and displacements using strain gauges. Vibration assessment. Experimental structural design of aircraft components. Computer simulations and commercial Computer-aided engineering tools. Experimental assessment of structural damage. Experimental assessment of repaired aircraft components. Manufacturing of aircraft parts using composite materials. Universal test and CNC machines. Non destructive Evaluation (NDE) techniques; Photo-Stress and LASER techniques. | | | | | | |

Faculties and departments requiring this course (if any): None.

***Textbook:***

- Bruhn, E.F., *Analysis and Design of flight vehicle structure*, Jacobs Publishing, 3rd edition, 1975

***References:***

- Curtis, H.D., *Fundamentals of Aircraft Structural Analysis*, McGraw-Hill, 1996.
- Donaldson, B.C., *Analysis of Aircraft Structures*, Cambridge University Press, 2nd edition, 2008.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Identify basic methods in the experimental analysis of aerospace structures.
2. Conduct experiments to measures stresses, strains, and displacements using strain gauges and computerized data acquisition.
3. Identify vibration assessment techniques.
4. Discuss theory, procedures, and applicability of NDT techniques.
5. Design and manufacture a structural part of an aircraft using composite materials.
6. Design an experiment to assess the structural damage of aircraft components taking into account safety measures
7. Communicate the details of an experimental procedure clearly and completely.
8. Conduct or simulate an experiment to validate/check the feasibility of proposed structural repair solutions
9. Use numerical methods and computer-aided engineering tools to perform in-depth aircraft structural design and analysis.
10. Develop a mathematical model or computer simulation to correlate or interpret experimental results.
11. List and discuss several possible reasons for deviations between predicted and measured results from an experiment, choose the most likely reason and justify the choice.
12. Perform a multidisciplinary analysis of aircraft components.
13. Demonstrate knowledge of contemporary issues and advanced techniques in experimental structural dynamics
14. Work effectively in a team.
15. Prepare a complete design report

16. Give clear, informative, and technical oral presentation

***Topic Covered During Class:***

| Course Topics | Duration in weeks |
|---|---|
| 1. Basic methods in the experimental analysis of aerospace structures. | 1 |
| 2. Computer-Aided engineering tools for aircraft structural design. | 1 |
| 3. Measurement of stresses, strains, and displacements using strain gauges. | 1 |
| 4. Vibration assessment. | 1 |
| 5. Experimental structural design of aircraft components. | 2 |
| 6. Experimental assessment of repaired aircraft components. | 1 |
| 7. Manufacturing of aircraft parts using composite materials. | 1 |
| 8. Universal test and CNC machines. | 1 |
| 9. Non Destructive Evaluation (NDE) techniques | 1 |
| 10. Experimental structural analysis/ design team project | 2 |

***Class Schedule:***

- **Lectures:** 1 hour per week.
- **Tutorials:** 1 hour per week.
- **Lab:** 2 hours per week

***Course Contribution to professional Component:***

- Engineering science: 75%
- Engineering design: 25%

***Course Relationship to Program Outcomes:***

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | | 3 | 3 | 2 | 2 | 2 | | 3 | | | 2 | |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><td rowspan="2">COURSE TITLE</td><td rowspan="2">ENGLISH CODE /NO</td><td rowspan="2">ARABIC CODE/NO.</td><td colspan="4">CREDITS</td></tr>
<tr><td>Th.</td><td>Pr.</td><td>Tr.</td><td>TCH</td></tr>
<tr><td>Aircraft Structural Design</td><td>AE 436</td><td>هـ ط ٤٣٦</td><td>٢</td><td>3</td><td>-</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisites</td><td colspan="5">AE 432, AE 333</td></tr>
<tr><td colspan="7">Structural design of wing, fuselage, tail-plane, fin, and landing gear. Design of ribs, frames, stiffeners, webs, and skins. Spar design. Diagonal semi tension field beams. Optimum design. Computer applications.</td></tr>
</table>

Faculties and departments requiring this course (if any)

***Textbook***

- Moaveni, S. *Finite Element Analysis, Theory and Application with ANSYS*, 2nd Edition, Pearson Education, Inc., 2003.

***Reference:***

- Nahas, M.N, *Stress Analysis in Aircraft Structures,* King Abdulaziz University Press, 2002.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Define limit and ultimate loads on an aircraft.
2. Calculate the inertia forces acting on an aircraft during maneuver.
3. Define the aerodynamic forces acting on an aircraft.
4. Identify all forces acting on a plane in flight.
5. Calculate maneuver and gust load factor.
6. Apply the equations of equilibrium in steady or accelerated flight.
7. Prepare the V-N diagram for a conventional airplane with a specified mission.

**Design – Finite Element Analysis**

8. List the basic steps of the Finite Element (FM) method.
9. Analyze 2Dand 3D trusses using the FE method.
10. Analyze 2D and 3D trusses using ANSYS software.
11. Analyze 2D and 3D beams using the FE method
12. Analyze 2D and 3D beams and frames using ANSYS software.
13. Analyze isotropic flat plates using ANSYS software
14. Analyze curved shells structures using ANSYS software
15. Develop a landing gear structure concept
16. Develop a wing structure concept with skin, spars, ribs and stringers
17. Analyze the suggested structure using ANSYS software and calculate margin of safety distributions in the different components.

**Teamwork and Project Management**

18. Work and communicate effectively in a team to solve engineering problems.

**Engineering Ethics**

19. Identify different scenarios related to structural design that require a decision with an ethical implication.

**Communication**

20. Prepare a complete design report.
21. Give clear, informative, and technically correct oral presentations.

***Topic Covered During Class:***

| | Course Topics | Duration in weeks |
|---|---|---|
| 1. | Basic steps of the Finite Element (FE) method | 1 |
| 2. | 2D and 3D trusses using FE method and ANSYS software | 1 |
| 3. | 2D and 3D beams using FE method and ANSYS software | 1 |
| 4. | Frames using ANSYS software | 1 |
| 5. | Landing structure | 1 |
| 6. | Isotropic flat plates using ANSYS software | 1 |
| 7. | Curved shells structures using ANSYS software | 1 |
| 8. | Wing structure (skin, spars, ribs and stringers) | 1 |
| 9. | Limit and ultimate loads on an aircraft. Inertia and aerodynamic | 1 |
| | forces acting on an aircraft. | 1 |
| 10. | Maneuver and gust load factors. Equations of equilibrium in steady | 1 |
| | and accelerated flight | 3 |
| 11. | V-N diagram for a conventional airplane with a specified mission | |
| 12. | Design Project | |

***Course Schedule*:**

- **Lectures:** two one-hour sessions per week
- **Tutorials**: one 3.0 hours session per week

***Course Contribution to professional Component:***

- Engineering science: 50 %
- Engineering design: 50 %

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 3 | | 3 | 3 | | | | 3 | 3 | 3 | 3 | 3 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | **Th.** | **Pr.** | **Tr.** | **TCH** |
| **Aircraft Structural Integrity** | **AE 437** | **437 هـط** | **٢** | **3** | **-** | **3** |
| **Pre-requisites** | | AE 432, AE 333 | | | | |
| Failure criteria, Slow damage, Fatigue (accumulative damage, crack closure, crack arrest, load spectrum, residual strength, environmentally assisted fatigue), Discrete damage, Impact damage (birds and debris), Reliability, Non-destructive testing, Computer applications | | | | | | |

Faculties and departments requiring this course (if any)

***Textbook*** : T. L. Anderson, Fracture Mechanics: Fundamentals and Applications, 3rd Edition. CRC Press, 2004

***Reference:*** H. L. Edwards and R. Wanhill, Fracture Mechanics, Edward Arnold, 1986

## ***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. explain the importance of flaw analysis in structural design and safety assessments.
2. describe the broad range of applicability of fracture mechanics concepts.
3. use the governing equations of plane linear elasticity and plasticity in Cartesian and polar coordinates, explain the conditions under which they can be used and how to solve plane problems involving them.
4. derive some of the plane governing equations and solve some simple plane problems.
5. derive crack tip stress, strain and displacement fields.
6. use the crack tip results to understand and determine limitations on various fracture criteria.
7. determine stress intensity factors for several important example cases via superposition and other methods such as the J-integral.
8. derive estimates of size and shape of crack tip plastic zones in Modes I, II and III.
9. analyze numerous specific problems requiring application of fracture criteria and comment on their validity.
10. explain what can be learned by application of fracture mechanics in several open-ended problems, and justify conclusions

## ***Topic Covered During Class:***

| Course Topics | Duration in weeks |
|---|---|
| 1. Design and analysis of engineering structures: general failure modes | 1 |
| 2. Examples of important fracture mechanics applications (buttressed by myriad articles from the popular press) | 1 |
| 3. Theoretical fracture strength of an unflawed crystalline solid. | 1 |
| 4. Stresses near an elliptical hole; Orowan (stress-based) fracture criterion | 1 |
| 5. Griffith (energy-based) fracture criterion; energy release rate in linear and nonlinear elastic materials; stability of crack growth in brittle materials | 1 |
| 6. Microscopic fracture mechanisms | 0.5 |
| 7. Charpy impact test; ductile-to-brittle transition temperature phenomenon | 0.5 |
| 8. Introduction to the mechanics of solids (concepts needed for crack analysis) | 1 |
| 9. Introduction to Linear Elastic Fracture Mechanics (LEFM): crack tip stress, strain and displacement fields in linear elastic materials (Modes I, II and III); the stress-intensity factor, K; Irwin's fracture criterion; design philosophy using K_Ic - specific examples | 1 |
| 10. Stress intensity factors for important geometries; methods for finding K | 0.5 |
| 11. Estimates of crack plastic zones in ductile materials; 3D effects | 0.5 |
| 12. Fracture toughness (K_Ic) testing; experimental results; limitations of LEFM | 0.5 |
| 13. The compliance method; experimental determination of compliance | 1 |
| 14. Introduction to fracture mechanics of nonlinear materials: the J-integral; the Hutchinson-Rice-Rosengren (HRR) crack tip fields; the J_Ic fracture criterion; J_Ic testing; J-controlled crack growth and the crack growth resistance (JR) curve; application of J to anisotropic and heterogeneous materials. | 1 |
| 15. One-dimensional crack-tip nonlinear zone models | 0.5 |
| 16. Fracture of composites and other advanced materials; mixed-mode fracture | 1 |
| 17. Application of fracture mechanics concepts in the analysis of fatigue crack growth | 1 |

***Course Schedule*:**
- **Lectures:** two one-hour sessions per week
- **Tutorials**: one 3.0 hours session per week

***Course Contribution to professional Component:***
- Engineering science: 50 %
- Engineering design: 50 %

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 3 | | 3 | 3 | | | | 3 | 3 | 3 | 3 | 3 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Avionic Systems** | **AE 451** | **451 هـط** | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | AE 362, EE 251 | | | | |

An introduction to modern avionic systems. Topics include: Terrestrial and Satellite Navigation Aids, Landing Systems, Surveillance Systems, Air-Ground and Onboard Communications, and Autopilots.

***Textbooks:***

- Helfrick, A., Principles of Avionics, Avionics Communications Inc., 3rd ed., 2004..

***References:***

- None

Faculties and departments requiring this course (if any): None.

***Course Leaning Objectives:***

*By completion of the course, the students should be able to*:

1. Explain the importance and vitality of the different modern avionic systems to the safety and performance of modern aircrafts.
2. Discuss the underlying concepts and theory of operation of each avionic system presented in the course – without going into the details of electronic circuits and systems.
3. Discuss the connection between the operation and functionality of the avionic systems and the student's prior knowledge of the different aerodynamic, structural, and propulsion aspects of the aircraft – whenever appropriate.

***Topic Covered During Class:***

| Course Topics | Duration in weeks |
|---|---|
| Introduction to Avionics | 1 |
| Terrestrial En Route Navigation | 2 |
| Terrestrial Landing Aids | 1 |
| Satellite Navigation | 1 |
| Surveillance Systems | 2 |
| Airborne Communication Systems | 2 |
| Onboard Communications | 1 |
| Air Data | 1 |
| Autopilots | 2 |
| Complete Avionic Systems | 1 |

***Course Schedule*:**

- **Lectures:** three one-hour sessions per week
- **Tutorials**: one hour session per week
-

***Course Contribution to professional Component:***

- Engineering science: 100 %
- Engineering design: 0 %

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 3 | | | 3 | | | 3 | | | 3 | | 3 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Basic Aircraft Systems** | **AE 452** | **هـط ٤٥٢** | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | AE 362 | | | | |
| Instrument displays and panels. Air data instruments. Attitude indicating instruments. Heading indicating instruments. Flight director systems. Power-plant related instruments. Hydraulic and pneumatic systems. | | | | | | |

***Textbooks:***

- Goodwin, A.B.; Fluid Power Systems, McMillan Press Ltd., London, 1976.

***References:***

- Al-Bahi, A.M.; Introduction to Aircraft Instruments and Systems, KAU, Jeddah, 2006 Course Notes (available from AE Dept.)

Faculties and departments requiring this course (if any): None

***Course Leaning Objectives:***

*By completion of the course, the students should be able to*:

1. Identify main elements of aircraft hydraulic systems
2. Analyze basic fluid power components
3. Analyze pressure measurement techniques as related to air data systems
4. Describe attitude indicating instruments
5. Analyze attitude indicating systems
6. Analyze heading indicating systems
7. Demonstrate ability to life-long learning skills
8. Access information from a variety of sources and critically assess their quality, validity, and accuracy.
9. Analyze new content by breaking it down, comparing, contrasting, and interpreting information.
10. Prepare correctly formatted and technically correct written documents that contain few, if any, typographical or grammatical errors.
11. Deliver well-organized oral presentations that maintain audience interest and, make effective use of visual aids during oral presentations.

***Topic Covered During Class:***

| **Course Topics** | **Duration in weeks** |
|---|---|
| 1. Aircraft hydraulic & pneumatic systems; Main hydraulic elements | 1 |
| 2. Analysis of hydraulic systems: Basic fluid power components | 1 |
| 3. Analysis of hydraulic systems: Transmission systems | 1 |
| 4. Analysis of hydraulic systems: Valve controlled systems, Accumulator systems. | 1 |
| 5. Analysis of hydraulic systems: Accumulator systems, Block diagrams & signal flow diagrams. | 1 |
| 6. Air data systems: Instrument systems and errors, Standard atmosphere, Speed equations, Total pressure measurement | 1 |
| 7. Air data systems: Static pressure measurement, Static pressure tubes, using air data tables. | 1 |
| 8. Attitude indicating instruments: Introduction, Airworthiness requirements, Instrument panels and layout, the gyroscope and its properties, free gyro, Steady precession gyro. | 1 |
| 9. Attitude indicating instruments: References established by gyroscopes, free gyroscope limitations, apparent drift & transport wander, Real drift, Control of drift and transport wander. | 1 |
| 10. Attitude indicating instruments: Displacement gyroscope limitations, Gimbal lock, Gimbal error, Gyro horizon. | 1 |
| 11. Attitude indicating instruments: Gyro Horizon, Erection rate, Erection errors. | 1 |
| 12. Heading indicating instruments: Direct reading magnetic compass, Terrestial magnetism, Compass construction, Acceleration and turning errors, Gyro compass, Compass construction. | 1 |
| 13. Heading indicating instruments: Gyro compass, Erection devices, Gimbal errors, Remote indicating compass. | 1 |
| 14. Presentation of term paper | 1 |

***Course Schedule*:**

- **Lectures:** three one-hour sessions per week
- **Tutorials**: one hour session per week
- 

***Course Contribution to professional Component:***

- Engineering science: 100 %
- Engineering design: 0 %

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 3 | | | 3 | | | 3 | | | 3 | | 3 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TC H |
| **Data Acquisition and Signal Processing** | AE 457 | 457 هط | 2 | 3 | - | 3 |
| **Pre-requisites** | | AE 412 | | | | |
| Introducing and Navigating LabView, Software Development Method and Virtual Instrument (VI) implementation, Developing Modular Applications, Design Techniques and Patterns, Data Acquisition Hardware and Software, Signal Conditioning and Signal Processing, Digital Signals and DSP, Digital Filters design. | | | | | | |

***Textbooks:***

- Labview User Manual 2009, National Instruments Corporation.

***Reference:***

Andreas Antoniou, 'Digital Signal Processing – Signal Systems and Filters', McGraw-Hill. Copyright © 2006.

Faculties and departments requiring this course (if any): None.

***Course Learning Objectives:***

By the completion of the course Data Acquisition and Signal Processing (DAQ_DSP), the students should be able to:

1. Describe the principles of instrumentation used in data acquisition and real-time control processes such as sensors and transducers.
2. Plan experiments according to a proper experimental design and choose the appropriate experimental design for different circumstances.
3. Understand fundamental graphical programming for instrumentation.
4. Write programs based on an industry-standard graphical programming language.
5. Gain experience in experimental design, technical specifications and selecting proper instruments for a given application.
6. Define terminologies associated with instrumentation systems and data analysis (e.g., range, sensitivity, dynamic response, calibration, hysteresis, error, accuracy, precision, data uncertainty, mean and standard deviation, fitting, etc.)
7. Use data acquisition software and hardware to collect and analyze data from a physical system.
8. Gain experience in developing computerized instrumentation systems for industrial processes using interface electronics, data acquisition card, serial instruments, etc.
9. Develop special skill and knowledge by training, practice and study of the following fundamentals and techniques:
   9.1 Data Acquisition Hardware and Software (DAQ)
   9.2 Signal Conditioning
   9.3 Signal Processing
   9.4 9.4 Digital Signals and DSP

***Course Schedule* and *Topic Covered During Class:***

## A - COURSE TOPICS

| Course Topics | Duration |
|---|---|

| | in weeks |
|---|---|
| 1. Navigating Labview | 1 |
| 2. Software Development Method and Virtual Instrument (VI) implementation | 1 |
| 3. Developing Modular Applications | 1 |
| 4. Design Techniques and Patterns | 1 |
| 5. Data Acquisition Hardware and Software | 2 |
| 6. Signal Conditioning and Signal Processing | 3 |
| 7. Digital Signals and DSP | 3 |
| 8. Digital Filters design | 2 |

## B - LABORATORY TOPICS

| Lab Topics | Duration in weeks |
|---|---|
| 1. Virtual lab: Process Design and Simulation | 3 |
| 2. Analog I/O: DAQ , Conditioning, and Processing | 3 |
| 3. Virtual lab: Device Design and Simulation | 3 |
| 4. Digital I/O: DAQ , Conditioning, and Processing | 3 |
| 5. Digital Filters Implementation | 2 |

***Course Schedule*:**
- **Lectures:** two one-hour sessions per week
- **Lab**: three hours per week

***Course Contribution to professional Component:***
- Engineering science: 75 %
- Engineering design: 25%

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 3 | 3 | 3 | 2 | | | | | | 2 | 3 | |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Performance of Aerospace Vehicles** | **AE 461** | **461هـط** | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | AE 311 | | | | |
| Aircraft performance in steady flight. Straight and level flight. Flight limitations. Drag, power, and performance curves in terms of thrust and power. Gliding flight. Range and endurance. Climbing flight. Aircraft performance in accelerated flight. Take off and landing. Turning flight. Introduction to helicopters performance. Thrust and torque theory. Rotor flow effects and power requirement. Vertical climb Space flight. Rocket Performance. Trajectories and escape velocity. Circular & elliptic Orbits. | | | | | | |

***Textbook:***

- Anderson, John D., *Introduction to Flight*, McGraw-Hill, 6th edition, 2007.

***Reference:***

- Houghton, E.L.& Caruthers, N.B., *Aerodynamics for Engineering students*, Edward Arnold, Houghton & P.W. Carpenter, 5th edition, 2003.
- Layton, D.M., *Helicopter Performance*, Matrix Publisher, Inc, 1984.

Faculties and departments requiring this course (if any): None

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Derive the equation of motion for an airplane in straight and level flight.
2. Show the flight limitation for airplane and identify the significance of the equivalent air speed in level flight.
3. Identify the importance of aircraft aspect ratio, zero lift drag coefficient and Oswald efficiency on aircraft performance.
4. Solve problems predict the effect of compressible drag on aircraft performance.
5. Derive the conditions of the minimum drag flight and the minimum power flight.
6. Compute and draw the performance curves in terms of thrust and in terms of power.
7. Show the effect of wing loading, thrust loading, zero lift drag coefficient and altitude on the maximum flight speed.
8. Explain the effect of change of aircraft weight, altitudes and aircraft configurations on performance curves
9. Solve problems related to aircraft performance in straight and level flight.
10. Derive the equation of motion for airplane in gliding flight.
11. Calculate the rate of glide for small and steep angles of glide.
12. Show the conditions of the maximum horizontal covered distance and the maximum duration.
13. Solve problems related to the performance of aircraft in gliding flight
14. Derive the equation of motion for aircraft in climbing flight.
15. Derive the equation to determine the maximum rate of climb for jet aircraft and for propeller driven aircraft.
16. Illustrate the performance curves for climbing flight and the climbing hodograph.
17. Derive the correction equations for steep climbing.
18. Solve problems related to aircraft climbing performance.
19. Explain the effects of altitude on aircraft straight and level performance power curves.
20. Define and calculate the aircraft absolute, service and cruise ceilings
21. Compute the time to climb to certain altitudes.
22. Derive and demonstrate the parameters affected to the fasted climb.
23. Discuss the accelerated rate of climb using the energy height techniques.
24. Derive equations for the range and endurance for propeller driven aircraft and jet aircraft.

25. Show the conditions for maximum range and endurance for different types of aircraft.
26. Solve problems related to range and endurance of aircraft.
27. Derive other method of solution to performance of aircraft having polar drag equation and solve related problems.
28. Solve performance problems of aircraft known its wing lift distribution and the equation of drag is non polar equation.
29. Describe the take- off and landing flight processes and define the related terms for speeds and distances.
30. Calculate the ground roll distance for take off and the braked ground run for landing and estimate the time corresponding to each case
31. Show the parameters affected to take off and landing ground distances.
32. Define the balanced field length.
33. Derive the equation of motion for aircraft in level turning and study the related parameters affecting turn flight.
34. Solve problems related correctly banked level turning flight.
35. Derive equations of the motion for pull-up and push-down flights.
36. Study the load factor-velocity curve and explain its limitations.
37. Apply momentum theory and blade element theory to study the aerodynamic of helicopter.
38. Predict the power required including flow effects in hover and solve related problems.
39. Derive performance equations of the helicopter vertical climb and solve related problems

***<u>Topic Covered During Class:</u>***

| **Course Topics** | **Duration in weeks** |
|---|---|
| 1. Straight and Level Flight | 3 |
| 2. Gliding Flight | 1 |
| 3. Climbing Flight | 2 |
| 4. Range and Endurance | 1 |
| 5. Other Methods of Solution to Performance Problems | 1 |
| 6. Take off and landing Flight | 2 |
| 7. Turning Flight | 2 |
| 8. Helicopter | 2 |

***<u>Course Schedule</u>*****:**

- **Lectures:** three one-hour sessions per week
- **Tutorials:** one hour session per week

***<u>Course Contribution to professional Component:</u>***

- Engineering science: 90 %
- Engineering design: 10 %

***<u>Course Relationship to Program Outcomes</u>*****:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | | 2 | 2 | | | 1 | | | 1 | | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><th rowspan="2">COURSE TITLE</th><th rowspan="2">ENGLISH<br>CODE /NO</th><th rowspan="2">ARABIC<br>CODE/NO.</th><th colspan="4">CREDITS</th></tr>
<tr><th>Th.</th><th>Pr.</th><th>Tr.</th><th>TCH</th></tr>
<tr><td>Aerospace Control Systems</td><td>AE 463</td><td>هط ٤٦٣</td><td>3</td><td>1</td><td>-</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisites</td><td colspan="5">AE 362, EE 251</td></tr>
<tr><td colspan="7">Flight control system elements and configuration, mathematical modeling for control design, transfer functions, state-space representation, block diagram reduction, first-order, second-order, and higher-order linear system characteristics, open versus closed-loop control, stability and performance of linear feedback control systems, Routh-Hurwitz stability criterion, root-locus technique, frequency response, Bode plot, Nyquist stability criterion, Nyquist plot, autopilot stability and command augmentation systems, introduction to modern control theory, linear state feedback, linear quadratic regulators, servoelasticity and other aerospace control system design considerations.</td></tr>
</table>

***Textbook:***

- Norman S. Nise, *Control Systems Engineering*, John Wiley & Sons, 4th edition, 2004.

***Reference:***

None

Faculties and departments requiring this course (if any)

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Model first and second-order LTI systems by differential operator method and state space method and by Laplace transform.
2. Transform linear equations of motion to the Laplace domain and solve differential equations using Laplace transforms
3. Derive transfer functions and characteristic equations for dynamical systems, state and apply initial and final value theorems.
4. Convert from state space to transfer function system representation and vice versa.
5. Infer the relation between pole-zero locations and time response, derive the impulse response function of first-order, second-order and higher order systems.
6. Identify the system type, and obtain impulse, step, ramp, and acceleration response.
7. Find time and frequency domain solutions of state equations.
8. Define the concepts of the transfer function and the block diagram, and obtain block diagram reductions for open loop systems.
9. Perform closed loop analysis of second order systems, and obtain closed loop transfer functions and the corresponding time response characteristics.
10. Analyze root loci, design closed loop systems using the magnitude and angle criteria, and plot the root locus.
11. Recognize the role frequency response techniques in linear system identification, plot Bode plots for open loop transfer functions, and reconstruct transfer functions from available Bode plots.
12. Derive and state the Nyquest stability criterion, and plot Nyquist diagram.
13. Obtain stability and gain/phase margins via the Nyquist diagram, and relate the concepts to robustness.
14. Design closed loop systems via frequency response to meet closed loop stability and robustness requirements
15. Design aircraft stability augmentation, attitude hold, altitude hold, and Mach hold control systems
16. Use state space analysis of dynamical systems to assess system controllability and observability, and design multivariable control systems via pole placement methodology.

***Topic Covered During Class:***

| Course Topics | Duration in weeks |
|---|---|
| Review of LTI systems and differential equations solution by Laplace transform | 1 |
| Transfer functions, zeros, poles, initial/final value theorems, block diagram reduction | 2 |
| System types, response to impulse, step, ramp, and acceleration inputs | 1 |
| State space modeling, time and frequency solution to state equations | 1 |
| Closed loop response and transfer functions, time response characteristics of first and second order systems | 1 |
| Root locus analysis and design | 1 |
| Frequency response, Bode plots, phase and gain margins | 1 |
| Nyquest stability criterion, Nyquist diagram, stability robustness via the Nyquist diagram.<br>Closed loop design by frequency response | 1 |
| MATLAB computer applications on aircraft stability and control augmentations | 1 |
| Introduction to modern control theory, controllability, observability, pole placement | 2 |

***Course Schedule*:**

- **Lecture:** three one-hour sessions per week
- **Tutorials:** one hour session per week

***Course Contribution to professional Component:***

- Engineering science: 60 %
- Engineering design: 40 %

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | | 2 | 2 | | | 1 | | | 1 | | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Aircraft Design** | **AE 465** | **هـط465** | **2** | **3** | **-** | **3** |
| **Pre-requisites** | | AE 362 | | | | |
| Mission specification. Weight estimation. Sensitivity of weight to different parameters. Estimating of wing area, take off thrust, and lift coefficient. Configuration design. Overall configuration. Fuselage layouts. Wing plan-form design. High lift devices. Empennage design. Control surfaces. Landing gear. Propulsion system selection. Design refinement. Computer applications. | | | | | | |

***Textbook:***

- Roskam, J., *Airplane Design*, Parts I through VIII, DARcorporation, 2nd edition, 2003.

***References:***

- Roskam, J., *Airplane Aerodynamics and Performance*, DARcorporation, 3rd reprint, 2000.
- Howe, D., *Aircraft Conceptual Design Synthesis*, Wiley, 2005.

Faculties and departments requiring this course (if any): None.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Define an appropriate set of mission requirements and sketch the mission profile of an airplane.
2. Perform a literature search and collect data to show the need for a particular airplane.
3. Identify the critical mission requirements of an airplane.
4. Evaluate the configuration of airplanes and describe the connection between configuration choices (ex. High wing, tandem landing gear) and mission requirements.
5. Describe the pros and cons of the various conventional aircraft configurations.
6. Describe the pros and cons of unconventional aircraft configuration such as canards, 3-surface, swept-forward wings, flying wings, tailless, V/STOL, stealth, etc.
7. Select an appropriate configuration for an airplane with a specified mission.
8. Estimate the takeoff weight of an airplane based on the mission requirements using the weight fraction method.
9. Calculate the takeoff weight sensitivity of an airplane to change of critical parameter such as L/D, SFC, etc.
10. Construct a matching graph based on specific performance constraints, such as stall speed, cruise speed, takeoff distance, and landing distance and used it to predict the required thrust / power and wing area for an airplane.
11. Prepare CAD drawing of the cockpit and fuselage of an airplane based on the specific payload requirements.
12. Design the wing, empennage and the landing gear of an airplane using tip-over and ground clearance criteria.
13. Discuses selected systems applied to the design of the airplane.
14. Calculate the direct operating cost for the designed airplane.
15. Communicate effectively in a team environment, negotiate and resolve conflicts, motivate and coach others in your team, organized and delegate and resolve as needed, develop a team vision and set team goals, manage resources.
16. Develop a milestone schedule (timeline) for an engineering project.
17. Write high quality design reports (i.e. using correct language and terminology, correct technical information, and professionally prepared graphs and graphs and tables).

18. Give clear information, technically correct oral presentations using professionally prepared visual aidsDefine an appropriate set of mission requirements and sketch the mission profile of an airplane.

***Topic Covered During Class:***

| Course Topics | Duration in weeks |
|---|---|
| 1. Determination of the takeoff weight, empty weight, and fuel weight from a given mission specification. Derivation and discussion of takeoff weight sensitivities to range, endurance, lift-to-drag ratio specific fuel consumption, and empty weight. | 2 |
| 2. Derivation and discussion of performance constraints for: stall speed, takeoff and landing field length, carrier compatibility, climb to altitude, climb with all-engines-operational and one-engine-out, specific excess power, cruise speed, maximum speed. The performance constraint plot and selection of takeoff wing landing and takeoff trust-to-weight ratio. Preliminary method for determining drag polar. Civil and military regulation. | 2 |
| 3. Selection of the overall configuration. Example of airplane design as a non –unique and iterative process. Preliminary design decision making for: cockpit and fuselage, wing, high lift devices, propulsion system, empennage, landing gear. Preparation of a preliminary three-view. | 2 |
| 4. Detailed discussion of why's and how's of the design of cockpit and fuselage, wing, high lift devices, propulsion system, empennage, landing gear. Procedures for analysis, design, and re-design of airplanes so that all mission, airworthiness and environmental regulations are met. | 2 |
| 5. Discussion of the design of systems. Reversible and irreversible fuel systems. Hydraulic systems. Electrical and Avionics systems. Water and waste system. Anti- and de-icing system. | 2 |
| 6. Airplane cost analysis and prediction. RDTE cost (through certification), manufacturing cost, operating cost for civil aircraft, indirect operating cost for civil aircraft, life cycle cost. The design-to-cost problem. Estimation of aircraft net worth. Design guides for low cost. Factors in airplane program decision making. Typical cost breakdown for aircraft. Factors in aircraft program decision making. | 2 |
| 7. Alternative schools of aircraft design, and why, the master equation. | 1 |
| 8. Technique for Order Preference by Similarity to Ideal Solution TOPSIS | 1 |

***Course Schedule*:**

- **Lectures:** two one-hour sessions per week
- **Design Lab**: 3 hours session per week

***Course Contribution to professional Component:***

1. Engineering science: 0 %
2. Engineering design: 100 %

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 3 | | 3 | | 3 | 3 | | 3 | 3 | 3 | | 3 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Propulsion II** | **AE 472** | **هـ ط ٤٧٢** | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | AE371, AE 412 | | | | |
| Jet engin components. Aerothermodynamics of intakes, combustors and nozzles. Aerothermo-dynamics of gas turbine engines turbomachines. Axial and centrifugal compressors and axial turbines. Matching of engine components. Application to the design of jet engine components. | | | | | | |

***Textbook:***

- Hill, G.H, and Peterson, C.R, *Mechanics and Thermodynamics of Propulsion,* Prentice Hall, 2nd edition 1991.

***References:***

Faculties and departments requiring this course (if any): None

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Explain the internal mechanism of various fixed GTE components (inlet, combustors, and nozzles) in order to describe the factors that impose practical limits on performance.
2. Explain conditions required for high performance of those fixed components.
3. Perform experiments to demonstrate the nozzle flow characteristics and analysis of results.
4. Apply Euler equation for turbomachines on axial and centrifugal compressors and axial turbines.
5. Explain the internal mechanisms of energy transfer and conversion inside turbomachines to find out sources of losses and methods to reduce these losses for high performance.
6. Relate the required performance to the rotor and stator blade shapes and angles.
7. Explain factors that impose limits on performance.
8. Explain the new trends in GTE designs, turbine blade cooling, new blade materials, use of composite materials, wide chord blades and their effect on engine performance.
9. Recognize the importance of components matching and its effect on the overall engine performance.
10. Proposing the optimum design (main shape and dimensions) of high performing GTE components to meet specified design requirements.

***Topic Covered During Class:***

| Course Topics | Duration in weeks |
|---|---|
| 1. Review of AE371 | 1 |
| 2. Aerothermodynamics of fixed components | |
| a. Inlets | 1.5 |
| b. Combustion chambers and afterburners | 2 |
| c. Exhaust nozzles | 1 |
| 3. Turbomachines | |
| a. Single and multistage axial compressors | 2 |
| b. Centrifugal compressor | 1.5 |
| c. Axial turbine | 2 |
| 4. General engine topics | 1 |
| 5. Laboratory | 1 |
| 6. Design project | 1 |

***Course Schedule*:**

- **Lectures:** three one-hour sessions per week
- **Tutorials**: one hour session per week

***Course Contribution to professional Component:***

- Engineering science 75 %
- Engineering design: 25 %

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | 2 | 2 | 2 | | | | 2 | 1 | | 2 | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Space Vehicle Propulsion** | **AE 473** | **473 هـط** | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | AE372, AE 412 | | | | |
| Types and performance of rocket vehicles, Chemical rockets, characteristics, propellants and combustion, expansion in nozzles, thrust chambers, Electrical rocket propulsion, Advanced propulsion concepts. | | | | | | |

***Textbook:***

Ronald W. Humble, Gary N. Henry, and Wiley J. Larson, Space Propulsion Analysis and Design, McGraw-Hill, ISBN 978-0077230296, 1995

***References:***

Faculties and departments requiring this course (if any): None

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Identify thrust, specific and total impulse, effective exhaust velocity, inert mass fraction.
2. Develop the design process stages from requirements to final choice.
3. Define mission and develop propulsion system requirements.
4. Apply the gas flow thermodynamic and combustion process basic laws.
5. Apply the design process to a liquid rocket propulsion system.
6. Apply the design process to a solid rocket motor.
7. Identify the hybrid rocket propulsion system ballistics.
8. Explain the fundamentals of nuclear and electric rocket systems.
9. Explain new advancements in propulsion systems.
10. Apply the design process to one space propulsion problem.

***Topic Covered During Class:***

| **Course Topics** | **Duration in weeks** |
|---|---|
| 1. Rocket Fundamentals | 1 |
| 2. The Design Process | 1 |
| 3. Mission Analysis | 1 |
| 4. Thermodynamics and Thermochemistry | 1 |
| 5. Liquid Rocket Propulsion Systems | 2 |
| 6. Solid Rocket Motors | 2 |
| 7. Hybrid Rocket Propulsion Systems | 1 |
| 8. Nuclear and Electric Rocket Propulsion Systems | 1 |
| 9. Advanced Propulsion Systems | 1 |
| 10. Case Study | 3 |

***Course Schedule*:**

- **Lectures:** three one-hour sessions per week
- **Tutorials**: one hour session per week

***Course Contribution to professional Component:***

- Engineering science 67 %
- Engineering design: 33 %

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | | 2 | 2 | | 1 | | | | 2 | | |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Air Transport Engineering** | **AE 481** | **481 هـ ط** | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | AE 362 | | | | |
| Air-worthiness, Fleet planning, Flight safety, Flight operations, Ground operations, Maintenance tasks, Initial maintenance programs, Quality control. | | | | | | |

***Textbooks:***

- Dr. Wail Harasani, Aeronautical Engineering Department, King Abdul Aziz University, Hand Outs

***Reference:***


1. Paul Clark, "Buying the Big Jets, Fleet Planning for Airlines", Aldershot: Asqate, 2001.
2. Alexander T. Wells, "Airport Planning and Management." TaB Books, 1986
3. C. Yau. 1993. "An interactive Decision Support system for Airline Planning". IEEE transaction on systems, man and cybernetics 23: 1617-1625.


Faculties and departments requiring this course (if any): None.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Describe and define fleet planning, and the importance of fleet selection.
2. Perform a literature search and collect data to show the need for a fleet planning.
3. Define Market Adaptability, Fleet flexibility, Fleet continuity, and Fleet life cycle.
4. Calculate Operating cost, Indirect operating cost, and direct operating cost
5. Analyses Traffic data
6. Identify suitable aircraft candidate
7. Calculate Aircraft performance, and cost efficiency by each stage length
8. Prepare or arrange traffic allocation and scheduling
9. Identify the preferred fleet choice
10. Communicate effectively in a team environment, negotiate and resolve conflicts, motivate and coach others in your team, organized and delegate and resolve as needed, develop a team vision and set team goals, manage resources.
11. Develop a milestone schedule (timeline) for an engineering project.
12. Write high quality design reports (i.e. using correct language and terminology, correct technical information, and professionally prepared graphs and graphs and tables).
13. Give clear information, technically correct oral presentations using professionally prepared visual aids.

***Topic Covered During Class:***

| **Course Topics:** | **Duration in weeks** |
|---|---|
| 1. Introduction to airline fleet planning, definition of airline fleet planning. The importance of aircraft selection, Market Adaptability, Fleet flexibility, Fleet continuity, and Fleet life cycle. | 2 |
| 2. Flight operations, Ground operations, Maintenance tasks, Initial maintenance programs | 3 |
| 3. Economic criteria, Operating cost, Indirect operating cost, Direct operating cost, Maintenance operating cost, Fuel operating cost, Crew cost, Fuel cost, Airport fees. | 3 |
| 4. The process of aircraft selection, which involves traffic data analysis, and identify suitable aircraft candidate. | 3 |
| 5. The final stage of aircraft selection, which involves, Aircraft performance, cost efficiency by each stage length, traffic allocation and scheduling, finally identify the preferred fleet choice. | 3 |

***Course Schedule*:**

- **Lecture:** three one-hour sessions per week
- **Tutorials:** one hour session per week

***Course Contribution to professional Component:***

- Engineering science: 100 %
- Engineering design: None

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | | | 3 | | | 3 | 3 | 3 | 3 | | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Aircraft Maintenance Systems** | **AE 482** | **482 هـ ط** | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | STAT 110, AE 362 | | | | |
| Introduction. Reliability theory. Life testing. Maintained systems. Integrated logistic support (ILS). Aircraft handling. Repair station requirements. Quality systems. Inventory control. Structural repair. Engine maintenance and overhaul. Maintenance of aircraft systems and instruments. | | | | | | |

***Textbooks:***

- Lewis, E.E.; *Introduction to Reliability Engineering*, John Wiley & Sons, New York, 1987.

***Reference:***

- Al Bahi, A.M.; *Introduction to Aircraft Maintenance Engineering and Practices – Part 1 & 2*, KAU, Jeddah, 2006, Course notes (available from AE Dept.)

Faculties and departments requiring this course (if any): None.

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Define reliability and mathematically formulate failures as a stochastic, age related, random process.
2. Calculate analytic reliability parameters for components as well as redundant and non redundant systems.
3. Use life testing to estimate reliability parameters of systems and components.
4. Plan optimal preventive/corrective maintenance policies for engineering systems.
5. Plan inspection/repair interval for both revealed and unrevealed failures.
6. Analyze maintainability, availability, and integrated logistic support parameters to ensure safe and economic life cycle operation of complex systems.
7. Use simple birth-death processes and queuing theory to measure the effectiveness of maintenance facilities.
8. Analysis inventory control systems including demand models, replenishment, inventory costs, and control policies.
9. Identify aircraft handling and servicing operations and their ground support equipments.
10. Describe aircraft repair station requirements and associated FAA regulations, certifications and publications.
11. Discuss inspection fundamentals applied in aircraft maintenance environment.
12. Evaluate non-destructive testing and crack detection techniques used for aircraft and engine components.
13. Identify load carrying components of the aircraft and their typical structural repair procedures.
14. Identify maintenance and overhaul policies for aircraft engines including fixed time between overhauls, on condition maintenance, cold/hot section inspection, and troubleshooting of malfunctioning.
15. Describe the main elements of aircraft hydraulic systems.
16. Demonstrate ability to achieve objectives of assigned tasks using independent, well organized, and regularly reported multidisciplinary team management techniques that integrate, evaluate, and improve different skills of team members.
17. Communicate details of personal and team assignments and express thoughts clearly and concisely, both orally and in writing, using necessary supporting material, to achieve desired understanding and impact
18. Perform professionally and ethically by demonstrating punctuality, behaving honestly, accepting responsibility, taking initiative, and providing leadership.

## ***Topic Covered During Class:***

| **Course Topics:** | **Duration in weeks** |
|---|---|
| 1. Introduction, Reliability definitions and function, Mortality curve | 1 |
| 2. Component mortality, Mean time to failure (MTTF), Useful life, Wearout, Early life, System Mortality. | 1 |
| 3. Series systems, Parallel systems, Stand-by systems, Multi-mode systems, De-rating. | 1 |
| 4. Reliability testing; Parametric and non-parametric methods, Censoring and acceleration, Maximum likelihood method, Weibull and exponential reliability papers. | 1 |
| 5. Maintained systems; Preventive maintenance (P.M.), Idealized P.M. Imperfect P.M., Replacement policy, Corrective maintenance, Revealed failures, Unrevealed failures. | 1 |
| 6. Maintainability, availability and integrated logistic support (ILS); Down time, Design for maintainability, Life cycle, Maintenance Eng. Analysis (MEA), Level of spare protection. | 1 |
| 7. Queuing theory; Queuing characteristics, Poisson Process, Birth-Death process. | 1 |
| 8. Queuing theory; Queuing models, M/M/1 model, M/M/C model, Machine interference model, Measures of effectiveness. | 1 |
| 9. Aircraft handling; Handling operations, Engine starting, Taxiing, Towing, Jacking, Tying down, Aircraft servicing, Lubrication, Ground support equipment. | 1 |
| 10. Repair station requirements; FAA regulations, Organization chart, Certification requirements, Storage, Publications, Cleaning operations. | 1 |
| 11. Inspection fundamentals; Regular inspections, Special inspections. Crack detection and Non Destructive Testing (NDT); Visual inspection, Magnetic Particle Inspection (MPI), Dye Penetrating Inspection (DPI), Radiography, Ultrasonic, Eddy current. | 1 |
| 12. Structural repair of load carrying components; Fuselage, Wing, Tail and control surfaces, Landing gear, Typical structural repairs. | 0.5 |
| 13. Engine maintenance & overhaul; Maintenance policy, Fixed Time Between Overhauls (TBO), on condition maintenance, Engine maintenance and repair, Cold section inspection, hot section inspection (HSI), Engine overhaul, troubleshooting. | 1 |
| 14. Aircraft hydraulic systems; Main hydraulic elements; Pumps, valves, Pressure regulators, Pressure reducers, Accumulators, Actuators. Oral presentation of a selected subject by each student. | 0.5 |
| 15. Inventory control systems; Demand models, Replenishment, Inventory costs, Control policies, some inventory models. | 1 |

## ***Course Schedule*:**

- **Lecture:** three one-hour sessions per week
- **Tutorials:** one hour session per week

## ***Course Contribution to professional Component:***

- Engineering science: 100 %
- Engineering design: None

## ***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | | | 3 | | | 3 | 3 | 3 | 3 | | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE/NO | ARABIC CODE/NO | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Aeronautical Engineering Seminar** | **AE 497** | **هـ ط ٤٩٧** | **1** | **-** | **-** | **1** |
| **Pre-requisite** | **AE 412, AE 432** | | | | | |
| Literature review methodologies and sources. Review of a recently published topics pertaining to contemporary social, economic or environmental issues in aeronautical engineering. Delivering a seminar lecture by a team of students based on a term paper prepared by them. | | | | | | |

***Faculties and departments requiring this course (if any):***

This is an elective course

***Textbook:***

Different Recommended Material will be used for this course.

***References:***

None

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Practice Effective Team Management tools.
2. Prepare effective business communications.
3. Demonstrate the methods of literature review.
4. Analyze recent publication (s) of Aeronautical Engineering.
5. Identify contemporary issues.
6. Prepare and deliver effective presentation using different computer applications.

***Topics Covered and Duration:***

| | |
|---|---|
| 1. Literature Review Methodologies | (3 weeks) |
| 2. Selection of Area of Aeronautical Engineering | (1 week) |
| 3. Selection of Field in the Area of Aeronautical Engineering | (1 week) |
| 4. Selection of Topic in the particular area of Aeronautical Engineering | (2 weeks) |
| 5. Preparation of research paper | (4 weeks) |
| 6. Preparation of Business Communication | (2 weeks) |

***Class Schedule:***

As per Schedule

***Course Contribution to professional Component:***

- Engineering science: 100%
- Engineering design:  0%

## ***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ABET and additional Program Outcomes** | **1** | **2** | **a** | **b** | **c** | **e** | **h** | **j** | **l** | **m** | **n** | **i** | **d** | **f** | **g** | **k** | **a** |
| **Max. Attainable Level of Learning*** | | | 2 | | 2 | 2 | 2 | 2 | 2 | 2 | | 2 | 3 | 3 | 3 | 2 | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Special Topics in Aeronautical Engineering** | **AE 498** | **498 هـ ط** | **3** | **1** | **-** | **3** |
| **Pre-requisites** | | **AE 412, AE 432** | | | | |
| Selected topics to develop the skills and knowledge in a given field of Aeronautical Engineering | | | | | | |

***Textbooks:*** *Varies from semester to semester*

***Reference:*** *Varies from semester to semester*

***Course Learning Objectives:*** *Varies from semester to semester*

***Topic Covered During Class:*** *Varies from semester to semester*

***Course Schedule*:**

- **Lecture:** three one-hour sessions per week
- **Tutorials:** one hour session per week

***Course Contribution to professional Component:***
*Varies from semester to semester*

***Course Relationship to Program Outcomes*:**
*Varies from semester to semester*

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| **Senior Project** | **AE 499** | **هـط ٤٩٩** | **2** | **4** | **-** | **4** |
| **Pre-requisites** | | AE 412, AE 432 | | | | |
| The student is required to function on multidisciplinary team to design a system, component, or process to meet desired needs within realistic constraints. A standard engineering design process is followed including the selection of a client defined problem, literature review, problem formulation (objectives, constraints, and evaluation criteria), generation of design alternatives, work plan, preliminary design of the selected alternative, design refinement, detailed design, design evaluation, and documentations. The student is required to communicate, clearly and concisely, the details of his design both orally and in writing in several stages during the design process including a final public presentation to a jury composed of several subject-related professionals. | | | | | | |

***Textbook:*** None

***References:***

- Notes by: Dr. Bahattin karagözoğlu, *A Guide to Engineering Design Methodologies and Technical Presentation*, KAU, faculty of engineering, department of electrical and computer engineering, 2007
- AAU Assessment Rubrics for Senior Projects, available from AE ABET Committee

Faculties and departments requiring this course (if any)

***Course Learning Objectives:***

By the completion of this course the students will be able to:

1. Analyze a project statement, brief, or proposal to identify the real problem and the most relevant needs and operational constraints.
2. Identify potential customers, their needs, and their operational constraints.
3. Collect and review related data such as technical information, regulations, standards, and operational experiences from credible literature resources.
4. Integrate previous knowledge from mathematics, basic sciences, engineering fundamentals and discipline related courses to address the problem.
5. Discuss all applicable realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
6. Define design objectives, measures of design viability, and the evaluation criteria of the final project, and reformulate the problem based on collected data.
7. Generate possible solutions; compare alternatives, and select one alternative based on evaluation criteria and feasibility analysis.
8. Plan an effective design strategy and a project work plan, using standard project planning techniques, to ensure project completion on time and within budget.
9. Implement a planned design strategy for an Experimental Design Project, if applicable:
   - 9.1 Identify experimental variables and parameter with ranges and desired accuracies.
   - 9.2 Select appropriate experimental tools such as sensors, instruments, and software.
   - 9.3 Explain a reliable experimental setup and experimental procedure that solves the problem.
   - 9.4 Explain efficient measures to deal responsibly with safety issues and environmental hazards.
   - 9.5 Use appropriate measurement techniques to ethically collect and record data.
   - 9.6 Analyze experimental data using appropriate tools such as data reduction and statistical analysis.
   - 9.7 Perform uncertainty analysis.

9.8 Judge, verify, and validate the experimental result by comparing them with theory and/or previous experimental works.

10. Implement a planned design strategy for a Product-Based Design Project, if applicable:
    10.1 Identify design parameters as well as assumptions.
    10.2 Carry out initial design calculations using modern engineering tools.
    10.3 Use modern engineering tools to estimate the performance parameters of the initial design.
    10.4 Use constraint analysis and trade-off studies of the design parameters to refine the initial design and obtain a final optimized design.
    10.5 Evaluate the project related environmental, social, health and safety issues, as well as hazards anticipated by the project.
    10.6 Evaluate project success in satisfying customer's needs, design criteria, and operational constraints.
11. Communicate design details and express thoughts clearly and concisely, both orally and in writing, using necessary supporting material, to achieve desired understanding and impact.
12. Demonstrate ability to achieve project objectives using independent, well organized, and regularly reported multidisciplinary team management techniques that integrate, evaluate, and improve different skills of team members

***Topic Covered During Class:***

| Course Topics | Duration in weeks |
|---|---|
| 1. Project selection and team formation | 1 |
| 2. Problem Definition | 2 |
| 3. Literature review and data collection | 3 |
| 4. Problem formulation: | 3 |
| a. Knowledge integration | |
| b. Operational and realistic constraints | |
| c. Design objectives | |
| d. Evaluation criteria | |
| 5. Design options and initial layout | 2 |
| 6. Work plan and budgeting | 1 |
| 7. Progress report and oral presentation | 2 |
| 8. Implementation phase | 7 |
| 9. Design refinement | 3 |
| 10. Final report writing and oral presentation | 4 |

***Course Schedule*:**

- Weekly meetings with the supervisor
- One or more oral presentation(s)
- Final general audience presentation and examination

***Course Contribution to professional Component:***

- Engineering science: None
- Engineering design: 100 %

***Course Relationship to Program Outcomes*:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 3 | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

# DEPARTMENT OF
# CHEMICAL AND MATERIALS ENGINEERING

## INTRODUCTION

Chemical and Materials Engineering are disciplines concerned with the application of basic and engineering sciences to the study of processes in which raw materials undergo both chemical and physical changes to produce value added products. Chemical and Material engineers deal with the design, construction and economic operation of plants and equipments in which these processes take place. Quality and characteristics of manufactured materials are also studied in these disciplines.

The Kingdom of Saudi Arabia is endowed with vast resources of petroleum and minerals, which require the expertise and services of chemical and materials engineers to harness these resources and contribute to the rapid development and progress of the country. In order to meet this challenge, the Department of Chemical and Materials Engineering was established in the year 1981/1982 at King Abdulaziz University. Since its inception, the Department has produced more than 500 qualified chemical engineers who are serving various organizations in different parts of the country.

The Department is well equipped to provide effective training to the graduating engineers. It has a B.Sc. degree program of a five-year duration consisting of 155 credit units with specialized courses, suitable to the requirements of the Kingdom. The programs leading to the Master of Science (M.Sc.) in Chemical Engineering and Materials Engineering started in 1996 G. Each of these programs requires two years of full-time study consisting of 36 credit units of course work and a thesis. The Department has well equipped laboratories and computer facilities as well as highly qualified faculty and technicians to achieve its educational aims and objectives.

## VISION AND MISSION STATEMENTS

### The Vision of the Department

Commitment to total quality in teaching and scientific research and aspiration to leadership in chemical and materials engineering education.

### The Mission of the Department

The mission of the Chemical and Materials Engineering Department at King Abdulaziz University (KAU) is to graduate highly qualified chemical and materials engineers who are well trained and prepared to pursue professional careers in industry, government or research. Moreover, the department thrives to conduct world-class research and provide consultation services sectors of the community in the chemical and materials engineering sciences and technology.

## EDUCATIONAL OBJECTIVES

4. Employ their extensive Chemical Engineering knowledge and skills to actively take part in solving techno-economical problems in private and public industries in general, and in the petrochemicals, petroleum refining, and gas related industries in particular
5. Pursue career building skills through long-life learning in the fields of Chemical Engineering in order to address contemporary local and global issues.

6. Uphold and reflect the core values and lofty principles of Islam through personal and professional integrity, ethical and responsible behaviors, proactivity and a sincere desire and effort to serve society both individually and within teams.

## Aspects of Development

The department of the Chemical and Materials Engineering has most of the necessary resources needed to implement the new plan, however, some improvements and extra resources are needed to increase the ability of the department to accommodate more students considering the increase in demand for chemical engineers for the expanding chemical, petroleum and petrochemical industries in the Kingdom. Future plans should consider the followings:-

9. Modernization and upgrading of the Corrosion Lab

   The corrosion lab need to be expanded to accommodate more students and should be provided with modern and sophisticated equipment needed such as

   a. Potentiostat Galvanostst (software & P.C)
   b. Thermal and stress corrosion
   c. Salt spray unit

10. Modernization and upgrading of the waste treatment lab

    The waste treatment lab need to be expanded to accommodate more students and should be provided with modern and sophisticated equipment needed

11. Providing pore equipment for expanding and upgrading of the Unit operation lab

    The unit operation lab need to be expanded to accommodate more students and should be provided with more modern and sophisticated equipment needed such as

    - Absorption Column
    - Evaporators,
    - Dryers
    - Mills and crusher

12. Recruiting high professionals to operate and maintain laboratory equipment.
    - One engineers holding master degree in Chemical engineering
    - One chemist holding master degree in analytical chemistry
13. Recruiting one additional faculty member specialized in materials science and engineering.
14. Recruiting one additional faculty member specialized in chemical engineering.

# ADMISSION AND GRADUATION REQUIREMENTS

## Admission Requirements for the Program

Before each semester and according to the demand and department capacity, a quota is set by the department council and communicated to AATU. In the specialization form, the student lists four programs as their preferred choices in ascending order. The applicants for a given program who have that program as their first choice are ranked according to their GPA and the students with the highest GPA are selected to join that program. This procedure is repeated for the second, third and fourth choices for the remaining students in the list. There is continuous growth in the number and quality of students accepted into the Chemical Engineering Program. This is attributed to the vast expansion in the area of the petrochemical and petroleum refining industries which has created a high demand for chemical engineers.

## Graduation Requirements

In order to qualify for a BS degree in Chemical Engineering, student must successfully complete 155 semester units with an overall GPA of 2.75 out of 5 or better. The student has to complete 50 required courses, two elective courses and summer Training (2 Credit units) for regular track and 50 required courses and coop work program (8 Credit units) for cooperative program.

# PROGRAM REQUIREMENTS AND CURRICULUM

## Key to Course Numbers and Department Code

Key of tenth digit in the codes of Chemical and Materials Engineerign Department Courses

| Tens Digit | Specialty |
|---|---|
| 0 | Basic chemical engineering |
| 1 | Materials science and engineering |
| 2 | Chemical reactions engineering and catalysis |
| 3 | Transport phenomena |
| 4 | Process control, modeling and simulation |
| 5 | Process and plant design |
| 6 | Chemical and petrochemical Technology |
| 7 | Special topics and applications |
| 8 | Biochemical Engineering |
| 9 | Training and research courses and occupational skills |

## Units Required for the B.Sc. Degree

Units required for the B.Sc. degree in the Chemical and Materials Engineering Department.

### Conventional Program

| **Requirements** | **Cr. Hrs** |
|---|---|
| University Requirements (including the prep year) | 41 |
| Faculty Requirements | 37 |
| Departmental Requirements (Compulsory) | 69 |
| Departmental Requirements (Electives) | 6 |
| Summer Training | 2 |
| **Total** | **155** |

### Cooperative Program

| **Requirements** | **Cr. Hrs** |
|---|---|
| University Requirements (including the prep year) | 41 |
| Faculty Requirements | 37 |
| Departmental Requirements (Compulsory) | 69 |
| Coop Program | 8 |
| **Total** | **155** |

## Department Compulsory Courses

Regular students are required to take 71 credits (2٢ courses) as indicated in the table.

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| **MENG 130** | Basic Workshop | 2 | MENG 102 |
| **EE 332** | Computational Methods in Eng | 3 | EE 201, MATH 204 |
| **CHEM 202** | General Chemistry II | 4 | CHEM 281 |
| **CHEM 231** | Principles of Organic Chemistry I | 4 | CHEM 281 |
| **CHEM 232** | Principles of Organic Chemistry II | 4 | CHEM 231 |
| **CHEM 240** | Physical Chemistry for Non Chemistry Majors | 4 | CHEM 202 |
| **ChE 201** | Introduction to Chemical Engineering | 3 | CHEM 281, IE 200 |
| **ChE 210** | Materials Science | 4 | CHEM 281 |
| **ChE 301** | Chemical Engineering Thermodynamics (1) | 3 | CHEM 202 |
| **ChE 302** | Chemical Engineering Thermodynamics (2) | 3 | ChE 301 |
| **ChE 311** | Corrosion Engineering | 3 | CHEM 240, ChE210, EE251 |
| **ChE 321** | Chemical Reaction Engineering | 3 | ChE 302, EE332 |
| **ChE 331** | Momentum Transfer | 3 | MATH 203, MATH 204, ChE 201, |
| **ChE 332** | Heat Transfer | 3 | ChE 331, IE 202 |
| **ChE 333** | Mass Transfer | 3 | ChE 331 |
| **ChE 334** | Separation Processes | 3 | ChE 302,ChE 333 |
| **ChE 390** | Summer Training (For Regular track) | 2 | ChE 334 |
| **ChE 435** | Unit Operation Lab. | 3 | ChE 332,ChE 334 |
| **ChE 441** | Modeling and Simulations | 3 | ChE 321, ChE 334 |
| **ChE 442** | Process Control | 4 | ChE 321,ChE 334, MATH 205 |
| **ChE 451** | Plant Design | 3 | ChE 321,ChE 334, IE255 |
| **ChE 499** | Senior project | 4 | ChE 321,ChE 334, MENG 130 |
| Total | | 71 | |

ChE 390 – the summer training, 400 hours of on-job training distributed over 10 weeks that is included in the counting of training units.

| Coop students are required to take all of the above mentioned 25 courses except ChE 390 which is replaced by the following course: | | | |
|---|---|---|---|
| **Course No.** | **Course Title** | **Cr. Hr.** | **Prerequisites** |
| ChE 400 | Coop Work Program | 8 | ChE 334 |

## Department Elective Courses

Regular students select 2 courses (6 credit units) out of those in the table. For coop students no elective courses are required.

| **Course No.** | **Course Title** | **Cr. Hr.** | **Prerequisites** |
|---|---|---|---|
| ChE 411 | Polymer Engineering | 3 | CHEM 232 |
| ChE 412 | Engineering Materials | 3 | ChE 210 |
| ChE 413 | Materials Selection | 3 | ChE 210 |
| ChE 414 | Extractive Metallurgy | 3 | ChE 210 |
| ChE 422 | Catalysis | 3 | ChE 321 |
| ChE 452 | Computer Aided Design for Chem. Eng. | 3 | ChE 441,ChE 451 |
| ChE 462 | Petroleum Refinery Engineering | 3 | ChE 321,ChE 334 |
| ChE 463 | Natural Gas Engineering | 3 | ChE 321,ChE 334 |
| ChE 464 | Petrochemical Technology | 3 | ChE 334 |
| ChE 465 | Industrial Pollution Control | 3 | ChE 321,ChE 334 |
| ChE 466 | Safety in Chemical Industries | 3 | ChE 334 |
| ChE 471 | Selected Topics in Chemical or Materials Engineering | 3 | ChE 334 |

- Each one theoretical hour calculated as one credit unit
- Each two or three practical hour calculated as one credit unit
- There is no circumstance for training hour (not counted in credit calculations)

# A TYPICAL PROGRAM FOR CHEMICAL AND MATERIALS ENGINEERING

### 3rd Year (Regular & Cooperative)

**5th Semester** | **6th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| CHEM 202 | General Chemistry II | 4 | ChE 331 | Momentum Transfer | 3 |
| ChE 210 | Materials Science | 4 | CHEM 240 | Physical Chemistry for Engineering | 4 |
| MATH 204 | Differential Equations I | 3 | ISLS 201 | Islamic Culture (2) | 2 |
| MENG 130 | Basic Workshop | 2 | EE 332 | Computational Methods in Engineering | 3 |
| ChE 201 | Introduction to Chemical Engineering | 3 | ChE 301 | Chem. Eng. Thermodynamics I | 3 |
| | | | IE 202 | Introduction to Engineering Design (2) | 2 |
| | Total | ١٦ | | Total | 17 |

### 4th Year (Regular and Cooperative)

**7th Semester** | **8th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| EE 251 | Basic Electrical Engineering | 4 | CHEM 232 | Principles of Organic Chemistry II | 4 |
| ChE 332 | Heat Transfer | 3 | ChE 334 | Separation Processes | 3 |
| ChE 333 | Mass Transfer | 3 | MATH 205 | Series and Vector Calculus | 3 |
| CHEM 231 | Principles of Organic Chemistry I | 4 | ChE 321 | Chemical Reaction Engineering | 3 |
| ChE 302 | Chem. Eng. Thermodynamics II | 3 | ISLS 301 | Islamic Culture (3) | 2 |
| | | | ChE 311 | Corrosion Engineering | 3 |
| | Total | ١٧ | | Total | 18 |

The student must select Regular or Cooperative track immediately after the eights semester.

### 4th Year Summer – Training (Regular)

| | | |
|---|---|---|
| ChE 390 | Summer Training | 2 Cr. Hr. |

### 4th Year Summer – Training (Cooperative)

| | | |
|---|---|---|
| ChE 400 | Coop Work Program | 8 Cr. Hr. |

## 5th Year (Regular)

**9th Semester** | **10th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| ChE 499 | Senior project | 4 | ChE xxx | Elective Course II | 3 |
| ChE 442 | Process Control | 4 | ChE 451 | Plant Design | 2 |
| ChE xxx | Elective Course I | 3 | ChE 435 | Unit Operation Lab | 3 |
| ISLS 401 | Islamic Culture (4) | 2 | ChE 441 | Modeling and Simulation | 3 |
| ARAB 201 | Arabic Language (2) | 3 | | | |
| | Total | ١٦ | | Total | 12 |

## 5th Year (Cooperative)

**9th Semester** | **10th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| ChE 499 | Senior Project | 4 | ChE 435 | Unit Operations Lab. | 3 |
| | | | ChE 441 | Modeling and Simulation | 3 |
| | | | ChE 442 | Process Control | 4 |
| | | | ChE 451 | Plant Design | 3 |
| | | | ISLS 401 | Islamic Culture (4) | 2 |
| | | | ARAB 201 | Arabic Language (2) | 3 |
| | Total | 4 | | Total | 18 |

## COURSE DESCRIPTION

**ChE 201 Introduction to Chemical Engineering (3:3,1)**

Broad definitions of Chemical Engineering. Introduction to chemical engineering calculations. Material balances in processes not involving chemical reactions/involving chemical reactions. Recycle by-pass and purge calculations. Critical properties and compressibility charts. Vapor-liquid equilibria, partial saturation and humidity. Computer applications.

**Prerequisite: CHEM 281, IE 200**

**ChE 210 Materials Science (4:3,2)**

Classification of engineering materials, atomic and molecular bonding. Properties and microstructure, elastic and plastic behavior. Order in solids, phases and solid- solutions, crystal geometry. Disorder in solids, atomic movement and rearrangment, phase diagrams, solid-state transformations. Applications of metals, ceramics, polymers and composites .Service stability, corrosion and failure. Involves laboratory experiments and practices.

**Prerequisite: CHEM 281**

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| Chemical Eng. Thermodynamics I(Core Course) | ChE 301 | هكم٣٠١ | 3 | 1* | - | 3 |
| Pre-requisites | | CHEM 202 | | | | |
| Introduction to thermodynamics concepts, first law of thermodynamics, Mass and energy balances in closed and open systems, volumetric properties of pure fluids, heat effects, humidity charts, second law of thermodynamics, entropy, Computer applications to thermodynamics problems. | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** Smith J.M, Van Nees H.C and Abott M.M., Introduction to Chemical Engineering Thermodynamics, 7th Edition, McGraw-Hill, 2005

**Reference:** Annamali K, and Puri I.K., Advanced Thermodynamics Engineering, CRC Press. 2002

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1. Define basic thermodynamic properties and concepts.
2. Summarize a general introduction to engineering ethics.
3. Understand the significance of the first law of thermodynamics and learn the relationship between heat and work.
4. Explain the fundamental meaning of the phase rule and implement it.

5. Identify open systems and apply conservation principles (mass and energy) to such systems.
6. Describe the general nature of the PVT behavior of pure fluids.
7. Provide examples of applications of thermodynamics properties using equations of state, charts and tables.
8. Distinguish between sensible heat effects and latent heat of pure substances.
9. Understand the applications of energy balances for industrial reactions.
10. Express the second law of thermodynamics in different statements that describe the general restrictions on processes beyond that imposed by the first law.
11. Analyze heat engines and conclude results related to the second law of thermodynamics.
12. Relate entropy generation mathematically to the second law and apply that to assess feasible processes.
13. Calculate the theoretical ideal work and assess efficiency of a process through this concept.

| *NO* | *Topic Covered During Class:* | *Duration in Weeks* |
|---|---|---|
| 1 | Fundamental principles Thermodynamics | **2** |
| 2 | First law of thermodynamics | **3** |
| 3 | Properties of pure fluids | **3** |
| 4 | Heat effects | **2** |
| 5 | The second law of thermodynamics | **3** |

**Class Schedule**:

- **Lecture**: two 1:30 hour sessions per week
- **Tutorial**: one three hours session per week

**Course Contribution to professional Component:**

- Engineering science: 100%
- Engineering design: 0%

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | X | | 3 | | | 3 | | | | | 2 | | | 3 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

***One hour tutorial session**

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCH |
| Chemical Eng. Thermodynamics II(Core Course) | ChE 302 | هكم٣٠٢ | 3 | 1* | - | 3 |

| **Pre-requisites** | **ChE301** |
|---|---|
| Review of first law and second law of thermodynamics. Thermodynamic properties of fluids. Power and refrigeration cycles. Vapor liquid equilibrium. Theory and applications of solution thermodynamics. Chemical reaction equilibrium**.** | |

Faculties and departments requiring this course (if any): None

**Textbook:** Smith J.M., Van Nees H.C., and Abott M.M., Introduction to Chemical Engineering Thermodynamics, $7^{th}$, McGraw-Hill, 2005

**Reference:** Annamali K., and Puri I.K., Advanced Thermodynamics Engineering, CRC Press. 2002

***Course Leaning Objectives: By completion of the course, the students should be able to*:**

1. **Review** previously learned first and second laws of Thermodynamics.
2. **Apply** first and second laws of thermodynamics to specific processes and systems**.**
3. **Develop** from the first and second laws the fundamental property relations which underlie the mathematical structure of thermodynamics.
4. **Derive** equations which allow calculation of enthalpy and entropy values from PVT and heat-capacity data.
5. **Calculate** changes in thermodynamics properties for ideal gases and for non ideal gases through the use of residual properties.
6. **Explain** the criteria of phase equilibrium for a pure substance and its utilization in the clapeyron equation.
7. **Discuss** the diagrams and tables by which thermodynamic property values are presented for convenient use.
8. **Estimate** of property values by generalized correlations in the absence of complete experimental information.
9. **Apply** thermodynamics to flow process, turbines, compressors, and pumps.
10. **Analyze** of thermodynamics cycles: steam cycles and heat engines.
11. **Solve** problems involving power systems that results from the production of power from heat.
12. **Identify** the assumptions behind Raoul's law and Henery's law as well as what things will make them fail.
13. **Recognize** the various ways (P-T, P-x-y, T-x-y and x-y) for representing phase equilibrium behavior of binary mixtures.
14. **Show** the typical phase equilibrium calculations (Bubl P, Bubl T, Dew P and Dew T) using Raoult's law and modified Raoult's law.
15. **Perform** flash calculations by introducing mass balances, phase equilibria relationships and evaluation of k-factors.
16. **Use** computer tools such as Excel spread sheet and MathCAD program.
17. **Develop** fundamental property relations to open phases of variable composition.
18. **Identify** the chemical potential and its role in the phase equilibria.
19. **Interpret** mathematically and graphically partial properties as properties of individual species as they exist in solution.
20. **Show** how the ideal-gas mixture model provides a conceptual basis for treatment of real gas mixtures.
21. **Recognize** the fugacity definition and utility as a transformation of the chemical potential that is mathematically well behaved and not as a replacement of pressure.
22. **Evaluate** fugacity from an equation of state and principle of corresponding states.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **1** | First and second law revision | 1 |
| **1** | Thermodynamic properties of fluid | 2 |
| **2** | Definition and evaluation of residual properties | 3 |
| **1** | Phase equilibrium of a pure substance | 4 |
| **1** | Thermodynamic diagrams and tables | 5 |
| **1** | Production of power from heat | 6 |
| **2** | Fugacity of pure substance and mixtures | 7 |
| **2** | Solutions thermodynamics | 8 |
| **1** | Partial molar properties | 9 |
| **2** | Criteria of phase equilibrium for mixtures | 10 |

**Class Schedule:**

- Lecture: Three 1 hour sessions per week
- Tutorials: One 3 hours session per week

**Course Contribution to Professional Component:**

- Engineering science: 100%
- Engineering design: 0 %

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | **1** | **2** | **a** | **b** | **c** | **e** | **h** | **j** | **i** | **d** | **f** | **g** | **k** | **a** |
| Max. Attainable Level of Learning* | **X** | | **3** | | | **2** | | | | | | **2** | | **3** |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

***One hour tutorial session**

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| **TCH** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **-** | **1*** | **3** | **هكم٣١١** | **ChE 311** | **Corrosion Engineering(Core Course)** |
| **CHEM 240, ChE 210 & EE 251** | | | | | **Pre-requisites** | |

Electrochemical mechanisms, corrosion kinetics, polarization and corrosion rates, passivity. Methods of testing corrosion of iron and steel and the effects of various parameters. Pourbaix diagrams. Effect of stresses on corrosion, (stress corrosion cracking, cold working, hydrogen cracking, etc.). Corrosion control technologies, corrosion of some engineering alloys. Design of simple processes.

Faculties and departments requiring this course (if any): None

**Textbook** Fontana M. G & Greene .N.D, Corrosion Engineering, 3rd Edition, 1995

**Reference** Jones D. A. Principles and Prevention of Corrosion, 2nd Edition, John Wiley, 1996

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1. **Appreciate** the impact and importance of corrosion on society and industry
2. **Recognize** the difference between corrosion engineering and corrosion science.
3. **Outline** the important tasks that the corrosion engineer must perform.
4. **Use** the information and the databases related to corrosion.
5. **Define** corrosion and metallic corrosion.
6. **Classify** the major environments and categorize the common engineering materials.
7. **Describe** and **appraise** that corrosion is a natural process.
8. **Recognize** the chemistry and electrochemistry of corrosion
9. Recognize the metallurgy of corrosion.
10. **Distinguish** among all types corrosion of reactions.
11. **Describe** the common types of corrosion cells.
12. **Recognize** and apply the equations to calculate the corrosion rates for metals and alloys.
13. **Explain** and use the emf series and the galvanic series.
14. **Distinguish** among the standard electrode and a reference electrode.
15. **Categorize and explain** the factors that affect corrosion.
16. **Classify** the different forms of corrosion**.**
17. **Discuss** the mechanisms of forms of corrosion.
18. **Discuss and explain** the thermodynamics of corrosion.
19. Discuss and explain the kinetics of corrosion.
20. **Recognize** and discuss the various measures used to control corrosion.

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **1** | Introduction | 1 |
| **1** | Basics in corrosion | 2 |
| **1** | Basics in chemistry | 3 |
| **1** | Basics in Metallurgy | 4 |
| **1** | Corrosion reactions | 5 |
| **1** | Corrosion cells | 6 |
| **1** | Corrosion rates | 7 |
| **1** | Electromotive series and Galvanic series | 8 |
| **2** | Factors affecting corrosion | 9 |
| **1** | Forms of corrosion | 10 |
| **2** | Thermodynamics and kinetics of corrosion | 11 |
| **1** | Corrosion control measures | 12 |

**Class Schedule:**

- Lecture: Three 1 hour sessions per week
- Lab: one 3 hours session per week

**Course Contribution to Professional Component:**

- Engineering Science: 100 %
- Design : 0 %

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | X | | 3 | 1 | | 1 | | | 2 | | | | | 3 |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

***One hour tutorial session**

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هكم٣٢١ | ChE 321 | Chemical Reaction Engineering(Core Course) |
| ChE 302 & EE 332 | | | | | Pre-requisites | |
| The course is intended to develop the student' s ability to understand mole balances, conversion and reactor sizing, rate laws and stoichiometry for single and multiple reactions and its applications to steady-state no isothermal reactor design. Collection and analysis of rate data and catalysis and catalytic reactor | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** Fogler H. S, Elements of Chemical Reaction Engineering, 3rd Edition, Prentice Hall Intl., 1999.

**Reference:** Smith J. M., "Chemical Engineering Kinetics, 3rd Edition, McGraw- Hill International Book Company, Singapore. 1981.

***Course Leaning Objectives: By completion of the course, the students should be able to*:**

1. **Define** the rate of chemical reaction.
2. **Apply** the mole balance equations to a batch reactor, CSTR, PFR, and PBR (l at B).
3. **Define** conversion and space time. (a at A)
4. **Write** the mole balances in terms of conversion for a batch reactor, CSTR, PFR, and PBR
5. **Calculate** the size of reactor needed for a certain duty either alone or in series once given the rate of reaction, -rA, as a function of conversion, X.
6. **Write** relationship between the relative rates of reaction.
7. **Define** reaction order and activation energy.
8. **Set up** a stoichiometric table for both batch and flow systems and express concentration as a function or conversion.
9. **Calculate** the equilibrium conversion for both gas and liquid phase reactions.
10. **Write** the combined mole balance and rate law in measures other than conversion.
11. **Describe** the algorithm that allows the reader to solve chemical reaction engineering problems through logic rather than memorization.
12. **Calculate** the size of batch reactors, semi batch reactors, CSTRs, PFRs, and PBRs for isothermal operation given the rate law and feed conditions.
13. **Compute** the reaction order and specific reaction rate from experimental data obtained from either batch or flow reactors.
14. **Describe** how to use equal-area differentiation, polynomial fitting, numerical difference formulas and regression to analyze experimental data to determine the rate law.
15. **Describe** how the method of half lives, and of initial rate, are used to analyze rate data.
16. **Describe** two or more types of laboratory reactors used to obtain rate law data along with their advantages and disadvantages.
17. **Define** different types of selectivity and yield.

18. **Select** the type of the reaction system that would maximize the selectivity of the desired product given the rate laws for all the reactions occurring in the system.
19. **Describe** the algorithm used to design reactors with multiple reactions.
20. **Calculate** the **size** of reactors to maximize the selectivity and to determine the species concentrations in a batch reactor, semibatch reactor, CSTR, PFR, and PBR, systems.
21. **Describe** the algorithm for CSTRs, PFRs, and PBRs that are not operated isothermally.
22. **Calculate** the size of adiabatic and no adiabatic CSTRs, PFRs, and PBRs needed for a certain duty.
23. **Define** a catalyst, a catalytic mechanism and a rate limiting step.
24. **Describe** the steps in a catalytic mechanism and how one goes about deriving a rate law and a mechanism and rate limiting step consistent with the experimental data.
25. **Calculate** the size of isothermal reactors for reactions with Langmuir-Hinschelwood kinetics.

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| 1 | Mole Balances | 1 |
| **2** | Conversion and Reactor Sizing | 2 |
| **2** | Rate Law and Stoichiometry | 3 |
| **2** | Isothermal Reactor Design | 4 |
| **2** | Collection and Analysis of Rate Data | 5 |
| **1** | Multiple Reactions | 6 |
| **2** | Steady-State Nonisothermal Reactor Design | 7 |
| **2** | Catalysis and Catalytic Reactors | 8 |

**Class Schedule**:

- Lecture: Three 1 Hour sessions per week
- Tutorials: One Three Hours session per week

**Course Contribution to professional Component**

- Engineering Science: 83.3 %
- Engineering Design: 16.7 %

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | **1** | **2** | **a** | **b** | **c** | **e** | **h** | **j** | **i** | **d** | **f** | **g** | **k** | **a** |
| Max. Attainable Level of Learning* | **X** | | **2** | | **3** | **1** | | | **2** | | | | **2** | **2** |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

***One hour tutorial session**

| CREDITS | ARABIC | ENGLISH | COURSE TITLE |
|---|---|---|---|

| TCH | Tr. | Pr. | Th. | CODE/NO. | CODE /NO | |
|---|---|---|---|---|---|---|
| 3 | - | 1* | 3 | هـكم٣٣١ | ChE 331 | **Momentum transfer(Core Course)** |
| **MATH 203, MATH 204 & ChE 201** | | | | | **Pre-requisites** | |
| Fluid static, Mass, momentum, and energy balance on finite and differential systems. Laminar and turbulent flow in pipes. Fluid flow in porous media. Introduction to boundary layer theory. Fluid flow | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** Welty J. R., Wicks, C. E., Wilson, R. E., & Rorrer, G., Fundamentals of Momentum Heat, and Mass Transfer, 4th Edition, John Wiley & Sons.2000

**Reference** McCabe, W.L. Smith J.C. & Harriett P., Unit Operations of Chemical Engineering, 5th Edition. McGraw Hill, 1993

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1. Distinguish between a fluid property and a flow property.
2. Find the gradient of a scalar field and discuss its implications.
3. Calculate pressure variation in a static fluid using inertia and non-inertia coordinate systems.
4. Apply the basic equation of fluid static to manometery and to calculate forces on submerged forces.
5. Recognize the need to apply the conservation of mass law to solve a given fluid flow problem.
6. Apply the integral expression of the conservation of mass law to steady and unsteady sate fluid flow problems of different natures and concerns using suitable control volumes.
7. Demonstrate an understanding of the implication of the outcome of the solution of the problem.
8. Recognize the need to apply Newton's second law of motion to solve a given fluid flow problem.
9. Define an appropriate control volume of a fluid flow system for the application of the integral expression of linear momentum.
10. Apply the integral expression of linear momentum to steady and unsteady sate fluid flow problems of different natures and concern by a term-by-term analysis of this expression as they pertain to the problem.
11. Utilize either a moving or a fixed coordinate system in the application of the momentum theorem to a control volume moving with a uniform velocity.
12. Recognize the need to apply the first law of thermodynamics to solve a given fluid flow problem.
13. Define an appropriate control volume of the fluid flow problem for the application of the integral expression of the conservation of energy equation
14. Apply the integral expression of the conservation of energy equation to steady and unsteady sate fluid flow problems of different natures and

concern by a term-by-term analysis of this expression as they pertain to the problem

15. Recognize conditions and /or assumptions of problems under which the integral expression of the conservation of energy equation would reduce to Bernoulli equation.
16. Apply Bernoulli equation to solve problems that satisfy necessary conditions.
17. Distinguish between Newtonian and non-Newtonian fluids in terms of their stress – rate of strain relationships
18. Define fluid viscosity and use appropriate SI and other Engineering system of units to express it.
19. Use Hirschfelder, Curtiss, and Bird equation to predict the viscosity of a non-polar gas, and recognize the effects of temperature and pressure on the viscosity of gases and liquids.
20. Predict shear stress and rate of shear work of a laminar flow of a Newtonian fluid using Newton's viscosity law.
21. Apply Newton's second law of motion to a differential control volume suitable for the geometry of an incompressible, fully developed laminar flow.
22. Derive expressions for the velocity profile, pressure drop, and shear stress of a Newtonian fluid in fully developed laminar flow in different flow geometries, such as flow in pipes and between parallel flat plates.
23. Apply the Hagen-Poiseuille equation to find the pressure drop and associated drag force on a circular conduit resulting from the flow of a viscous fluid.
24. Develop the differential continuity equation based on a differential element in different coordinate systems.
25. Recognize the physical meaning of the substantial derivative.
26. Use the Navier-Stokes equation for incompressible flow to solve simple flow problems.
27. Group the variables in a given physical situation into dimensionless parameters using the governing equation if available or the Buckingham Method if such equation is not available
28. Define geometric, kinematic, and dynamic similarities between a model and a prototype of a system.
29. Recognize the requirements of these similarities to use model data to predict the behavior of a prototype of a system and apply model theory.
30. Solve simple frictional drag problem of an external flow of a viscous fluid over a solid surface.
31. Use Blasius's solution and/ or the approximate solution of the laminar boundary layer on a flat plate to find boundary layer thickness, local skin friction coefficient, mean skin friction coefficient, and frictional drag force.
32. Recognize and use empirical relations of turbulent flow such as empirical velocity profiles and sheer stress.
33. Use the approximate solution of the turbulent boundary layer over a flat plate to estimate boundary layer thickness, local and mean skin friction coefficients, and frictional drag forces.
34. Define and use relationships for fanning friction factor for both laminar and turbulent flow in pipe flow.
35. Determine friction factor and head-loss for pipe flow and fittings.
36. Analyze simple pipe flow problems.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Fluid and Flow properties. | 1 |
| **2** | Conservation of mass | 2 |
| **1** | Newton's second law of motion | 3 |
| **2** | Conservation of energy | 4 |
| **1** | Shear stress in laminar flow. | 5 |
| **1** | Analysis of a differential fluid element in laminar flow | 6 |
| **1** | Differential equations of fluid flow. | 7 |
| **1** | Dimensional analysis | 8 |
| **1** | Viscous flow and the boundary layer concept | 9 |

**Course Schedule:**

- Lecture: two 1.5 hour sessions per week
- Tutorials: one 3.0 hours session per week

**Course Contribution to professional Component:**

Engineering science: 100%

Engineering design: 0%

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | **1** | **2** | **a** | **b** | **c** | **e** | **h** | **j** | **i** | **d** | **f** | **g** | **k** | **a** |
| Max. Attainable Level of Learning* | **X** | | **2** | | | **2** | | | | | | **2** | | **2** |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

***One hour tutorial session**

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| **TCH** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **-** | **1*** | **3** | **هكم ٣٣٢** | **ChE 332** | **Heat Transfer(Core Course)** |
| **ChE 331, IE 202** | | | | | **Pre-requisites** | |
| Modes of heat transfer, steady and un-steady-state conduction in different co-ordinates, convective heat transfer with and without phase change. Correlation's for forced and natural convection. Analogy between momentum and heat transfer. Heat transfer applications | | | | | | |

Faculties and departments requiring this course (if any): None

**Text Book:** Incropera F.P &, Dewitt D.P, Fundamentals of Heat & Mass Transfer 6th Edition, John Wiley & Sons.2005

**Reference** Yunus A. C, Heat Transfer , Second Edition, McGraw- Hill ,2003

***Course Leaning Objectives: By completion of the course, the students should be able to*:**

1. Define heat transfer and relate its concept to thermodynamics.
2. Apply the laws of heat transfer due to conduction, convection, and radiation to solve simple problems related to the three modes of heat transfer.
3. Apply the law of conservation of energy to write the energy balance equations for a system.
4. Translate any heat transfer problem by a schematic.
5. Recognize the general HDE in Cartesian coordinates, cylindrical coordinates, and spherical coordinates.
6. Rewrite the HDE for a specific system using the proper assumptions, including the three coordinates.
7. Write the initial and the boundary conditions needed to solve the specific HDE.
8. Generate the steady state one dimensional the temperature distribution, using the initial and/or the boundary conditions for a single wall, a single cylinder, and a sphere with / without convection and with / without uniform generation.
9. Modify part (1) for composite walls.
10. Diagram the thermal circuit for walls with / without convection and with / without generation.
11. Apply the thermal circuit diagram to find any unknown temperature, overall heat transfer coefficient and the thermal resistances of a system.
12. Apply the thermal circuit diagram to write different forms of the heat transfer equation.
13. Recognize the different methods to handle transient conduction for different bodies.
14. Analyze transient problems using the lumped capacitance method, approximate solution, charts, and semi – infinite solution.
15. Write the proper equation to determine the required time, temperature or heat transfer rate for a system.
16. Identify the different forms of Newton Laws.
17. State the concept of each boundary layer including the velocity boundary layer, thermal boundary layer, and concentration boundary layer.
18. Identify the dimensionless groups related to the three transport phenomena: momentum transfer, heat transfer, and mass transfer.
19. Recognize the analogies among the three transport phenomena.
20. Analyze problems in heat transfer with conduction and convection.
21. Analyze problems with combined processes of convection and evaporation.
22. Correlate heat transfer coefficient to mass transfer coefficient.
23. Recognize the importance of the ( Blasius solution) similarity solution for laminar flow over a flat plate.
24. Recognize basic results of the similarity solution for laminar flow over a flat plate.
25. Analyze the laminar flow over a heated flat plate.
26. Analyze the turbulent flow over a heated flat plate
27. Analyze the conditions of mixed (laminar and turbulent) flow over a heated flat plate.
28. Recognize the different methods used to obtain the heat transfer coefficient.
29. Outline the hydrodynamic conditions and the thermal conditions for the flow in a pipe.
30. State the conditions of fully developed flow (hydrodynamic or thermal conditions).
31. Analyze the fully developed region and the entry region in a circular pipe.
32. State the concept of boiling and condensation.
33. Define Newton's law of cooling for boiling and condensation.
34. Analyze the different processes for boiling and condensation.
35. Recognize and diagram the different types of heat exchangers.
36. Use the LMTD method and the Effectiveness –NTI method to analyze heat transfer rates in heat exchangers, and understand which method to choose for a given problem.
37. Applying the fundamentals of conduction, convection and radiation to do the thermal design of heat exchangers and condensers.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Introduction | 1 |
| **1** | General heat conduction equation | 2 |
| **2** | Steady-state conductions | 3 |
| **2** | Heat transfer from extended surfaces | 4 |

| | | |
|---|---|---|
| 2 | Transient Conduction | 5 |
| 2 | External flow convection heat transfer | 6 |
| 2 | Internal flow convection heat transfer | 7 |
| 2 | Heat exchangers and design oriented problems | 8 |

**Class Schedule:**

- **Lecture**: Three 1 hour sessions per week
- **Tutorials**: One 3 hours session per week

**Course Contribution to professional Component:**

- Engineering Science: 83.3 %
- Engineering Design: 16.7 %

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | X | | 1 | | 3 | | | | | 3 | | | | 1 |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

*One hour tutorial session

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | ٣٣٣هـكم | ChE 333 | Mass Transfer(Core Course) |
| ChE 331, | | | | | Pre-requisites | |

Fundamentals of mass transfer processes. The control volume approach to the mass transfer processes, differential equations of mass transfer. Steady and unsteady –state molecular diffusion. Natural and forced convection mass transfer. Mass transfer theories. Convective mass transfer correlations. Analysis of chemical engineering operations involving mass transfer. Simultaneous heat and mass transfer; mass transfer accompanied by chemical reaction

Faculties and departments requiring this course (if any): None

**Textbook:** Welty J. R., Wicks, C. E., Wilson, R. E., & Rorrer, G., Fundamentals of Momentum Heat, and Mass Transfer, 4th Edition, John Wiley & Sons.2000

**Reference:** Incropera F.P &, Dewitt D.P, Fundamentals of Heat & Mass Transfer 6th Edition, John Wiley & Sons.2005

***Course Leaning Objectives: By completion of the course, the students should be able to*:**

1. **Define** the rate of mass transfer and describe the two mass transfer mechanisms
2. **List** and explain the industrial importance of mass transfer processes and their relationship with course material
3. **Calculate** the diffusion coefficients for gases, liquids and solids
4. **Write** the Fick's rate equation in different forms and define concentration, diffusion velocity and flux
5. **Explain** the importance of molecular diffusion inside the pores of porous solids
6. **Use** the general differential equation for mass transfer to describe the mass balance associated with a diffusing component in a mixture
7. **Distinguish** between the four types of boundary conditions used to solve the differential equation for mass transfer
8. **Apply** the initial and boundary conditions in solving the differential equation for mass transfer
9. **Describe** the steady-state transfer of mass from a differential view point and explain how to measure the diffusion coefficient for a gas using an Arnold diffusion cell
10. **Recognize** the relationship between the convective mass transfer coefficient and the diffusion coefficient based on the film theory and penetration theory
11. **Distinguish** between the two types of chemical reactions (homogeneous and heterogeneous reactions) and write the difference between diffusion controlled and chemically controlled reactions
12. **Apply** the differential equation for mass transfer in presence of homogeneous and /or heterogeneous chemical reactions
13. **Identify** the difference between steady and unsteady- state molecular diffusion and define the one directional mass transfer by Fick's second law of diffusion
14. **Describe** the transient diffusion in a semi infinite medium, the transient diffusion in medium under conditions of negligible surface resistance and define the penetration depth for mass transfer
15. **Define** the mass transfer by convection and describe the difference between mass transfers by forced convection and natural convection
16. **Recognize** the relationship between concentration boundary layer, thermal boundary layer and momentum boundary layer and recognize the similarities in the differential equations that describe these transfer processes
17. **Use** different methods to evaluate the mass transfer coefficient and explain what the physical significance of Schmidt , Sherwood , and Lewis numbers
18. **Use** analogy between mass, energy and momentum transfer processes to predict the behavior of systems for which united quantitative data are available
19. **Explain** the two film theory
20. **Illustrate** how to determine the individual and the overall mass transfer coefficients
21. **Describe** the different techniques employed to obtain the mass transfer coefficient
22. **Correlate** experimental data in terms of empirical correlation and describe how to use such empirical correlations to calculate the mass transfer coefficient for different geometries

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Fundamentals principles of mass transfer | 1 |
| **2** | Diffusion coefficients; mass transfer coefficient | 2 |

| | | |
|---|---|---|
| **2** | Differential equations of mass transfer | 3 |
| **2.5** | Steady-state molecular diffusion | 4 |
| **1.5** | Unsteady-state molecular diffusion | 5 |
| **1** | Convective mass transfer between phases | 6 |
| **2** | Convective mass transfer | 7 |

**Class Schedule**:

- **Lecture:** three 1 hour sessions per week
- **Tutorial**: one three hours session per week

**Course Contribution to professional Component:**

- Engineering science: 100%
- Engineering design: 0%

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | **1** | **2** | **a** | **b** | **c** | **e** | **h** | **j** | **i** | **d** | **f** | **g** | **k** | **a** |
| Max. Attainable Level of Learning* | **X** | | **3** | | | | | | | **2** | **1** | | | **3** |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

***One hour tutorial session**

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| **TCH** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **-** | **1*** | **3** | **هكم٣٣٤** | **ChE 334** | **Separation Processes(Core Course)** |
| **ChE302,ChE333** | | | | | **Pre-requisites** | |
| Phase equilibrium, continuous contact and stage wise processes; fractional distillation, gas absorption and liquid-liquid extraction processes | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** Seader **J**. D. & Ernest J. Henley, Separation Process Principles, $2^{nd}$ Edition, John Wiley & Sons.2003

**Reference:** Judson C. K, Separation Processes, $2^{nd}$ Edition, McGraw Hill Book Co, 1980

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1. **List** the five general separation techniques.
2. **Explain** how separations are made by phase creation , phase addition and by introducing selective barriers
3. **Explain** how separations are made by introducing solid agents and list the three major separation operations that utilize this technique.

4. **Explain** the concept of phase equilibria in terms of, chemical potential, fugacity, fugacity coefficients, activity, and activity coefficients.
5. **Write** vapor-liquid K-value expressions for Ragout's law (ideal), a modified Ragout's law, and Henry s law.
6. **Define** relative volatility between two components of a vapor-liquid mixture and explain the difference between min. and max. boiling azeotropes
7. **Use** component material balance equations with K-values to calculate bubble-point, dew-point, and equilibrium flash conditions for multi-component mixtures.
8. **Determine** the length and diameter of a flash drum
9. **Use** T-x-y and y-x diagrams of binary mixtures, with the concept of the q-line, to determine equilibrium phase compositions.
10. **Determine** the five construction lines used in the McCabe-Thiele method using component material balances and vapor-liquid equilibrium relations.
11. **Distinguish** among five possible phase conditions
12. **Apply** the McCabe-Thiele method for determining minimum reflux ratio, minimum number of equilibrium stages and number of equilibrium stages.
13. **Calculate** condenser and reboiler heat duties and condenser use of a feed pre-heater.
14. **Use** the Murphree vapor stage efficiency to determine actual number of plates from the number of equilibrium stages.
15. **Extend** the McCabe –Thiele method to multiple feeds, side streams, and open steam (in place of re-boiler).
16. **Calculate**, by graphical and /or algebraic means, batch –still temperature, residue compositions and instantaneous distillate compositions as a function of time.
17. **List** situations where liquid-liquid extraction might be preferred distillation and list characteristics of an ideal solvent.
18. **Define** the distribution coefficient and show its relationship to activity coefficients and relative selectivity of a solute between carrier and solvent.
19. **Use** triangular phase diagrams for ternary systems with component materials balances to determine equilibrium phase compositions.
20. **Determine** the number of equilibrium stages for ternary systems using equilateral and right triangle diagrams for co-current and counter current contact
21. **Determine** minimum and maximum solvent- to- feed flow- rate ratios
22. **Explain** the difference between physical and chemical absorption.
23. **Enumerate** different types of industrial equipment for absorption and stripping and explain which are most popular and **Compare** three different types of trays.
24. **Calculate** the minimum MSA flow rate to achieve a specified recovery of a key component in a single-section, countercurrent cascade.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | General separation Techniques | 1 |
| **2** | Phase equilibrium and phase diagrams | 2 |
| **2** | Equilibrium stages and flash distillation | 3 |
| **4** | Staged binary distillation: McCabe-Thiele | 4 |
| **3** | Liquid-liquid extraction | 5 |
| **2** | Absorption and stripping | 6 |

**Class Schedule:**

- Lecture: Three 1 hour sessions per week
- Tutorials: One three hours session per week

**Course Contribution to professional Component:**

- Engineering science: 83.3%
- Engineering design: 16.7%

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | X | | | | 2 | 2 | 2 | | | | | | | |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

*One hour tutorial session

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 2 | 400** | - | - | هكم ٣٩٠ | ChE 390 | Summer training(Core Course) |
| ChE 334 | | | | | Pre-requisites | |
| 10 weeks of training in industry under the supervision of a faculty member. Students have to submit a report about their achievements during training in addition to any other requirements assigned by the Department | | | | | | |

Faculties and departments requiring this course (if any):

**Textbook**: None.

***Course Leaning Objectives: By completion of the course, the students should be able to:***

By the completion of the summer training, the student should be able to:

1. **Formulate** an objective or mission statement that identify the real problem and describe the expected outcomes of the training activity.
2. **Break-down** a work environment into its units and work functions, and describe how these units are assembled into a whole entity.
3. **Describe** a professional organizational structure, its size and how it is related to its main products and to market issues.
4. **Exhibit** integrity, punctuality, and ethical behavior in engineering practice and relationships.
5. **Demonstrate** enthusiasm and business focusing.
6. **Establish** successful relationships with team members, advisors, and clients to understand their needs and to achieve or exceed agreed-upon quality standards.
7. **Maintain** focus to complete important tasks on time and with high quality, amidst multiple demands
8. **Relate** practical work to previous knowledge from basic sciences, engineering fundamentals, and discipline related courses.

9. **Collect** and review related data such as technical information, regulations, standards, and operational experiences from credible literature resources
10. **Utilize** prior knowledge, independent research, published information, and original ideas in addressing problems and generating solutions
11. **Monitor** achievement, identify causes of problems, and revise processes to enhance satisfaction
12. **Communicate**, clearly and concisely, training details and gained experience, both orally and in writing, using necessary supporting material, to achieve desired understanding and impact.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 2 | Acquainting the trainee by the company, its work environment, organizational structure, products, costumers, engineering units, and quality system | **1** |
| **1** | Familiarizing the trainee of one production or design unit with deep understanding of the work environment, regulations, standards, etc... | **2** |
| **1** | Allocating the trainee to a project team and allowing him to study and collect necessary data about the project using internal and external data sources. | **3** |
| **6** | Working as a team member to execute assigned tasks with the following objectives:<br>• Apply engineering practices related to his specialization.<br>• Enhance team work skills.<br>• Relate practical work to his engineering knowledge.<br>• Use modern engineering tools such as equipment and computer software.<br>• Use project management techniques.<br>• Complete assigned tasks on time with high quality.<br>• Develop personal communication skills. | **4** |

**Class Schedule:**

Oral Presentation after submitting a written training report; both evaluated by at least 2 faculty members.

**Course Contribution to professional Component:**

- Engineering science: None
- Engineering design: None
- Others 100%

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | | X | | | 3 | 3 | | 2 | 3 | 3 | 3 | 3 | 3 | |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

** 400 hours of on-job training distributed over 10 weeks

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 8 | 1000*** | - | - | هكم٤٠٠ | ChE 400 | Cooperative Work(Core Course) |
| ChE334 | | | | | Pre-requisites | |
| Extensive 26 weeks of supervised hands-on work experience at a recognized firm in a capacity which ensures that the student applies his engineering knowledge and acquires professional experience in his field of study at KAU. The student is required to communicate, clearly and concisely, training details and gained experience both orally and in writing. The student is evaluated based on his abilities to perform professionally, demonstrate technical competence, work efficiently, and to remain business focused, quality oriented, and committed to personal professional development. | | | | | | |

Faculties and departments requiring this course (if any)

Textbooks: None

***<u>Course Leaning Objectives: By completion of the course, the students should be able to:</u>***

1. **<u>Formulate</u>** an objective or mission statement that identify the real problem and describe the expected outcomes of the training activity .
2. **<u>Break-down</u>** a work environment into its units and work functions, and describe how these units are assembled into a whole entity.
3. **<u>Describe</u>** a professional organizational structure, its size and how it is related to its main products and to market issues .
4. **<u>Exhibit</u>** integrity, punctuality, and ethical behavior in engineering practice and relationships.
5. **<u>Demonstrate</u>** enthusiasm and business focusing .
6. **<u>Establish</u>** successful relationships with team members, advisors, and clients to understand their needs and to achieve or exceed agreed-upon quality standards .
7. **<u>Maintain</u>** focus to complete important tasks on time and with high quality, amidst multiple demands
8. **<u>Relate</u>** practical work to previous knowledge from basic sciences, engineering fundamentals, and discipline related courses .
9. **<u>Collect</u>** and review related data such as technical information, regulations, standards, and operational experiences from credible literature resources
10. **<u>Utilize</u>** prior knowledge, independent research, published information, and original ideas in addressing problems and generating solutions
11. **<u>Monitor</u>** achievement, identify causes of problems, and revise processes to enhance satisfaction
12. **<u>Communicate</u>**, clearly and concisely, training details and gained experience, both orally and in writing, using necessary supporting material, to achieve desired understanding and impact

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **2** | Acquainting the trainee by the company, its work environment, organizational structure, products, costumers, engineering units, and quality system | **1** |

| | | |
|---|---|---|
| **2** | Familiarizing the trainee of one production or design unit with deep understanding of the work environment, regulations, standards, etc... | **2** |
| **2** | Allocating the trainee to a project team and allowing him to study and collect necessary data about the project using internal and external data sources. | **3** |
| **20** | Working as a team member to execute assigned tasks with the following objectives:<br>• Apply engineering practices related to his specialization.<br>• Enhance team work skills.<br>• Relate practical work to his engineering knowledge.<br>• Use modern engineering tools such as equipment and computer software.<br>• Use project management techniques.<br>• Complete assigned tasks on time with high quality.<br>• Develop personal communication skills. | **4** |
| End of week #6<br>End of week #12<br>End of week #18 | N.B.: If the assigned project is to be completed in less than 20 weeks, the student should complete his training period working on several successive projects<br>• Submitting first Progress Report to his academic supervisor<br>• Submitting second Progress Report to his academic supervisor<br>• Submitting third Progress Report to his academic supervisor | |

**Class Schedule:**

Oral Presentation after submitting a written training report; both evaluated by at least 2 faculty members

**Course Contribution to Professional Component:**

- Engineering science: None
- Engineering design: None
- Others: 100%

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | | X | | | 3 | 3 | | 2 | 3 | 3 | 3 | 3 | 3 | |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

*** 1000 hours of on-job training distributed over 25 weeks

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO.</th><th rowspan="2">ENGLISH CODE /NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCH</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>-</td><td>1*</td><td>3</td><td>411 هكم</td><td>ChE 411</td><td>Polymer Engineering( Elective Course)</td></tr>
<tr><td colspan="5">CHEM 232</td><td colspan="2">Pre-requisites</td></tr>
<tr><td colspan="7">Classification of polymeric materials, calculation of molar mass and molar mass distribution, polymerization reactions, kinetics of polymerization reactions, composites materials, polymer processing, mechanical and physical properties, commercial polymer.</td></tr>
</table>

Faculties and departments requiring this course (if any): None

**Textbook:** Young R.J, Introduction to polymers, 2nd Edition, Chapman & Hall Publishers, 2000

**Reference:** Powel P.C, Engineering with polymers, 1st Edition, Chapman & Hall Publishers, .1992

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1. **Define** the basic vocabulary of polymer science.
2. **List and explain** the classification of polymeric materials.
3. **Recognize** the different structure of polymeric materials.
4. **Distinguish** between thermoplastics, elastomers and thermosets Polymers.
5. **Explain** the difference between homo and copolymers from engineering point of view.
6. **Apply** the Molar mass distribution.
7. **Calculate** Molar mass averages.
8. **Define** the difference between condensation and addition polymerization reactions.
9. **Define** linear step polymerization
10. **List and explain** different polycondensation and polyaddition reactions
11. **State and apply** Carothers theory.
12. **Describe** ring formation and explain it effect on the molar mass distribution.
13. **Define** non Linear step polymerization
14. **Describe** network polymers such as phenol formaldehyde and epoxy resins and defined its application in engineering.
15. **Define** polyurethane networks and its application.
16. **Define** free radical polymerization and the three stages of formation.
17. **Explain** the rate of Polymerization and the effecting steps.
18. **Describe** the steady state conditions and its effect on polymerization conditions.
19. **Explain** auto-acceleration phenomena.
20. **Explain** chain transfer concept and its effect on polymerization calculations.
21. **Describe** the effect of inhibitor and retardant on the physical properties of polymeric materials.
22. **Define** the different methods of free radical polymerization such as bulk, solution, suspension, emulsion, and Ionic polymerization.
23. **Describe** the advantage and disadvantage of different methods.
24. **Define** the term tacticity and its effect on the mechanical properties of polymeric materials.
25. **Define** the basic vocabulary of reinforced polymer.
26. **Describe** the principle of polymer reinforcement
27. **Explain** the mechanism of reinforcement and its effect on the mechanical properties of engineering polymer.
28. **Define** the effect of different polymer matrixes such as thermosets and thermoplastic materials.
29. **Define** the effect of different fibrous reinforcement and the influence of structure on the mechanical properties of composite materials.
30. **Define** the effect of different types of fibrous reinforcement such as, glass fiber, carbon fiber, aremid polymer (fiber) and platelet reinforcement on the mechanical properties of composite materials.

31. **Explain** different forming techniques such as pultrusion, filament winding, hand lay-up, hand spray-up, compression moulding reinforced reaction injection moulding (RRIM) and reinforced thermoplastics in engineering applications.
32. **Define** the mechanics of continuous fibers reinforcements and its mathematical application.
33. **Calculate** the minimum volume fraction of reinforcement.

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **1** | Polymer Chemistry. | 1 |
| **1** | Molar mass and degree of polymerization. | 2 |
| **1** | Classification of polymerization reactions. | 3 |
| **1** | Kinetics of step polymerization reaction. | 4 |
| **1** | Chain polymerization. | 5 |
| **1** | Degree of polymerization. | 6 |
| **1** | Method of free radical polymerization | 7 |
| **1** | Stereochemistry of polymerization | 8 |
| **1** | Reinforced polymer. | 9 |
| **1** | Reinforced plastic | 10 |
| **1** | Fibrous reinforcement | 11 |
| **1** | Forming of reinforcement plastic | 12 |
| **1** | Mechanics of fiber reinforcement | 13 |
| **1** | How the composite fails under load | 14 |

**Class Schedule**:

- Lecture: Three 1 hour sessions per week
- Tutorial: One 3.0 hours session per week

**Course Contribution to professional Component:**

- Engineering science: 100%
- Engineering design: 0%

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | **1** | **2** | **a** | **b** | **c** | **e** | **h** | **j** | **i** | **d** | **f** | **g** | **k** | **a** |
| Max. Attainable Level of Learning* | | **X** | **2** | **3** | **2** | **3** | | | | | | | | **2** |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

*One hour tutorial session

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | 412 هكم | ChE 412 | Engineering Materials( Elective Course) |
| ChE 210 | | | | | Pre-requisites | |
| Ferrous and non-ferrous metals and alloys. Ceramics. Polymers. Composites. Conductors, semiconductors and superconductors. Glasses | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** Michael F. Ashby, D, Jones, An Introduction to Properties, Applications and Design, Third Edition, 2008

**Reference:** Norman E. D Mechanical Behavior of Materials, 3rd Edition, 2006

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1- Discovering the breadth of materials science, with sessions exploring not just engineering materials.
2- Learning the art of materials selection, combination and optimum use in materials technology across a range of engineering applications
3- Discovering the fundamental relationships between different materials, the form they take and the jobs they perform
4- Exploring the physical and chemical properties of modern materials and how they determine their application
5- Working on a team project to design, build and test such as aerospace component and materials used in car manufacture
6- Improving skills in team building, communication, time management, problem-solving, planning and presentation

| Duration in Weeks | Topic Covered During Class: | NO |
|---|---|---|
| 1 | Discovering the breadth of materials science, | 1 |
| 3 | Learning the art of materials selection, combination and optimum use in materials technology across a range of engineering applications | 2 |
| 3 | Discovering the fundamental relationships between different materials, the form they take and the jobs they perform | 3 |
| 2 | Exploring the physical and chemical properties of modern materials and how they determine their application | 4 |
| 3 | Working on a team project to design, build and test such as aerospace component and materials used in car manufacture | 5 |
| 2 | Improving skills in team building, communication, time management, problem-solving, planning and presentation | 6 |

**Class Schedule**:

- Lecture: Three 1 hour sessions per week
- Tutorial: One 3.0 hours session per week

**Course Contribution to professional Component:**

- Engineering science: 50%
- Engineering design: 50%

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | | X | | | | | | | 2 | | | | | 2 |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

*One hour tutorial session

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | 413 هكم | ChE 413 | Materials Selection( Elective Course) |
| ChE 210 | | | | | Pre-requisites | |
| Selection criteria for metals, alloys, ceramics and plastics. Mechanical behavior, corrosion and oxidation resistance at ambient and elevated temperatures. Materials for marine environments, oil production and transport, refineries, petrochemical and desalination industries. Refractory materials. Computer applications, and economic considerations | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** Michael F. Ashby , Kara Johnson Materials and Design: The Art and Science of Material Selection in Product Design, 2005

**Reference**: Mahmud M. F Materials Selection for Engineering Design: Structure, Properties and Application, 1997 B002BMJ5QU

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1- Provide students with the knowledge and skills required to enable them to carry out the selection of appropriate materials for a wide range of engineering and other applications.

2- Learning about materials selection procedures. Check lists. Elementary stressing calculations. Choice of fabrication techniques. Case studies. Data sources. Material selection group exercise. Material selection individual exercise.

3- familiarity with the chemical names and/or compositions of metals and alloys

4- Understanding of the ranges of properties and processing characteristics exhibited by the above materials, including the variations within a single family and the differences between families of materials.

5- Understanding of the importance of consideration of component manufacturing method as part of the materials selection exercise.

6- Learning how to interrogate the database and become familiar with materials selection charts and materials selection indices for a wide variety of engineering situations

| Duration in Weeks | Topic Covered During Class: | NO |
|---|---|---|
| 2 | Provide students with the knowledge and skills required to enable them to carry out the selection of appropriate materials for a wide range of engineering and other applications. | 1 |
| 2 | Learning about materials selection procedures. Check lists. Elementary stressing calculations. Choice of fabrication techniques. Case studies. Data sources. Material selection group exercise. Material selection individual exercise. | 2 |
| 2 | familiarity with the chemical names and/or compositions of metals and alloys | 3 |
| 3 | Understanding of the ranges of properties and processing characteristics exhibited by the above materials, including the variations within a single family and the differences between families of materials. | 4 |
| 2 | Understanding of the importance of consideration of component manufacturing method as part of the materials selection exercise. | 5 |
| 2 | Learning how to interrogate the database and become familiar with materials selection charts and materials selection indices for a wide variety of engineering situations | 6 |

**Class Schedule**:

- Lecture: Three 1 hour sessions per week
- Tutorial: One 3.0 hours session per week

**Course Contribution to professional Component:**

- Engineering science: 90%
- Engineering design: 10%

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | | X | | | | 2 | | | | 2 | | | | 2 |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

*One hour tutorial session

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | 414 هكم | ChE 414 | Extractive |

| | | | | | | Metallurgy( Elective Course) |
|---|---|---|---|---|---|---|
| ChE 210 | | | | | Pre-requisites | |
| Major operations in the iron and steel-making industry; direct reduction processes, blast furnaces, converter and electric-arc steel-making and steel refining methods; electro slag (ESR) and vacuum induction refining (VIR). Bauxite production. Electro-thermal reduction of cryolite to produce commercial aluminum. Production of $TiO_2$. Extractive metallurgy of titanium. Gold extraction. Continuous casting. | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** Alan. C, an introduction to Metallurgy, 2nd Edition, Arnold, 1975

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1. Describe the various fields of material sciences and their relationship and purpose as well as the relationship of various metallurgic studies and their application
2. Explain the process of extractive metallurgy specific to iron and steel making.
3. Define the characteristics of various metals, the methods of Identification and material standards.
4. Describe and demonstrate the various types of heat-treatment performed on carbon steels.
5. Describe and demonstrate various procedures required for basic mechanical testing of metals.
6. Read and interpret simple binary phase diagrams and explain various topic areas related to metallographic and structure of metals.
7. Describe and identify key knowledge relating to non-ferrous metals, specialty materials, surface treatments and testing.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 2 | Describe the various fields of material sciences and their relationship and purpose as well as the relationship of various metallurgic studies and their application | 1 |
| 2 | Explain the process of extractive metallurgy specific to iron and steel making. | 2 |
| 2 | Define the characteristics of various metals, the methods of Identification and material standards. | 3 |
| 2 | Describe and demonstrate the various types of heat-treatment performed on carbon steels. | 4 |
| 2 | Describe and demonstrate various procedures required for basic mechanical testing of metals. | 5 |
| 2 | Read and interpret simple binary phase diagrams and explain various topic areas related to metallographic and structure of metals. | 6 |
| 2 | Describe and identify key knowledge relating to non-ferrous metals, specialty materials, surface treatments and testing. | 7 |

**Class Schedule**:

- Lecture: Three 1 hour sessions per week
- Tutorial: One 3.0 hours session per week

**Course Contribution to professional Component:**

- Engineering science: 100%
- Engineering design: 05

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | | X | | 2 | | 2 | | | | 2 | | | | 2 |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

*One hour tutorial session

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | 422 هكم | ChE 422 | Catalysis |
| ChE 321 | | | | | Pre-requisites | |
| Kinetics of homogeneous and heterogeneous catalytic reactions. Physical and chemical properties of solid catalysts. Preparation, activity, selectivity, deactivation and regeneration of catalysts. Applications to refining and petrochemical industries | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** M. Albert M, V, Kinetics of Catalytic reactions, Springer, 2000

**Reference:** Thomas, W, j and Thomas, J, M, Introduction to the Principles of Heterogeneous Catalysis, Academic Press, London, 2001

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1. **Define** and **Understand** difference between homogeneous and heterogeneous catalytic reactions.
2. **Design** kinetic experiments involving heterogeneous catalysts.
3. **Acquire** valid rate data, to determine the presence or absence of heat and mass transfer limitations in these data. A special **emphasis** is placed on assessing mass transfer effects, particularly in liquid-phase reactions.
4. **Select** and **simplify** reaction models, to derive rate expressions based on these models, and to assess the consistency of these rate equations.
5. **Discuss** of the assumptions related to the derivation of adsorption isotherms and reaction models to understand the limitations of these models and to feel comfortable in their application.
6. **Define** the rate of chemical reaction and **apply** the mole balance equations to a batch reactor, CSTR, PFR, and PBR.

7. **<u>Learn</u>** Solid catalysts preparation and characterization techniques.
8. **<u>Compute</u>** the catalyst activity, conversion, selectivity and the yield if catalytic techniques.
9. **<u>Discuss</u>** catalyst deactivation and poisoning of the catalyst.
10. **<u>Know</u>** Industrial catalytic processes.

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| 1 | Introduction | 1 |
| 2 | Adsorption | 2 |
| 2 | Allied phenomena on catalyst surface | 3 |
| 2 | Design of catalytic reactors | 4 |
| 1 | Preparation of solid catalysts | 5 |
| 1 | Characterization of solid catalysts | 6 |
| 2 | Catalyst deactivation | 7 |
| 1 | Poisoning of catalysts | 8 |

**<u>Class Schedule</u>**:

- Lecture: Three 1 hour sessions per week
- Tutorial: One 3.0 hours session per week

**<u>Course Contribution to professional Component:</u>**

- Engineering science: 90%
- Engineering design: 10%

**<u>Course Relationship to Program Outcomes:</u>**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | | X | | 2 | | | | 1 | | | | | | 2 |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

***One hour tutorial session**

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITL |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 5 | 1 | هكم٤٣٥ | ChE 435 | Unit operation laboratory( Core Course) |
| ChE 332, ChE 334 | | | | | Pre-requisites | |

Experimental study of unit operations using pilot size equipment. Safety considerations . Data analysis. Selected topics related to unit operation such as membrane separation and mechanical separation, etc

Faculties and departments requiring this course (if any): None

**Textbook:** McCabe, W.L. Smith J.C. & Harriott P., Unit Operations of Chemical Engineering, 5th Edition. McGraw Hill, 1993

**Reference:** Coulson J.M. and Richardson J.F., Chemical Engineering. Vol. 2, Pergamon Press (U.K.) 1990

***Course Leaning Objectives: By completion of the course, the students should be able to*:**

1. **Determine** diffusion coefficients of vapor in air.
2. **Determine** diffusion coefficients of liquid in liquid.
3. **List** main heat exchangers used in industry.
4. **Explain** differences between counter current and co current flow in heat exchangers.
5. **Derive** expression for LMTD for double pipe and shell and tube Heat exchanger.
6. **Determine** overall heat transfer coefficient for double pipe and shell and tube heat exchanger.
7. **Explain** effect of change of Reynolds number ($R_e$) on the heat transfer coefficient.
8. **Study** sedimentation operation and its applications
9. **List** factors affecting sedimentation operation.
10. **Calculate** sedimentation velocity of solid particles and the effect of different concentrations on mass flux.
11. **Explain** drying operation and its applications.
12. **Define** drying rate (constant and falling and rising rate)
13. **Determine overall** drying coefficient
14. **Explain** size reduction operation and particulate solids characteristics.
15. **Draw over**size, undersize and sieve opening curves.
16. **Use** screen analysis to determine the average particle size.
17. **Explain** liquid-liquid extraction operation, distribution, extract and raffinate phases.
18. **List** types of liquid - liquid extraction equipments.
19. **Determine** extraction efficiency for ternary system.
20. **List** safety considerations for flammable and toxic liquids in the laboratory.
21. **List** the types of cooling towers.
22. **List** the application of cooling towers in chemical industries.
23. **Explain** distillation operation and its applications.
24. **List the** types of distillation columns and distillation operations.
25. **Use** T-y-x and y-x diagram of binary mixture to determine the effect of reflux ratio on quality of top product and the pressure drop in the column.
26. **Determine the** number of theoretical plates by McCabe Thiele method.
27. **Determine** the overall efficiency and tray efficiency using Murphree method.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Liquid Diffusion | 1 |
| **1** | Gas Diffusion | 2 |
| **2** | Heat exchangers | 3 |
| **1** | Sedimentation operation | 4 |
| **1** | Drying Operation | 5 |
| **1** | Size Reduction | 6 |
| **1** | Liquid – liquid extraction | 7 |
| **1** | Cooling Towers | 8 |

| | | |
|---|---|---|
| 2 | Distillation Process and its applications | 9 |

**Course Schedule**

- Lecture: 2 one hour session per week
- Lab.: one session 3 hours lab per week

**Course Contribution to professional Component:**

- Engineering Science: 90 %
- Engineering Design: 10 %

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | X | | | 3 | | | | | | 3 | 3 | | | |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هكم٤٤١ | ChE 441 | Modeling and Simulation(Core Course) |
| ChE 321, ChE 334 | | | | | Pre-requisites | |

This course is designed to give a chemical engineering student the ability to solve system of algebraic- differential equations. The course will develop student ability's to drive system models and simulate digitally. The student is also trained on available simulation computer packages (Design II, ChE-Cad & Math-lab).

Faculties and departments requiring this course (if any): None

**Textbook:** Luyben W. L, Process Modeling Simulation & Control, 2nd Edition, McGraw-Hill, 1990

**Reference:** Norman .H, Process Modeling and Computer Aided Design in Chemical Engineering, John Wiley and Sons ,2000

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1. **Apply** Newton-Raphson method and wegstein method to find roots of non-linear equation.
2. **Apply** of Euler method and 4th order Runge-Kutta method for numerical solution of ordinary differential equation.
3. **Apply** of the above root finding method for State equations.

4. **Breakdown** Higher order O.D.E. into system of 1st order O.D.E
5. **Apply** of system of 1st order O.D.E. for chemical processes
6. **Define** Control volume (CV) for any chemical process.
7. **Identify** CV characteristic to chemical system.
8. **State** Assumptions for simplifying system model.
9. **Analyze** Total Material Balance for flow system
10. **Write** the basic principle of total material balance to holding tank with constant density.
11. **Write** Model of holding tank with constant cross-section area and variable cross-section area.
12. **Demonstrate** Simulation of holding tank using Euler method or 4th order Rung-kutta method with initial condition and final time using Excel.
13. **Develop** Component Material Balance for flow system
14. **Write** Model of mixing tank with multi-inputs and multi-output.
15. **Write** Model of CSTR with general reversible two reactant and two product reaction.
16. **Illustrate** Simulation of mixing tank with total and components material balance using Euler Method or 4th order Rung-kutta method , applying on Excel
17. **Develop** energy Balance for flow system with single input single output, and multi input multi output system. **Define** enthalpy temperature relation.
18. **Write** Modeling and setup simulation a heater with input output steams.
19. **Write** Model and Setup simulation of non-isothermal CSTR.
20. **Write** Model coil heater/cooler and jacket heater/cooler.
21. **Develop** Model and Setup simulation of holding tanks in series.
22. **Develop** Model and Setup simulation of CSTR in series ( with constant holdup and variable holdup, isothermal and non-isothermal )
23. **Develop** Model and Setup simulation of Distillation column ( plate, condenser and re-boiler )
24. **Develop** Model and setup simulation for CSTR and Distillation in series
25. **Define** C.V. for distributed parameter system.
26. **Apply** finite difference method for solving partial differential equation.
27. **Develop** Model and setup simulation for a fluid flow in pipe
28. **Develop** Model and setup simulation for a plug flow reactor.
29. **Develop** Model and setup simulation for a double pipe heat-exchanger.
30. **Develop** Model and setup simulation for one direction conduction and one direction diffusion.
31. **Develop** Model and setup simulation for a closed loop system; study the effect of different controller type and controller parameters on state variable.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Introduction – review numerical method | 1 |
| **1** | Total mass balance &Components mole alance | 2 |
| **1** | Energy Balance | 3 |
| **1** | 4th Order Runge -Kutta method | 4 |
| **1** | System in series | 5 |
| **1** | Distillation Column | 6 |
| **2** | CSTR & Distillation in series | 7 |
| **2** | Closed loop system | 8 |

**Class Schedule**:

- Lecture: Two 1.5 hour sessions per week

- Tutorial: 2 hours per week

**Course Contribution to professional Component:**

- Engineering science: 100%
- Engineering design: 0%

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | X | | 3 | | | 3 | | | | 3 | | | 2 | 3 |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

*One hour tutorial session

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 4 | - | 3 | 3 | هكم٤٤٢ | ChE 442 | Process Control(Core Course) |
| ChE 321, ChE 334 , MATH 205 | | | | | Pre-requisites | |

Mathematical modeling of process control. Transfer functions. Dynamic behavior of chemical processes. Feedback control. Dynamic behavior of closed-loop systems. Stability analysis. Frequency response analysis. Controller design and tuning. Introduction to computer control. Laboratory and simulations applications

Faculties and departments requiring this course (if any): None

**Textbook** Donald R. C, Process Systems Analysis and Control, 2nd second Edition, McGraw-Hill, 1991

**Reference:**

Luyben W. L, Process Modeling Simulation & Control, 2nd Edition, McGraw-Hill, 1990

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1. **Define** what is meant by chemical process control.
2. **Describe** the needs and the incentives for controlling a chemical process
3. **Provide** the rationale for studying the material that follows in subsequent topics.
4. **Analyze** the characteristics of a control system
5. **Formulate** the problems that must be solved during its design
6. **Explain** why we need to develop a mathematical description (model)
7. **Describe** a methodology for the modeling of a chemical process
8. **Determine** the scope and the difficulties of the mathematical modeling for process control purpose.

9. **Develop** simple input and output models for chemical processes.
10. **Use** Laplace transforms.
11. **Use** initial and final value theory
12. **Describe** the behavior of different basic systems
13. **Analyze** various typical processes
14. **Describe** the dynamic response of the process
15. **Develop** the transfer function of the process.
16. **Identify** the order of the process.
17. **Develop** the response of the system to different forcing function
18. **Compare** between different order processes.
19. **Calculate** the process gain and time constant.
20. **Analyze** the first order systems in series.
21. **Develop** the main characteristics of second order systems.
22. **Discuss** the notion of the feedback loop.
23. **Describe** the hard ware elements needed for its implementation.
24. **Identify** the types of feedback controllers
25. **Examine** the effect of feedback controllers and response of a chemical process.
26. **Design** appropriate types of feedback controllers to control a given process.
27. **Design** the controller parameters
28. **Solve** some special problems that are encountered during the design of feedback controllers.
29. **Analyze** the stability characteristics of a feedback control system.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Meaning of chemical process control | 1 |
| **1** | Characterization of control system | 2 |
| **1** | Simple input and output models for chemical processes | 3 |
| **1** | Laplace transform | 4 |
| **4** | Linear open loop systems | 5 |
| **6** | Linear closed loop systems | 6 |

**Course Schedule:**

- Lecture: two 1.5 hour session per week
- Tutorial: one 3 hours session per week

**Course Contribution to professional Component:**

- Engineering science: 87.5 %
- Engineering design: 12.5 %

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. Attainable Level of Learning* | X | | 3 | 3 | 3 | 3 | | | 2 | 3 | | | 3 | 3 |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| ٣ | - | 1* | 3 | هـكم٤٥١ | ChE 451 | Plant Design(Core Course) |
| ChE 321, ChE 334, IE 255 | | | | | Pre-requisites | |
| Chemical and petrochemical processes plant design. Locations and layout of chemical process plant. Operability, controllability reliability and safety requirement of the design. Cost estimation. Utilization of simulation and design packages | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** Peter M.S and Timmerhaus K.D., Plant design and Economics for Chemical Engineers, 5th Edition, McGraw-Hill, 1991

**Reference:** Turton R, Bailie R, Whiting W & Shaeiwitz J, Analysis, Synthesis, and design of chemical processes, 1st Edition ,Printice Hall, PTR 1998

***Course Leaning Objectives: By completion of the course, the students should be able to*:**

1. **List** the stages of a plant design process and feasibility study steps
2. **Differentiate** between optimum economic and operating design alternatives
3. **State** the various types of diagrams used and be able to interpret and sketch them and identify the plant site selection, site layout and plant layout criteria
4. **Estimate** column diameter and **calculate** tray hydraulic for bubble cap and sieve tray, calculate pressure drop for packed tower and column cost
5. **List** types of reboilers and condensers and apply energy balance for the column to estimate the reboiler and condenser duties and utilities requirement
6. **Recognize** types of control valves and its operational problems, explain distillation column control system and calculate important parameters in sizing the control valves
7. **Explain** the theory of ejectors, types, steam and cooling water required
8. **Differentiate** between different types of vessels and recognize vessel operational problems and their design solutions
9. **Estimate** diameter, length of horizontal and vertical vessels
10. **Identify** reactor types and applications
11. **Calculate** reactor volume, residence time, pressure drop and the reactor cost
12. **Outline** different heat exchange systems and estimate the heat exchanger cost
13. **Recognize** fan cooler different types and calculate fan cooler duty and dimensions
14. **Apply** psychrometric chart and energy balance for cooling tower calculations
15. **Estimate** moody and Fanning friction factors and calculate line and fittings pressure drop for a given process
16. **Distinguish** the difference between bubble, slug, churn and annular flow pattern

17. **Recognize** different types of pump and compressor and describe pump cavitation and compressor surge problems
18. **Explain** net positive suction head for a pump, NPSH, and calculate the required NPSH.
19. **Apply** affinity law for a pump with different variables and calculate head and capacity for pumps in series and parallel
20. **Construct** system curve of a given process and calculate compressor head
21. **Identify** metallic and non metallic group materials and its characteristics and select the proper pipe material for a given process
22. **Distinguish** between atmospheric and pressure storage tanks
23. **Estimate** storage tank dimensions and storage tanks losses
24. **Express** important safety measurements
25. **Recognize** different safety codes
26. **Estimate** fixed, working capital investments, pay back time and profitability
27. **Outline** and estimate different cost indexes
28. **Use** Excel in spreadsheet calculation and graph demonstration and use of any equation solver software
29. **Use** either CHEMCAD or HYSYS simulation package to design a chemical process

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| 1 | Design process basics | 1 |
| **1** | Design of a distillation column | 2 |
| **1** | Design of vessels | 3 |
| **2** | Design of a reactor | 4 |
| **1** | Design of heat exchange systems | 5 |
| **1** | Hydraulic calculations and line sizing | 6 |
| **2** | Pumps and compressors | 7 |
| **1** | Materials selection | 8 |
| **1** | Storage tanks | 9 |
| **1** | Safety | 10 |
| **1** | Cost estimation | 11 |
| **1** | Computer use | 12 |

**Course Schedule:**

- **Lecture: two 1.5 hour sessions per week**
- **Tutorials: one 3.0 hours session per week**

**Course Contribution to professional Component:**

- **Engineering science: 30 %**
- **Engineering design: 70 %**

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | **1** | **2** | **a** | **b** | **c** | **e** | **h** | **j** | **i** | **d** | **f** | **g** | **k** | **a** |
| Max. Attainable Level of Learning* | **X** | | **3** | | **3** | **3** | **3** | **2** | | | | | **3** | **3** |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

***One hour tutorial session**

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| **TCH** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **-** | **1*** | **3** | **452 هـكم** | **ChE 452** | **Computer Aided Design for Chem. Eng. (Elective Course)** |
| **ChE 441 &ChE 451** | | | | | **Pre-requisites** | |
| Techniques for computer aided design of chemical processing systems. Thermodynamic property models and data bases. Introduction to linear and nonlinear programming. Design of unit operations and chemical reactors. Flow sheeting. Process integration. Development of algorithm. Case studies with extensive use of computer software. | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** Seider W., Seader J. D., Lewin D., Process Design Principles: Synthesis, Analysis, and Evaluation, John Wiley, 1999

***Course Leaning Objectives: By completion of the course, the students should be able to:***

This course provides a hands-on-experience to the art of computer-aided process design and how to use simulation software to solve process design problems. Flow sheet simulator (Aspen Plus) will be employed to perform detailed (rigorous) plant design calculations and to evaluate alternative design and operation options.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 2 | Introduction to computer-aided process design packages | 1 |
| 2 | General structure of computer-aided design programs | 2 |
| 2 | Introduction to Aspen Plus | 3 |
| 2 | Aspen Plus Graphical User Interface | 4 |
| 2 | Aspen Plus Basic Input | 5 |
| 2 | Unit Operations Models; Distillation, Reactors, Heat Exchangers, | 6 |
| 2 | Design Specification | 7 |

**Class Schedule**:

- Lecture: Three 1 hour sessions per week
- Tutorial: One 3.0 hours session per week

**Course Contribution to professional Component:**

- Engineering science: 30%
- Engineering design: 70%

## Course Relationship to Program Outcomes:

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | | X | | | 2 | | | 1 | | | | | | 2 |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

*One hour tutorial session

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | 462 هـكم | ChE 462 | Petroleum Refinery Engineering(Elective Course) |
| ChE 321 & ChE 334 | | | | | Pre-requisites | |
| Oil production. Surface operations. Characterization and classification of crude oils. Physical properties of oils. Refinery operations; atmospheric and vacuum distillation, treatment processes, catalytic cracking, reforming, alkylation, coking, asphalt production and lubricating oil production. Blending of refinery products. Waste treatment. | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** Nelson, W.L., Petroleum Refining Engineering,. McGraw Hill, New York. ١٩٨٧

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1- To present overview of the operations of a typical Refinery
2- To highlight the physical and chemical principles involved and how they are utilized in these operations
3- To highlight important product specification and their relevance to product performance.
4- Major insights into the technology, economics and major trends of the petroleum refining industry
5- Detailed study of petroleum refinery processes and products
6- To understand unit configurations, process variables, and its monitoring
7- To provide students with some case studies in important process parameters and their control

| *Duration in Weeks* | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| 2 | To present overview of the operations of a typical Refinery | 1 |

| | | |
|---|---|---|
| 2 | To highlight the physical and chemical principles involved and how they are utilized in these operations | 2 |
| 2 | To highlight important product specification and their relevance to product performance. | 3 |
| 2 | major insights into the technology, economics and major trends of the petroleum refining industry | 4 |
| 2 | detailed study of petroleum refinery processes and products | 5 |
| 2 | To understand unit configurations, process • variables, and its monitoring | 6 |
| 2 | To provide students with some case studies in important process parameters and their control | 7 |

**Class Schedule**:

- Lecture: Three 1 hour sessions per week
- Tutorial: One 3.0 hours session per week

**Course Contribution to professional Component:**

- Engineering science: 70%
- Engineering design: 30%

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | | X | 2 | 3 | 2 | 3 | | | | | | | | 2 |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

***One hour tutorial session**

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | 463 هـ كم | ChE 463 | Natural Gas Engineering (Elective Course) |
| ChE 321 & ChE 334 | | | | | Pre-requisites | |
| Characterization and properties of natural gas. Gas gathering systems. Gas-oil multistage separation. Gas treatment and liquefaction. Gas transportation through pipelines, signal-telemetering Industrial usages. | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** Xiuli.W & Michael's Advanced Natural Gas Engineering, First Edition, Gulf publishing Company, 2009

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1. Understand the methods used to predict the volumetric and thermodynamic properties of natural gas.
2. Predict conditions for hydrate formation in natural gases.
3. Specify compressor power requirements and calculate appropriate efficiencies.
4. Calculate flow rates through valves and chokes.
5. Calculate pressure losses through pipelines, both vertical and horizontal.
6. Understand the derivation of the pseudo-pressure function for flow of gas in reservoirs.
7. Understand the basis for and application of the various well test methods for gas reservoirs

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| 2 | Understand the methods used to predict the volumetric and thermodynamic properties of natural gas. | 1 |
| 2 | Predict conditions for hydrate formation in natural gases. | 2 |
| 2 | Specify compressor power requirements and calculate appropriate efficiencies. | 3 |
| 2 | Calculate flow rates through valves and chokes. | 4 |
| 2 | Calculate pressure losses through pipelines, both vertical and horizontal. | 5 |
| 2 | Understand the derivation of the pseudo-pressure function for flow of gas in reservoirs. | 6 |
| 2 | Understand the basis for and application of the various well test methods for gas reservoirs | 7 |

**Class Schedule**:

- Lecture: Three 1 hour sessions per week
- Tutorial: One 3.0 hours session per week

**Course Contribution to professional Component:**

- Engineering science:
- Engineering design:

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | **1** | **2** | **a** | **b** | **c** | **e** | **h** | **j** | **i** | **d** | **f** | **g** | **k** | **a** |
| Max. Attainable Level of Learning* | | **X** | **2** | **3** | **2** | **3** | | | | | | | | **2** |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

***One hour tutorial session**

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | 464 هكم | ChE 464 | Petrochemical Technology( Elective Course) |
| ChE 334 | | | | | Pre-requisites | |
| Production technologies of synthesis gas, olefins and aromatic. Manufacture of important petrochemicals derived from base chemicals and synthesis gas. Production technologies of important polymers and plastics. | | | | | | |

Faculties and departments requiring this course (if any): None

**Textbook:** **Hatch.** L.F. & Matter. S. From Hydrocarbons to Petrochemicals, Gulf Publishing Company, Houston.1981

***Course Leaning Objectives: By completion of the course, the students should be able to*:**

1. **Introduce** The students to petrochemical industries in Saudi Arabia.
2. **Discuss** The major petrochemicals produced in Saudi Arabia and the economic importance of petrochemical industries.
3. **Explain** The major components of petrochemical plants.
4. **Acquire** The knowledge of the different types of catalytic processes, catalytic reactors and separation techniques.
5. **Understanding** The safety precautions in petrochemical processes.
6. **Knowledge** The different processes employed in natural gas purifications.
7. **Know** The processes for petrochemicals from methane
8. **Explain** the production of olefins as primary petrochemical products.
9. **Discuss** The production of petrochemical from ethylene, propylene, higher olefins and BTX.
10. **Understand** The concept of thermoplastic and thermosetting resins.
11. **Explain** The production processes for polyethylene, PVC, polypropylene and thermosets.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Introduction | 1 |
| 2 | Petrochemical from methane | 2 |
| 1 | Production of olefins | 3 |
| 2 | Petrochemicals from ethylene | 4 |
| 2 | Petrochemical from propylene and higher olefins | 5 |
| 2 | Petrochemical from benzene, toluene and xylene | 6 |
| 2 | Thermoplastics, thermosetting end engineering resins | 7 |

**Class Schedule**:

- Lecture: Three 1 hour sessions per week
- Tutorial: One 3.0 hours session per week

**Course Contribution to professional Component:**

- Engineering science: 100%
- Engineering design: 0%

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | Knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Max. Attainable Level of Learning* | | X | | | | | | | | | | | | 2 |

1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

*One hour tutorial session

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| ٣ | - | 1* | 3 | 465 هـ كم | ChE 465 | Industrial Pollution Control(Elective Course) |
| ChE 321, ChE 334 | | | | | Pre-requisites | |

Sources of pollution from chemical industries. Standards and legalization. Health and environmental effects of pollution. Air pollutants; particulate, $SO_x$, $NO_x$, and organic vapors. Air pollution control. Treatment of industrial wastewater. Handling of solid waste. Monitoring of pollutants. Case studies for specific industries like petrochemicals, fertilizers, desalination and petroleum refining

Faculties and departments requiring this course (if any): None

**Textbook:** Howard S. Peavy, Donald R. Rove & George Tchobanoglous, Environmental Engineering, 4th edition, McGraw-Hill, 2001

**Reference:** Turton R, Bailie R, Whiting W & Shaeiwitz J, Analysis, Synthesis, and design of Chemical processes, 1st Edition, Printice Hall, PTR 1998

***Course Leaning Objectives: By completion of the course, the students should be able to:***

1. **Define** the impact of humans upon the environment and the role of the environmental engineer.
2. **Define** and **characterize** the physical, chemical, and biological water quality parameters.
3. **Identify** and **describe** basic laboratory measurements, such as BOD, TSS; as stated in *standard Methods.*
4. **Discuss** the microbiological impact of bacteria, virus, and protozoa in wastewater.
5. **Classify** water purification processes in natural systems.

6. **Discuss** why sanitary wastes must be treated before the liquids and solids are returned to the environment.
7. **Categorize** common wastewater plant equipments, definitions and abbreviations.
8. **Implement** a planned design strategy for a sludge treatment process.
9. **Define** and **characterize** the air quality parameters.
10. **Classify** air pollutants according to origin, chemical composition and state of matter.
11. **Apply** the natural processes of air purification in engineered systems.
12. **List** control devices for particulate and gaseous contaminants.
13. **List** and **describe** the classes of hazardous materials.
14. **Describe** the methodologies utilized for the management and disposal of hazardous solid wastes.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Introduction | 1 |
| | Part 1 Water | 2 |
| **2** | Water Quality | 3 |
| **2** | Water Purification Processes in Natural Systems | 4 |
| **2** | Engineered Systems for Wastewater treatment | 5 |
| | Part 2 Air | 6 |
| **1** | Air Quality | 7 |
| **2** | Engineered Systems for Air Pollution Control | 8 |
| | Part 3 Solid Waste | 9 |
| **1** | Solid Waste: Definitions, Characteristics and Perspectives | 10 |
| **2** | Engineered Systems for Solid Waste Management | 11 |

# DEPARTMENT OF CIVIL ENGINEERING

# INTRODUCTION

Civil engineering is the profession which designs, constructs, operates and manages the basic systems that make civilization possible and which assesses the impacts of such systems on the natural environment. The civil engineer must deal with the human impact of engineering, social, moral, legal and environmental issues that concern us to a far greater degree than ever before. As a matter of fact, civil engineering has played a key role in the development of the Kingdom of Saudi Arabia during the past several decades.

The Department of Civil Engineering is one of the major and active engineering departments at King Abdulaziz University (KAU) since 1395H/1975G. It offers B.Sc., M.Sc. (thesis and non-thesis options) as well as Ph.D. degrees in civil engineering. The Department has a strong highly qualified and experienced full-time faculty comprising 11 professors, 10 associate professors, 13 assistant professors, and 5 lecturers, apart from the supporting laboratory and secretarial staff .

Civil engineering programs are intended to satisfy the needs of the country. The rapid introduction of modern materials, measurement techniques, construction methods and management tools require properly trained civil engineers. The civil engineering program and its objectives are continuously updated keeping in view these factors.

The civil engineering program B. Sc. at KAU is designed to develop knowledgeable and creative engineers with strong capabilities for innovation and management. Civil Engineering graduates have a wide variety of employment opportunities in both the private as well as the public sectors. Civil engineering has become an extremely diverse field with many areas of application.

# VISION AND MISSION STATEMENTS

## The Vision of the Department

A distinguished learning and research community in Civil Engineering knowledge

## The Mission of the Department

Offer high-quality education and conduct innovative research in Civil Engineering to provide sustainable solutions for societal needs.

# EDUCATIONAL OBJECTIVES

The Program Educational Objectives are:

7. Graduates will have the necessary knowledge of engineering fundamentals for successful professional careers in civil engineering.
8. Graduates will demonstrate professional skills and actively participate in the sustainable development of the society.
9. Graduates will continue to learn and adapt to an evolving professional environment.

### Aspects of development

The department of the Civil Engineering has the basic resources needed to implement the new plan. However, additional resources are needed to enhance the department ability to continually improve offering of the program and accommodate additional number of students due to the increase in demand for civil engineers in the Kingdom. Future plans shall consider the following:

15. Acquisition of specialized software program necessary for teaching of the different civil engineering subjects.
16. Modernization and upgrading of Civil Engineering Laboratories and facilities.
17. Recruiting highly qualified technicians to operate and maintain laboratories equipment.
18. Recruiting highly qualified faculty members in all specializations to fill the vacancies and to replace retiring faculty members.

## GRADUATION REQUIREMENTS

In order to qualify for a BS degree in Civil Engineering, students must successfully complete 155 semester credit units with an overall GPA of 2.٧٥ out of 5 or better. The student has to complete 49 required courses and two elective courses with a grade of D or better including 10 weeks of Industrial Summer Training and a Capstone B.Sc. design project as detailed in the ChE curriculum requirements described here after.

## PROGRAM REQUIREMENTS AND CURRICULUM

### Key to Course Numbers and Department Code

Key of tenth digit in the codes of CE courses

| Tens Digit | Specialty |
|---|---|
| 2 | Construction engineering and management |
| 3 | Geotechnical Engineering |
| 4 | Structural Engineering |
| 5 | Water Resources Engineering |
| 6 | Environmental Engineering |
| 7&8 | Surveying & Transportation Engineering |
| 9 | Training and research courses and special topics |

5. Each department is referred to by a code of a minimum of two and max of 4 letters
6. The hundredth digit refers to the school year
7. The tenth digit refers to specialty within the department/branch
8. The ones digit refers to course serial within the same specialty

### Units Required for the B.Sc. Degree

Units required for the B.Sc. degree in the Department of Civil Engineering.

| **Requirements** | **Cr. Hrs** |
|---|---|
| University Requirements (including the prep year) | 41 |
| Faculty Requirements | 37 |
| Departmental Requirements (Compulsory) | 69 |
| Departmental Requirements (Electives) | 6 |
| Summer Training | 2 |
| **Total** | **155** |

## Department Compulsory Courses

Regular students are required to take 71 credits (2٤ courses) as indicated in the table.

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| MENG 130 | Basic Workshop | 2 | MENG 102 |
| MEP 290 | Fluid Mechanics | 3 | PHYS 281, MATH 202 |
| CE 201 | Engineering Mechanics (Statics) | 3 | IE 200 , PHY 281 |
| CE 202 | Strength of Materials | 4 | CE 201, MENG 130, MATH 203 |
| CE 321 | Construction Management | 3 | IE 255 |
| CE 332 | Geology for Civil Engineers | 3 | CE 202, CHEM 281 |
| CE 333 | Geotechnical Engineering | 4 | CE 332, IE 202, EE 251 |
| CE 340 | Structural Analysis-I | 3 | CE 202, EE 201, MATH 205 |
| CE 341 | Materials of Construction | 4 | CE 202, CHEM 281 |
| CE 342 | Reinforced Concrete Design – I | 3 | CE 340, CE 341, IE 202 |
| CE 352 | Hydraulics | 3 | MEP 290, IE 202, MATH 204 |
| CE 353 | Hydrology & Water Resources Engineering | 3 | CE 352 |
| CE 371 | Surveying | 3 | MATH 202, MENG 102 |
| CE 381 | Transportation Engineering | 3 | CE 371, ARAB 201 |
| CE 390 | Summer Training | 2 | CE 321, CE 332, CE 340, CE 341, CE 352 |
| CE 401 | Civil Engineering Fundamentals | 1 | CE 321, CE 333, CE 342, CE 352, CE 381 |
| CE 422 | Construction Engineering | 3 | CE 321, CE 342, ISLS 301 |
| CE 434 | Foundation Engineering | 3 | CE 333 |
| CE 440 | Structural Analysis -II | 3 | CE 340 |
| CE 442 | Reinforced Concrete Design –II | 3 | CE 342 |
| CE 461 | Environmental Engineering | 4 | CE 352 |
| CE 482 | Highway Design & Construction | 4 | CE 381, CE 341 |
| CE 499 | B.Sc. Project | 4 | CE 321, CE 333, CE 342, CE 352, CE 381 |
| Total | | 71 | |

## Department Elective Courses

Students select 2 courses (6 credit units) out of those in the table.

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| CE 423 | Construction Estimating & Scheduling | 3 | CE 422 |
| CE 424 | Construction Contracting | 3 | CE 321 |
| CE 435 | Applications in Foundation Engineering | 3 | CE 434 |
| CE 439 | Soil Improvement | 3 | CE 434 |
| CE 441 | Design of Steel Structures | 3 | CE 340 |
| CE 444 | Advanced Reinforced Concrete Design | 3 | CE 342 |
| CE 451 | Design of Hydraulic Structures | 3 | CE 352 |
| CE 457 | Water Resources Planning & Management | 3 | CE 353 |
| CE 465 | Wastewater Reclamation and Reuse | 3 | CE 461 |
| CE 471 | GPS and GIS Applications | 3 | CE 371 |
| CE 483 | Traffic Engineering | 3 | CE 381 |
| CE 486 | Flexible Pavement Maintenance | 3 | CE 381 , CE 341 |
| CE 497 | Special Topic in Civil Engineering | 3 | Chairman's Approval |

- Each one theoretical hour calculated as one credit unit
- Each two or three practical hour calculated as one credit unit
- There is no circumstance for training hour (not counted in credit calculations)

# A TYPICAL PROGRAM FOR CIVIL ENGINEERING

## 3rd Year

**5th Semester** | **6th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| ARAB 201 | Arabic Language(2) | 3 | CE 202 | Strength of Materials | 4 |
| CE 201 | Engineering Mechanics (Statics) | 3 | EE 251 | Basic Electrical Engineering | 4 |
| CE 371 | Surveying | 3 | ISLS 201 | Islamic Culture (2) | 2 |
| IE 202 | Introduction to Engineering Design II | 2 | MATH 205 | Series and Vector Calculus | 3 |
| MATH 204 | Differential Equations | 3 | MEP 290 | Fluid Mechanics | 3 |
| MENG 130 | Basic Workshop | 2 | | | |
| | Total | ١٦ | | Total | 16 |

## 4th Year

**7th Semester** | **8th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| CE 321 | Construction Management | 3 | ISLS 301 | Islamic Culture (3) | 2 |
| CE 332 | Geology for Civil Engineers | 3 | CE 333 | Geotechnical Engineering | 4 |
| CE 340 | Structural Analysis-I | 3 | CE 342 | Reinforced Concrete Design - I | 3 |
| CE 341 | Materials of Construction | 4 | CE 381 | Transportation Engineering | 3 |
| CE 352 | Hydraulics | 3 | CE 353 | Hydrology & Water Resources Engineering | 3 |
| | | | CE 390 | Summer Training | 2 |
| | Total | ١٦ | | Total | 17 |

### 4th Year Summer – Training (Regular)

| | | |
|---|---|---|
| CE 390 | Summer Training | 2 Cr. Hr. |

## 5th Year

| 9th Semester | | | 10th Semester | | |
|---|---|---|---|---|---|
| **Course No.** | **Course Title** | **Cr. Hr.** | **Course No.** | **Course Title** | **Cr. Hr.** |
| CE 401 | Civil Engineering Fundamentals | 1 | ISLS 401 | Islamic Culture (4) | 2 |
| CE 422 | Construction Engineering | 3 | CE 440 | Structural Analysis -II | 3 |
| CE 434 | Foundation Engineering | 3 | CE 442 | Reinforced Concrete Design -II | 3 |
| CE 461 | Environmental Engineering | 4 | CE 482 | Highway Design & Construction | 4 |
| CE 499 | B.Sc. Project | 4 | CE xxx | Elective from CE Dept. | 3 |
| CE xxx | Elective from CE Dept. | 3 | | | |
| | Total | ١٨ | | Total | 15 |

## COURSE DESCRIPTION

### CE 202 Strength of Materials (4:3,3)

Review of statics, internal reactions. Concept of stress. Concept of strain, Stress-strain relations. Deformation of axially loaded members. Torsion of circular members. Normal force, shear force and bending moment diagrams. Flexure and shearing stresses in beams. Transformation of plane stresses. Concept of design of beams. Concept of beam deflection. Concept of buckling of columns. Laboratory experiments.

**Prerequisite: CE 201, MENG 130, MATH 203**

### CE 321 Construction Management (3:3,0)

Characteristics of Construction Industry; project delivery systems. The design and construction process. Construction contracting. Construction planning. Cash flow. Conceptual cost estimation. Quality and Safety Management.

**Prerequisite: IE 255**

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCU |
| Geology for Civil Engineers | CE 332 | هـ مد ٣٣٢ | 3 | 3 | 0 | 3 |
| Pre-requisites | | CE 202 Strength of Materials,<br>CHEM 281 General Chemistry Laboratory | | | | |
| Introduction to engineering geology, earth surface and physical properties of earth materials, geological processes, types and classification of rocks, physical and mineralogical properties of rocks, basics of structural geology, soil formation and properties, clay minerals, groundwater | | | | | | |

**Textbook(s):**
Mathewson, C.C., Engineering Geology, Bell & Howell Co., Columbus, OH 43216, USA, latest edition.
Dunn, I.S., Anderson, L.R. and Keifer, F.W., Fundamentals of Geotechnical Analysis, John Wiley and Sons, Inc., N.Y., USA, latest edition.
Das, B.M., Properties of Soils , Engineering Press, Inc. San Jose, CA, USA., latest edition

**Reference(s):**
- McLean,A.C. and Gribble,C.D. Geology for Civil Engineers.
- Waltham,T. Foundations of Eng. Geology

**Course Leaning Objectives: By completion of the course, the students should be able to:**

1. Explain geology, earth surface features and processes
2. Discuss rock formation and rock types.
3. Describe minerals and their physical properties

4. Recognize structural features of earth crust and engineering considerations
5. Determine weight-volume relationships
6. Classify rocks and soils. According to engineering systems

## Course Topics and their Duration:

| Sr. No. | Course Topics | Duration in Weeks |
|---|---|---|
| 1 | **INTRODUCTION:**<br>-Engineering geology and civil engineering; Earth surface;<br>-Physical properties of earth materials | <br>0.5<br>0.5 |
| 2 | **PHYSICAL GEOLOGY:**<br>-Surface processes; Work of Wind, River and Sea.<br>-Weathering of rocks; physical and chemical weathering.<br>-Landslides and Earthquakes | <br>0.5<br>1.0<br>0.5 |
| 3 | **PETROLOGY:**<br>-Rock formation processes;<br>-Types and properties of rocks; Igneous, sedimentary and metamorphic rocks<br>-Tutorial: Lab study of rock specimens;<br>-Types and properties of rocks; Igneous, sedimentary and metamorphic rocks | <br>0.5<br>0.5<br><br>0.5<br>0.5 |
| 4 | **MINERALOGY:**<br>-Physical properties of minerals;<br>-Tutorial: Lab study of mineral specimens; Hardness and streak | <br>0.5<br>0.5 |
| 5 | **ENGINEERING CLASSIFICATION OF ROCKS:**<br>-Rock substance classification<br>-Tutorial: Lab study of Schmidt hammer test;<br>-Rock mass classification;<br>-Tutorial: Lab. Study of rock cores for RQD. | <br>0.5<br>0.5<br>0.5<br>0.5 |
| 6 | **STRUCTURAL GEOLOGY:**<br>-Introduction to plate tectonics;<br>-Dip and strike. Folds; Faults; Joints;<br>Engineering considerations. | <br>1.0<br>0.5 |
| 7 | **SOIL FORMATION:**<br>-Weathering and soils;<br>-Important soil types.<br><br>**CLAY MINERALS:**<br>Types of clay minerals; | <br>0.5<br>0.5 |

| | | |
|---|---|---|
| | -Particle forces. | 0.5<br>0.5 |
| 8 | **WEIGHT-VOLUME RELATIONSHIPS:**<br>-Introduction to weight-volume relationships; -exercises | 0.5,0.5 |
| 9 | **SOIL CLASSIFICATION:**<br>Grain size distribution by mechanical and hydrometer methods; Atterberg limits;<br>soil classification systems; AASHTO, and Unified soil classification systems. | 0.5<br>0.5 |
| 10 | student presentations. | 2 .0 |

**Class Schedule:**
Lectures: Two 1 hour and twenty minutes sessions per week

**Course Contribution**

- Eng. Science: 100 %
- Eng. Design: 0 %

**Course Relationship to Program Outcomes:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 2 | | | | | | 1 | | | | | 2 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

## Prepared by:

Dr. Zaki A Baghdadi

Civil Eng. Dept., Room 219 Building H , E-mail: baghdadiz @ yahoo.com

**Last Updated:** December 2009

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCU |
| **Geotechnical Engineering** | **CE 333** | **هـ مد ٣٣٣** | **4** | **3** | **0** | **4** |
| **Pre-requisites** | | CE 332: Geology for Civil Engineers,<br>EE 251: Basic Electrical Engineering and<br>IE 202 : Introduction to Engineering Design II. | | | | |
| Weight-volume relationships. Physical properties of soil. Soil classification. Permeability and seepage. Shear strength. Compressibility, consolidation and settlement. Introduction to lateral earth pressure and slope stability. | | | | | | |

**Textbook:**
Das, B. M. Principles of Geo-technical Engineering (latest ed.)

**Reference:**
Dunn, et Al. Fundamentals of Geo-technical Analysis(latest ed.)

**Course Leaning Objectives: By completion of the course, the students should be able to:**

1- Identify engineering properties of soil.
2- Apply principles of fluid flow to permeability and seepage problems.
3- Solve for soil stresses: in situ and external loads.
4- Apply principles of shear strength and compressions and its applications in soils.
5- Apply geotechnical information for solving lateral earth pressure and slope stability problems
6- Conduct experiment, analyze and interpret data.

**Course Topics and their Duration:**

| SR. NO. | COURSE TOPICS | DURATION IN WEEKS |
|---|---|---|
| 1 | Review of weight-volume relations;<br>Engineering classification of soil;<br>Site investigation. | 1 |
| 2 | Soil water;<br>Soil permeability | 1 |
| 3 | Seepage | 1 |
| 4 | In-situ stresses;<br>Stresses in a soil mass;<br>Mohr circle of stress;<br>Stresses due to external loads | 2 |
| 5 | Compressibility of soils | 2.5 |
| 6 | Shear strength of soils | 2.5 |

| | | |
|---|---|---|
| 7 | Soil compaction | 1.5 |
| 8 | Lateral earth pressure | 1.5 |
| 9 | Slope stability | 1 |

**Class Schedule:**

Lectures: Two 1 hour and twenty minutes sessions per week.

There is laboratory work in this course; each lab session is of 3 hours duration. Lab Reports on lab. experiments are required

**Course Contribution:**
Eng. Science: 100 %
Eng. Design: 0 %

**Relationship to Program Outcomes:**

| NCAAA Domains of Learning | knowledge | | Cognitive Skills | | | | | | Interpersonal Skills and Responsibility | | | Communication, IT, and Numerical Skills | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABET and Additional Program Outcomes | 1 | 2 | a | b | c | e | h | j | i | d | f | g | k | a |
| Maximum Attainable Level of Learning* | | | 1 | 1 | | | | | | | | | 1 | 1 |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Contact:**
Dr Muhammed Z. Gutub
Civil Eng. Dept., Room 203 Building H , E-mail: mgutub@hotmail.com

**Last Updated:** December, 2009

| COURSE TITLE | ENGLISH CODE /NO | ARABIC CODE/NO. | CREDITS | | | |
|---|---|---|---|---|---|---|
| | | | Th. | Pr. | Tr. | TCU |
| Structural Analysis I | CE 340 | هـمد ٣٤٠ | 3 | 2 | 0 | 3 |
| Pre-requisites | | CE 202: Strength of Materials,<br>EE 201: Structured Computer programming, and<br>MATH 205: Series & Vector calculus. | | | | |

Basic principles. Analysis of statically determinate trusses, beams, frames, arches, suspension cables. Influence lines for statically determinate structures. Deflection of structures. Buckling of columns.

**Textbook**:

R. C. Hibbeler , " Structural Analysis" $6^{th}$ ed. PEARSON Prentice Hall, 2006

**Course Learning Objectives:**

By the completion of the course, the students should be able to:

1. Discuss statically determinacy of beams, frames, trusses in 2D space
2. Analyze statically determinate beams and frames by computing the supports reactions, internal resisting forces, and drawing normal force (N), shear force (V), and bending moment (BM) diagrams
3. Analyze statically determinate three hinged arches by computing external reactions and internal resting forces
4. Construct influence lines (IL) for different functions including reactions, shearing force, and bending moment in statically determinate beams .Also be able to maximize certain function by setting the critical location and pattern of the live load (LL) on the beam
5. Calculate deflections for determinate trusses using virtual work method, and for beams, and frames using virtual work method, double integration method, moment area method, and conjugate beam method
6. Calculate loads and stresses Buckling of columns using Euler's formula

**Course Topics and their Duration:**

| No of weeks | Chapter | Topics |
|---|---|---|
| 1 | 1 | 1- Basic principals, Review of main topics of Static & Strength of Materials |
| 1 | 2 | 2- Stability and Determinacy of Determinate Structures |
| 1 | 3 | 3- Statically Determinate Trusses, Determinacy & Stability , Method of Joints, Method of Sections, |

| No of weeks | Chapter | Topics |
|---|---|---|
| | | and Combined Method |
| 1 | 4 | 4- Statically Determinate Beams. Reactions, Internal Forces. Axial Force, Shear Force, and Bending Moment Diagrams using Method of sections (expressions), and Step-by-Step procedure (summation) |
| 1 | 4 | 5- Statically Determinate Frames. Stability & Determinacy, Reactions, Internal Forces. (N), (V), (BM) diagrams |
| 1 | 5 | 6- Types of Arches. Analysis of three Hinged Arches. Suspension Cables |
| 2 | 6 | 7- Influence Lines (IL) for Statically Determinate Beams |
| 4 | 8 | 8- Deflection of Trusses using the Virtual Work Method. Deflection of Beams and Frames using the Double Integration Method, the Moment Area Method, the Virtual Work Method, and the Conjugate Beam Method |
| 2 | Hand out | 9- Buckling of Columns. |
| **14** | **Total Number of weeks** | |

**Course Schedule:**
Two lecture sessions per week, 80-mintus each. + One session tutorial
**Course Contribution to professional Component:**

Eng. Science: 95 %
Eng. Design: 5 %

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| 2 | 2 | | | | 1 | | | 2 | | | 2 | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Talal A. Radain

**Phone**: 6952793 / 6402000 ext: 52793 or 684231

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| **TCU** | **Tr.** | **Pr.** | **Th.** | | | |
| **4** | **1** | **3** | **4** | **هـ مد ٣٤١** | **CE 341** | **Material of Construction** |
| CE 202: Strength of Materials and CHEM 281: Chemistry Lab | | | | | **Pre-requisites** | |
| Manufacturing, Properties and Tests of metals, aggregate, cementing materials, fresh and hardened PC concrete, asphalt concrete, masonry, wood and plastics. Design and production of PC concrete and asphalt mixtures. Computer applications in mix design. | | | | | | |

**Text Book:** Mamlouk, Michael S. and Zaniewski John P. M, "Materials for Civil and Construction Engineers", 2nd edition, Pearson and Printice Hall, USA, 2006.

**Course Leaning Objectives: By completion of the course, the students should be able to:**

1. Describe manufacturing process, types, and utilization of metals (steel and aluminum), aggregate, Portland cement, Asphalt, masonry, wood, and plastics.
2. Interpret materials of construction concepts such as behavior, by identifying physical, chemical, and mechanical properties of metals (steel and aluminum), aggregates, fresh and hardened concrete, Asphalt, masonry, wood, and plastics
3. Determine weight - volume relations, and grain size distribution of combined aggregate (Blending of aggregate),
4. List factors affecting durability of Portland cement concrete.
5. Design of Portland cement concrete and hot asphalt HMA mixtures.
6. Practice long life learning through locating sources of information and reporting the results and recognizing contemporary issues related to construction materials.

**Course Topics and their Duration:**

| Duration in weeks | Topic No. |
|---|---|
| 2 | 1. Materials Engineering Concepts |
| 1.5 | 2. Metals (steel and aluminum) |
| 2.5 | 3. Aggregates |
| 2.5 | 4. Cementing Materials |
| 2.5 | 5. Portland Cement Concrete |
| 1 | 6. Asphalt Cement Concrete |
| 1 | 7. Masonry & Tiles |
| 1 | 8. Wood |
| | **Total** |

**Class Schedule**:
Two lecturer sessions per week, 80-mintus each.
Laboratory/tutorial meets once a week , 3 hours

## Course Contribution to professional Component:

- Eng. Science: 85 %
- Eng. Design: 15 %

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| 2 | | | | 2 | 2 | | | | 2 | 2 | 2 | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

## Prepared by:

Dr. Waleed H. Khushefati.

Phone: 6402000/68223

## Last Updated:

Dec. 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 2 | 3 | ٣٤٢ هـ مد | CE 342 | Reinforced Concrete Design I |
| CE 340: Structural Analysis<br>CE 341: Material of Construction<br>IE 202: Introduction to Engineering Design II | | | | | Pre-requisites | |
| Introduction to properties of concrete and reinforcing steel. Behavior of reinforced concrete under flexure and shear. Introduction to ACI-Code. Types of loads ant their factors. Ultimate strength method of design. Analysis and design of singly and doubly reinforced sections. Analysis and design of T-section. Design of beams against shear forces. Design of one-way slab and stairways. Development length. Design of isolated, combined and wall footings | | | | | | |

### Textbooks:

Hasson, M. N. and Al-Manseer, A. “Structural Concrete- Theory and Design”, 4 th Edition, John Wiley $ Sons, Inc. 2008.

### Course Leaning Objectives: By completion of the course, the students should be able to:

1.Analyze and design rectangular sections
2.Analyze and design T and L-shape beams
3.Design beams for shear
4.Design one-way slab
5.Design isolated, combined and wall footings
6. Specify the Development Length of steel reinforcement

•

## Course Topics and their Duration:

| Duration in weeks | Topic No. |
|---|---|
| 1.5 | 1- Introduction and revision, materials and properties of concrete and reinforcing bars. |
| 1.5 | 2- Analysis and design of singly reinforced concrete beams, ACI safety code provisions. |
| 1.5 | 3- Analysis and Design of doubly reinforced concrete beams |
| 1.5 | 4- Analysis and design of T and L reinforced concrete beams. |
| 1.5 | 5- Ultimate strength analysis and design for shear and diagonal tension. |
| 1.5 | 6- Analysis and Design of continuous beam for flexure using ACI moment coefficients method. |
| 1.5 | 7- Analysis and design of Reinforced Concrete solid one-way slabs. . |
| 2 | 8- Footings: types, loads, bearing pressure, size, single, combined and wall footings |
| 1.5 | 9- Design for bond, anchorage and development length. |
| **14** | **Total** |

**Class Schedule**:
Two lecture sessions per week

**Course Contribution to professional Component:**

- Eng. Science: 88 %
- Eng. Design: 12 %

**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| 1 | 1 | 1 | | 1 | | | | 1 | 1 | 1 | 1 | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:**

Dr. Rashad Husein

Phone: 6402000/68108

**Last Updated:**

September 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 2 | 3 | هـمد ٣٥٢ | CE 352 | Hydraulics |
| MEP 290: Fluid Mechanics,<br>IE 202: Introduction to Engineering Design II<br>MATH 204: Differential Equations | | | | | **Pre-requisites** | |
| Pipe flow analysis and design. Steady flow in closed conduits and networks. Steady uniform flow in open channels. Non-uniform flows in open channels. Flow measurements. Hydraulic machinery (i.e. Pumps and hydraulic turbines), urban storm drainage, Hydraulic structures, Computer simulation and analysis. | | | | | | |

**Textbook(s):**
Ned H. C. Hwang and Robert J. Houghtalen, Fundamentals of Hydraulic Engineering Systems, 3rd edition, Prentice Hall, 1996

**References:**
Roberson, J.A., Cassidy J.J., Chaudhry, M.H., Hydraulic Engineering, 2nd edition, John Wiley & sons, inc.,1997

**Course Leaning Objectives: By completion of the course, the students should be able to:**

1. Design and analyze of flow in pipelines and water distribution systems and using computer models for simulation.
2. Study, Analyze and Design uniform and Non-uniform flow in different types of open channels.
3. Study the flow measurements methods in pipes and open channel.
4. Identify and select different types of pumps and learn about cavitation phenomenon.
5. Study, analyze and design storm water sewer systems.
6. Identify different types of dams and reservoirs

## Course Topics and their Duration:

| Duration in weeks | Topic No. |
|---|---|
| 4 | 1- Pipelines and Pipe Networks |
| 3 | 2- Open Channel Flow |
| 2 | 3- Hydraulic Machinery (Water Pumps and Turbines Turbines) |
| 2 | 4- Storm Water Network |
| 2 | 5- Hydraulic Structures |
| 1 | 6- Flow Measurements |
| **14** | **Total** |

## Class Schedule:

Two lecture sessions per week
Laboratory meets once a week, 3 hours

## Course Contribution to professional Component:

Eng. Science: 25 %
Eng. Design: 75 %

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| 1 | 1 | | | | | | | | 1 | 2 | 1 | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

## Prepared by:

Dr. Abdullah Al-Ghamdi.
Phone: 695-1761

**Last Updated:** Fall 1430-1431 H (Fall 2009)

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 0 | 3 | ٣٥٣ هـمد | CE 353 | Hydrology and Water Resources Engineering |
| CE 352: Hydraulics | | | | | Pre-requisites | |

Principles of hydrology and water resources engineering. Objectives of water resources development. Water demand. Hydrologic cycle. Measurement and analysis of precipitation, evaporation, infiltration and stream flows. Water balance. Reservoirs, Dams and Spillways. Conjunctive use of surface and groundwater. Planning for water resources development. Economical analysis of water resources projects.

**Textbooks:**

Linsley, Kohler and Paulhus, "Hydrology for Engineers", 1988

**References:**

1. Ojha, Berndtsson and Bhunya "Engineering Hydrology", 2008
2. Chow, Maidment and Mays, "Applied Hydrology", 1988.
3. Ram S. Gupta, "Hydrology and Hydraulic systems", 1989.
4. Niel S. Grigg, "Water Resources Planning", 1995.

**Course Leaning Objectives: By completion of the course, the students should be able to:**

1. Identify the Importance of water for human activities and the water resources engineering.
2. Understand and review the global water resources especially S. A.
3. Define the Global Hydrologic Cycle and calculate the Hydrologic items in SA.
4. Analyze the rainfall and runoff data.
5. Identify technical, economical and social factors affecting dam type, site selection, forces of gravity dams and factors cause dam failure
6. Identify and formulate the groundwater flow, aquifers and wells

**Course Topics and their Duration:**

| Duration in weeks | Topic No. |
|---|---|
| 2 | 1. Introduction to water resources |
| 2 | 2. Water Demand |
| 1 | 3. Engineering Hydrology |
| 2 | 4. Evaporation & Transpiration |
| 1 | 5. Precipitation |
| 2 | 6. Rainfall Runoff relationship |
| 2 | 7. Hydraulic structures (dams) |
| 2 | 8. Groundwater Hydrology structures (dams) |
| • **14** | **Total** |

**Class Schedule:**

Two lecture sessions per week

**Course Contribution to professional Component**:

Eng. Science: 75 %
Eng. Design: 25 %

**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 2 | 2 | | | | | | 1 | | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Prof. Omar S. Aburizaiza, Dr. Maged H. Hussein
Phone: 6952821

**Last Updated:** Fall 1430-1431 H

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 2 | 3 | هـمد ٣٧١ | CE 371 | Surveying |
| MENG 102: Engineering Graphics<br>MATH 202: Calculus II | | | | | Pre-requisites | |
| Introduction to the basic surveying theory and practice; Units of measurements and conversions; Error analysis; Distance measurements by taping; Leveling; Angle measurements; Traversing and traverse computations; Topographic surveying and mapping; Area and volume computations; Circular curves; Use of surveying software such as Wolfpack and Surfer. | | | | | | |

**Textbook:**
ELEMENTARY SURVEYING (Twelve Edition 2008) by Paul R. Wolf/ Russel C. Brinker

**Reference:**
1. SURVEYING (Seventh Edition), by Francis H. Moffitt/ Harry Bouchard
2. SURVEYING WITH CONSTRUCTION APPLICATIONS by Barry F. Kavanagh

**Course Leaning Objectives: By completion of the course, the students should be able to:**
1. **Explain** the surveying fundamentals, and errors.
2. **Apply** different techniques for surveying observations, such as distance, elevations, and angles.
3. **Analyze** and **calculate** the unknown surveying parameters, and map productions.
4. **Calculate** area and volume from ground data and maps.
5. **Design** of simple circular curve, and stakeout by deflection angles.

## Course Topics and their Duration:

| Duration in Weeks | Course Topics | Sr. No. |
|---|---|---|
| 0.5<br>0.6 | **Introduction to surveying.**<br>1.Definition of surveying, classification of surveying, specialized surveys.<br>2.Units of measurement, accuracy and precision, significant figures, rounding off numbers. | 1 |
| 0.3<br>0.3<br>0.5 | **Error analysis.**<br>3.Definition of error, sources of errors, types of error, elimination of errors.<br>4.Mean value, residuals, standard error, variance weighted measurements and their adjustments.<br>5.Error propagation. | 2 |
| 1.1<br>0.2 | **Distance measurements.**<br>6. Methods: pacing, stadia, taping, electronic distance measurements, and others equipment: surveying tapes, EDM instruments.<br>7. Error and corrections. | 3 |
| 1.4<br>1.3<br>0.7 | **Elevation measurements [leveling].**<br>8. Methods: differential leveling, trigonometric leveling, and profile leveling.<br>9. Equipment: automatic level, tilting level, and theodolite T16.<br>10. Errors and corrections. | 4 |
| 0.5<br>0.7 | **Angle measurements.**<br>11. Horizontal angles: azimuths, bearings, deflection angles, angles to the right, and others Vertical and zenith angles.<br>12. Techniques. | 5 |
| 0.3<br>0.7<br>0.7 | **Traversing and traverse computations.**<br>13. Open and closed traverses.<br>14. Traverse classifications according to measured angles.<br>15. Traverse computations, adjustments and methods used. | 6 |
| 0.3<br>0.3<br>0.8 | **Topographic surveys.**<br>16. Contour lines.<br>17. Maps and scales.<br>18. Drawing a topographic map. | 7 |
| 0.4<br>0.9 | **Area and volume computations.**<br>19. Methods of area and volume calculations. | 8 |

| | | |
|---|---|---|
| | 20. Area and volume computations from maps. | |
| 0.4<br>0.3<br>0.8 | **Circular curves.**<br>21.Definition of circular curve parameters.<br>22.Derivation of formulas.<br>23.Curve layout by deflection angles. | 9 |

**Lectures:**

Two 2 hour sessions per week. There is 10 laboratory work in this course

**Course Relationship to Program Outcomes**:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| 1 | 2 | | | 1 | | | | | | 2 | 1 | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Adel S. Elkomy

**Last Updated:** January, 2010 G

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO.</th><th rowspan="2">ENGLISH CODE /NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCU</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>هـمد ٣٨١</td><td>CE 381</td><td>Transportation Engineering</td></tr>
<tr><td colspan="5">CE 371 : Surveying<br>ARAB 201: Arabic Language (2)</td><td colspan="2">Pre-requisites</td></tr>
<tr><td colspan="7">Transportation as a system; human and vehicle characteristics; traffic flow characteristics; highway capacity analysis; highway control devices; public transportation; urban transportation planning; parking facilities; transportation safety; intelligent transportation system and computer applications; introduction to railway, waterway, airport and pipeline</td></tr>
</table>

**Textbook:**

- *Transportation Engineering- An Introduction*, C. Jotin Khisty and B. Kent Lall, 3rd Edition, Prentice Hall, 2003.

**Reference:**

- Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, 2nd Edition, PWS Publishing Company, 1997.
- Highway Capacity Manual, Special Report 209, Transportation Research Board, 2000.
- Manual of Uniform Traffic Control Devices, Ministry of Communications, Kingdom of Saudi Arabia

**Course Leaning Objectives: By:**

After successful completion of the course, the students should be able to:

1) Recognize the function and scope of Transportation Engineering
2) Identify Driver, User, vehicle and Roadway characteristics and Analyze the interaction among the parameters.
3) Analyze Speed-Volume-Density, Perform Highway Capacity Analysis and Describe Traffic Control System Components and Devices
4) Recognize problems and issues of Parking, Accident, Public Transport and ITS
5) Describe Transportation Planning Process and apply Traffic Forecasting Methods. Prepare Transportation Impact Analysis Report.
6) Describe basic components of Railway, Waterway, Airport and Pipeline.

**Topics Covered during Class**

| Duration in Weeks | Course Topics | |
|---|---|---|
| 1.0 | Introduction, Transportation system components, Transport modes, specialties in transportation engineering | 1 |
| 1.0 | Characteristics of drivers and vehicles | 2 |
| 2.0 | Traffic flow theory | 3 |

| | | |
|---|---|---|
| 1.0 | Highway Capacity Analysis | 4 |
| 1.0 | Intersection control and design | 5 |
| 0.75 | Parking Study | 6 |
| 0.75 | Public transportation | 7 |
| 2.5 | Transportation planning | 8 |
| 1.0 | Transportation safety | 9 |
| 0.5 | Intelligent transportation system | 10 |
| 1.0 | Computer application | 11 |
| 1.5 | Introduction to Railway, Waterway, Airport and Pipeline | 12 |

**Course Schedule**

- Three 1-hour sessions per week (S M W @ 10:00 A.M.)

**Course Contribution to professional Component:**

- Engineering Science: 100%
- Engineering Design: 0%

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 1 | 2 | 1 | | 1 | 1 | | 2 | | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared By:** Dr. Md. Jobair Bin Alam

**Last Updated:** October 2009

<table>
<tr><td colspan="4">CREDITS</td><td rowspan="2">ARABIC CODE/NO.</td><td rowspan="2">ENGLISH CODE /NO</td><td rowspan="2">COURSE TITLE</td></tr>
<tr><td>TCU</td><td>Tr.</td><td>Pr.</td><td>Th.</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>هـمد ٣٩٠</td><td>CE 390</td><td>Summer Training</td></tr>
<tr><td colspan="5">CE 321: Construction Management,<br>CE 332: Geology for Civil Engineers,<br>CE 340: Structural Analysis-I,<br>CE 341: Materials of Construction,<br>CE 352: Hydraulics</td><td colspan="2">Pre-requisites</td></tr>
<tr><td colspan="7">Field training conducted under the supervision of a faculty member. The student must submit a detailed technical report by the end of training period, explaining what he learned during this training.</td></tr>
</table>

**Textbook:** None

**Course Leaning Objectives:**
By the completion of the course, the students should be able to:

1. Formulate an objective that identifies the training purpose and describe the expected outcomes of the training activity.
2. Describe a professional organizational structure and Break-down a work environment into its units and work functions.
3. Complete important tasks on time and with high quality.
4. Apply principles of engineering practices related to CE specializations.
5. Communicate, clearly and concisely, training details and gained experience, both orally and in writing, using necessary supporting material.

## Course Topics and their Duration:

| Duration in weeks | Topic No. |
|---|---|
| 2 | 5. Acquaint the trainee with the company working environment, organizational structure, regulations, products, customers, engineering units, and quality system. |
| 1 | 6. Familiarize the trainee with one of the production or design units |
| 1 | 7. Allocate the trainee to a project team and allow him to study and collect necessary data about the project. |
| 6 | 8. Work as a team member to execute assigned tasks with the following objectives:<br>▪ Apply principles of engineering practices related to CE specialization.<br>▪ Enhance team work skills.<br>▪ Relate practical work to his theoretical engineering<br>▪ Use modern engineering tools such as equipment and computer software<br>▪ Use project management techniques.<br>▪ Complete assigned tasks on time with high quality.<br>▪ Develop personal communication skills. |

## Class Schedule:

- Oral Presentation after submitting a written training report; both evaluated by at least 2 faculty members

## Course Contribution to professional Component:

Eng. Science: 0%

Eng. Design: 0%
Others: 100%

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 2 | 2 | 2 | 2 | 2 | | | | | | | 3 | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

## Prepared by:


- Eng. Abdul-Aziz Al-Mohamady (Coordinator)

Phone: 6402000/68117.

**Last Updated:**
October 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 1 | 0 | 0 | 1 | هـ مد ٤٠١ | CE 401 | Civil Engineering Fundamentals |
| CE 321 - Construction Management,<br>CE 333- Geotechnical Engineering,<br>CE 342 - Reinforced Conc. Design- I,<br>CE 352 – Hydraulics,<br>CE 381 - Transportation Engineering | | | | | Pre-requisites | |
| The course is designed to review the basic fundamentals of civil engineering. The students will be exposed to the different fields of Civil Engineering. | | | | | | |

**Textbook:** Non

**References:** Text books, handouts and lecture notes of the above mentioned prerequisite courses.

**Course Leaning Objectives: By completion of the course, the students should be able to:**

1) Review the fundamentals of Civil Engineering.

**Course Topics and their Duration:**

| Duration in weeks | Topic No. |
|---|---|
| 1 | 1. Introduction |
| 3 | 2. Building Structural Fundamentals |
| 2 | 3. Principals of Construction Management |
| 2 | 4. Soil Properties and Basic Foundations Engineering |
| 2 | 5. Basics of Surveying and Transportation Engineering Fundamentals |
| 2 | 6. Fundamentals of Water Conveyance and Basics of Environmental Engineering |
| 2 | 7. Ethics and Professional matters |
| 14 | **Total** |

**Class Schedule:**

Class meets once a week for 2 hours (tutorial)

**Course Contribution to Professional Component:**

Eng. Science: 100%
Eng. Design: 0%

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 2 | | 2 | | 2 | | | | | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

## Prepared by:

Dr. Mahmoud A. Taha
Phone: 6402000 / 68906

## Last Updated:

December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 0 | 3 | هـ مد ٤٢٢ | CE 422 | Construction Engineering |
| ISLS 301: Islamic Studies (3),<br>CE 321: Construction Management, and<br>CE 342: Concrete Design I. | | | | | Pre-requisites | |
| Types, selection, utilization, and unit cost of construction equipment regarding soil compaction and stabilization, excavation and earthmoving operations. Formwork design. Detailed cost estimation for civil works. Project control. | | | | | | |

**Textbook:**

"Construction Planning, Equipment, and Methods. 7th edition. By R.L. Peurify and C. J. Schexnayder. McGraw Hill, 2006.

Construction Estimating Using Excel. Steven J. Peterson, Prentice Hall, 2007.

**Course Leaning Objectives: By completion of the course, the students should be able to:**

1) Describe the characteristics of certain construction equipment e.g. Dozers, Scrapers, Compactors, Excavating equipment, and Trucks.
2) Calculate the productivity and unit cost of using certain construction equipment e.g. Dozers, Scrapers, Compactors, Excavating equipment, and Trucks.
3) Design a wooden formwork system for a slab, wall and column.
4) Prepare detailed cost estimation for civil works.
5) Evaluate the performance of a project using Earned Value metrics.
6) Practice long life learning through identifying new course topics, locating sources of information, and reporting the results.

**Course Topics and their Duration:**

| Duration (Weeks) | Course Topics |
|---|---|
| 0.5 | 1. Construction Productivity |
| 1.5 | 2. Labor & EQP cost |
| 1.0 | 3. Compaction and Stabilization Equipment |
| 1.0 | 4. Machine Equipment Power Requirements |
| 3.5 | 5. Dozers, Excavators, Compactors, Graders & Hauling units. |
| 3.0 | 6. Q.S & detailed estimate of Civil Works |
| 1.0 | 7. Project Control |
| 2.0 | 8. Formwork Design |
| 0.5 | 9. Life Long Learning |

| Duration (Weeks) | Course Topics |
|---|---|
| 14 | **T O T A L** |

**Class Schedule:**

Two lectures per week 11:00-12:20 .S.T.

**Course Contribution to Professional Component:**

Eng. Science: 90%
Eng. Design: 10%

**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 1 | | | | 1 | | | 2 | | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Mahmoud A. Taha
Phone: 6402000 / 68906

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 0 | 3 | هـ مد ٤٢٣ | CE 423 | Construction Estimating & Scheduling |
| CE 422: Construction Engineering | | | | | Pre-requisites | |
| Drawings of a typical civil engineering project. quantity take-off. pricing. use of computer programs in estimating. identification of activities and their sequence. scheduling of activities using critical path method. resource leveling and allocation. time-cost trade-off. using PERT technique. Project scheduling using MS Project and Primavera software. | | | | | | |

**Textbooks:**

1. Construction Estimating Using Excel. Steven J. Peterson, Prentice Hall, 2007.
2. R.S. Means Cost Data.
3. Computer-Based Construction Project Management. Tarek Hegazy. Prentice Hall 2002.

**Course Learning Objectives:**

By the completion of the course, the students should be able to:

1. Prepare detailed cost estimate for civil works according to Master Format 2004.

2. Prepare construction schedules using precedence diagram with complex logic.
3. Construct a linear schedule for a project of a repetitive nature
4. Perform resource management: loading, leveling and time-cost trade off.
5. Perform PERT analysis.
6. Use computer-based scheduling software to develop and communicate a schedule for a construction project.

## Course Topics and their Duration:

| Duration in weeks | Topic No. |
|---|---|
| 1.0 | 1. Introduction to Estimating |
| 3.0 | 2. The quantity take off |
| 1.0 | 3. Putting costs to the estimate |
| 1.0 | 4. Finalizing the bid |
| 1.5 | 5. Precedence diagram with complex logic |
| 1.0 | 6. Scheduling Repetitive Projects |
| 1.5 | 7. Resource Allocation & Leveling |
| 1.0 | 8. Time-Cost Tradeoff |
| 1.0 | 9. Schedule Updating |
| 1.0 | 10. Probabilistic Networks |
| 14 | T O T A L |

## Class Schedule:

2 Lectures per week

## Course Contribution to professional Component:

Eng. Science: 100%
Eng. Design: 0%

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 2 | | 1 | | | | | 2 | | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Mahmoud A. T. Salem (Coordinator)

**Phone:** 6402000/68906

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 0 | 3 | هـمد ٤٢٤ | CE 424 | Construction Contracting |
| CE 321: Construction Management | | | | | Pre-requisites | |
| Participants in a construction contract. Contract definition. Types of contracts; formation principles of a contract, performance or breach of contractual obligations. Analysis and comparison of the different kinds of construction contracts. Bidding logistics. Legal organizational structures. types and uses of specifications. Sample of different forms of contracts utilized in construction. | | | | | | |

**Textbooks:**

"Construction Contracting," 6th Edition, Richard H. Clough and Glenn A. Sears

**Reference:**

- "Construction Contract Administration," Charles S. Phillips. 1999.

**Course Learning Objectives:**

By the completion of the course, the students should be able to:

1. Identify and deal with the respective roles of design professionals, owner/developers and prime contractors in the design and construction process.
2. Understand the different types of construction contracts and how the construction supervisors role may be affected by them.
3. Learn how to recognize, develop and manage a documentation system.
4. Understand the effects of changes as they are encountered and develop methods to react to potential conflicts resulting from changes.
5. Know how to handle schedule impacts, delays, accelerations, suspensions and disruption of time related work activities.

**Course Topics and their Duration:**

| Duration in weeks | Topic No. |
|---|---|
| 1.0 | 1. Contract Definition |
| 1.5 | 2. Company Organization |
| 1.0 | 3. Contractual Relationships |

| Duration in weeks | Topic No. |
|---|---|
| 1.5 | 4. Drawings and Specifications |
| 3.0 | 5. Managing General Conditions |
| 4.0 | 6. Implementing the Contract |
| 2.0 | 7. Site Management Documents |
| 14 | TOTAL |

**Class Schedule:**
Two lecturers per week 11:00-12:20 .S.T.
**Course Contribution to professional Component:**

Eng. Science: 100%
Eng. Design: 0%
**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 2 | | | 2 | | | | | | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Mahmoud A. T. Salem (Coordinator)

**Phone:** 6402000/68906

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 0 | 3 | هـمد ٤٣٤ | CE 434 | Foundation Engineering |
| CE 333: Geotechnical Engineering, | | | | | Pre-requisites | |
| Site exploration and selection. Types of foundations. Bearing capacity of shallow foundations. Foundation settlement. Deep foundations. Lateral earth pressure. Retaining walls. Computer applications. | | | | | | |

**Textbook :** Das, B.M., Principles of Foundation Engineering (latest ed.)

**Reference:** Bowles, J.E., Foundation Analysis and Design (latest ed.)
**Course Leaning Objectives:**
**By the completion of the course, the students should be able to:**
1. Know the different types of foundations and their advantages.
2. Describe the methodology and techniques of soil exploration.
3. Apply bearing capacity theories and allowable pressure equations to shallow foundations.

4. Apply different methods of calculating soil layers deformations to evaluate foundation settlements.
5. Know types and benefits of mat foundations and evaluate their bearing capacity.
6. Know types of deep foundations, classifications of piles and apply methods of evaluating the bearing capacity and settlement of piles.

**Topic Covered During Class:**

| Duration in Weeks | Course Topics | Sr. No. |
|---|---|---|
| 1 | Introduction to foundation engineering and its importance.<br>Classification of foundations exploration | 1 |
| 1 | Site exploration | 2 |
| 2 | Bearing capacity of shallow foundations | 3 |
| 1.5 | Allowable settlements<br>Review of elastic and consolidation settlements | 4 |
| 2.5 | Combined footings. Mat foundations; types and bearing capacity. | 5 |
| 1 | Allowable bearing pressure in sand based on settlement | 6 |
| 3.5 | Deep foundations; types and bearing capacity | 7 |
| 1.5 | Review of lateral earth pressure. Retaining walls. | 8 |

**Class Schedule:**

The class meets twice a week and each session is 1 hr 20 min. long.

**Course Contribution:**

Eng. Science: 75 %

Eng. Design: 25 %

**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| 2 | 2 | | | | | | 1 | 2 | 2 | | 2 | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:**

Dr. Abdulghany O. Sabbagh

**Contact:** Civil Engineering Department Room 248 E mail: agsabbagh@yahoo.com

**Last Updated:** Dec 2009

| CREDITS | | | | ARABIC | ENGLISH | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | CODE/NO. | CODE /NO | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **3** | **0** | **0** | **3** | **هـمد ٤٣٥** | **CE 435** | **Applications in Foundation Engineering** |
| CE 434: Foundation Engineering | | | | | **Pre-requisites** | |
| Introduction to foundation engineering; purpose and classification of foundations; site exploration and foundation selection; loads and calculations of allowable pressures and settlements; foundations in variety of conditions; foundations on fill and improved ground; combined footings; slope stability; computer applications. | | | | | | |

**Textbooks:**

Das, B. M. Principles of Foundation Engineering (latest ed.)

**Reference:**

Bowles, J, E,, Foundation Analysis and Design (latest ed)

**Course Learning Objectives:**

By the completion of the course, the students should be able to:

1- Calculate loads on foundations.
2- Calculate allowable pressures and settlements.
3- Solve for a variety of footing conditions.
4- Analyze foundations on different ground conditions.
5- Analyze slope stability.
6-Use computer programs for foundation and slope problems.

**Course Topics and their Duration:**

| Duration in Weeks | Course Topics | Sr. No. |
|---|---|---|
| 1 | Introduction to Foundation Engineering, purpose and classification of foundations. | 1 |
| 1 | Site exploration and foundation selection | 2 |
| 1 | Types of loads on foundations: gravity and lateral loads. | 3 |
| 1 | Calculations of allowable pressures and settlements. | 4 |
| 3 | Comparative selection of footing sizes: interaction within a group; relative settlement between footings; applications in selecting footing sizes; effect of close proximity; effect of unequal loads; effect of intermixed footing types; effect of adjacent excavations | 5 |
| 1 | Foundations on slopes and foundations on layered soils. | 6 |
| 1 | Foundations on fill and improved ground | 7 |
| 1 | Combined footings; lateral friction loads on footings; foundations on expansive soils; introduction to liquefaction. | 8 |
| 2 | Slope stability; analysis of stability of earth slopes. | 9 |
| 2 | Computer applications: shallow and deep foundations. Slope stability | 10 |

**Class Schedule:**

Two lectures per week 11:00-12:20 .S.T.

**Course Contribution to professional Component:**

Eng. Science: 75%

Eng. Design: 25%

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| 2 | 2 | 1 | | | | | | | | | 2 | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Prof. Zaki A. Baghdadi and Dr Ahmed M. Khan

**Civil Eng. Dept., Rooms 219 / 250 Building H ,**

**E-mail**: baghdadiz@yahoo.com / akhan@kau.edu.sa

**Phone:** 6402000/68906

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 0 | 3 | هـمد ٤٣٩ | CE 439 | **Soil Improvement** |
| CE 434: Foundation Engineering | | | | | **Pre-requisites** | |
| Principles of soil improvement. Types of improvement and factors influencing them. Mechanical and hydro improvements. Physical and chemical improvements. Computer applications. | | | | | | |

**Textbooks:**

Hausmann, Manfred R. "Engineering Principles of Ground Modification", McGraw-Hill Publishing Company, N.Y., USA, 1990

**Reference:**
Ingles and Metcalf," Soil Stabilization", Butterworths Pty. Ltd., Sydney, 1972.

**Course Learning Objectives:**
By the completion of the course, the students should be able to:

1- Define ground improvement techniques.
2- Explain shallow and deep compaction principles and techniques.
3- Describe modification by admixtures.
4- Discuss soil reinforcement techniques.
5- Discuss practical aspects of soil improvement techniques.
6- Present a selected topic on soil improvement.

## Course Topics and their Duration:

| Duration in Weeks | Course Topics | Sr. No. |
|---|---|---|
| 1 | **INTRODUCTION**<br>Purpose of the course; Options when encountering problematic soils; Ground improvement techniques; The traditional objectives and emerging trends. | 1 |
| 2 | **MECHANICAL MODIFICATION(COMPACTION)**<br>Compaction purposes; Laboratory compaction; Field shallow compaction.<br>Deep compaction techniques; pre-compression; Heavy tamping and dynamic consolidation; vibro-compaction; Compaction grouting | 2 |
| 1 | **PRINCIPLES OF SOIL DENSIFICATION**<br>Moisture content; Compaction effort; Soil type and preparation; Confinement. | 3 |
| 2 | **PROPERTIES OF COMPACTED COHESIVE SOILS**<br>The effect of compaction on strength; over-compaction; stress-strain behavior of compacted soils;<br>The effect of compaction on compression; swelling; shrinkage and permeability. | 4 |
| 1 | **PROPERTIES OF COMPACTED COHESION_LESS SOILS**<br>Compactibility; Shear strength; Liquefaction ; Collapse. | 5 |
| 1 | **GEOSYNTHETICS**<br>Types of geo-synthetics; Uses of geo-synthetics, Filtration; Separation; Reinforcement; Erosion control. | 6 |
| 3 | **PRELOADING AND VERTICAL DRAINS**<br>Purpose of pre-loading; Purpose of vertical drains; Methods of vertical draining; sand drains and geo-synthetic drains.<br>**Preloading** without vertical drains; Preloading with vertical drains.<br>**Radial** consolidation; Combined vertical and redial consolidation. | 7 |
| 3 | **MODIFICATION BY ADMIXTURES**<br>Uses of admixtures; Types of Admixtures; Cement stabilization;<br>**Soil**-cement-water reactions; Engineering benefits of cement stabilization.<br>**Lime** stabilization; Types of lime; Soil-lime reactions; Engineering benefits of lime stabilization. | 8 |
| 1 | **Student presentations**. | 9 |

## Class Schedule:

Lectures: Two 1 hour and twenty minutes sessions per week.

## Course Contribution to professional Component:

Eng. Science: 80%
Eng. Design: 20%

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| 3 | 2 | | | | | | | 3 | 2 | | 3 | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Ahmed M. Khan
Civil Eng. Dept., Room 250
Building H , E-mail akhan@kau.edu.sa

**Phone:** 6402000

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 0 | 3 | هـمد ٤٤٠ | CE 440 | Structural Analysis II |
| CE 202: Strength of Materials, EE 201: Structured Computer programming, and MATH 205: Series & Vector calculus. | | | | | Pre-requisites | |
| Analysis of statically indeterminate structures by method of consistent deformations. Method of slope-deflection and moment distribution. Influence lines for statically indeterminate structures. Approximate methods of analyze of multi-sections forms. Classical stiffness method of structural analysis. Direct stiffness method for trusses. | | | | | | |

**Textbook :** R. C. Hibbeler , " Structural Analysis" 6th ed. PEARSON Prentice Hall, 2006

## Course Learning Objectives:

By the completion of the course, the students should be able to:

1. Discuss statically determinacy of beams, frames, trusses in 2D space
2. Analyze statically determinate beams and frames by computing the supports reactions, internal resisting forces, and drawing normal force (N), shear force (V), and bending moment (BM) diagrams
3. Analyze statically determinate three hinged arches by computing external reactions and internal resting forces
4. Construct influence lines (IL) for different functions including reactions, shearing force, and bending moment in statically determinate beams .Also be able to maximize certain function by setting the critical location and pattern of the live load (LL) on the beam
5. Calculate deflections for determinate trusses using virtual work method, and for beams, and frames using virtual work method, double integration method,

moment area method, and conjugate beam method
6. Calculate loads and stresses Buckling of columns using Euler's formula

**Course Topics and their Duration:**

| No. of weeks | Chapter | Topics |
|---|---|---|
| 1 | 1 | 1. Basic principals, Review of main topics of Static & Strength of Materials |
| 1 | 2 | 2. Stability and Determinacy of Determinate Structures |
| 1 | 3 | 3. Statically Determinate Trusses, Determinacy & Stability , Method of Joints, Method of Sections, and Combined Method |
| 1 | 4 | 4. Statically Determinate Beams. Reactions, Internal Forces. Axial Force, Shear Force, and Bending Moment Diagrams using Method of sections (expressions), and Step-by-Step procedure (summation) |
| 1 | 4 | 5. Statically Determinate Frames. Stability & Determinacy, Reactions, Internal Forces. (N), (V), (BM) diagrams |
| 1 | 5 | 6. Types of Arches. Analysis of three Hinged Arches. Suspension Cables |
| 2 | 6 | 7. Influence Lines (IL) for Statically Determinate Beams |
| 4 | 8 | 8. Deflection of Trusses using the Virtual Work Method. Deflection of Beams and Frames using the Double Integration Method, the Moment Area Method, the Virtual Work Method, and the Conjugate Beam Method |
| 2 | Hand out | 9. Buckling of Columns. |
| **14** | **Total Number of weeks** | |

**Course Schedule:**
Two lecture sessions per week, 80-mintus each. + One session tutorial
**Course Contribution to professional Component:**

Eng. Science: 95 %
Eng. Design: 5 %

**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| 2 | 2 | | | | | | | 2 | | | 2 | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Talal A. Radain

**Phone:** 6952793 / 6402000 ext: 52793 or 684231

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| **TCU** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **0** | **0** | **3** | **هـمد ٤٤١** | **CE 441** | **Design of Steel Structures** |
| CE 340: Structural Analysis I | | | | | **Pre-requisites** | |
| Properties of steel. Types of loads. Philosophy of allowable stress design (ASD) method. Analysis and design of tension and compression members. Axially loaded columns. Base plate. Design of beams for flexure and shear. Beams with cover plates. Unsymmetrical bending. Deflection. Design of beams-column. Bolted and welded connections. | | | | | | |

**Textbooks:**

1. AISC Manual of Steel Construction
2. Structural Design by Jack C. Mc Cormac, 3rd Edition
3. Applied Structural Steel Design by Leonard Spiegel and George F. Limbrunner.

**Course Learning Objectives:**

By the completion of the course, the students should be able to:

1. Analyze tension and compression members, flexural members, beam-column s, bolted connections and welded connection.
2. Design of tension and compression members, flexural members, beam-column s, bolted connections and welded connection.

**Course Topics and their Duration:**

| Duration in weeks | Topic No. |
|---|---|
| 0.5 | 1. Introduction: |
| 2 | 2. Tension members: |
| 2.5 | 3. Compression members: |
| 3 | 4. Flexural members: |
| 2 | 5. Bending and axial stress: |
| 2 | 6. Bolted connections: |
| 2 | 7. Welded connections: |
| 14 | Total |

**Class Schedule:**

Lectures: Three lecturer sessions per week, 50-mintus each.

**Course Contribution to professional Component:**

Eng. Science: 50%
Eng. Design:  50%

**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 2 | | | | | | | 2 | 3 | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Prof. Samir A. Ashour
Room 259 – Building H,

**Phone:** 6402000/68496

**Last Updated:** December 2009

| **CREDITS** | | | | **ARABIC CODE/NO.** | **ENGLISH CODE /NO** | **COURSE TITLE** |
|---|---|---|---|---|---|---|
| **TCU** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **0** | **3** | **3** | **هـ مد ٤٤٢** | **CE 442** | **Reinforced Concrete Design II** |
| CE 342 - Reinforced Concrete Design I | | | | | **Pre-requisites** | |
| Review ACI 318- Code provisions. Design of Continuous Beams and Frames: Continuity of reinforced concrete structures, load combinations. Design of Two-way slabs: Edge supported vs. column supported slab systems(DDM). Design of rectangular and circular Reinforced Concrete Columns:, Axialy and eccentrically loaded columns, interaction diagrams. Slender columns and biaxial bending. | | | | | | |

**Textbooks:**

Hasson, M. N. & Al-Manaseer,A., "Structural Concrete- Theory and Design", 4th Edition, Wiley, 2008.

**References**:

1. " Building Code Requirements For Structural Concrete and Commentary"- ACI 318M-08.
2. Saudi Building Code (SBC).

**Course Learning Objectives:**

By the completion of the course, the students should be able to :

1. Recognize and define basic knowledge of material properties and reinforced concrete behavior.
2. Design of two-way solid slabs using the moment coefficient method (Method 2).
3. Design of two-way slabs using the Direct-Design Method.
4. Design of short columns.

5. Design of long (Slender) columns.
6. Apply Computer calculation.

## Course Topics and their Duration:

| Duration in weeks | Topic No. |
|---|---|
| 1.5 | 1. Review of knowledge gained in CE 342 |
| 1.0 | 2. RC slab: different types; behavior of one-way and two-way slabs; internal actions in two-way slabs; design requirements. |
| 1.0 | 3. Analysis and design of two-way edge supported slabs by method of coefficients (method 2). |
| 2 | 4. Analysis and design of two-way solid slab using the direct design method: ACI code requirements for thickness and moment distribution |
| 2 | 5. Analysis and design of two-way beamless slab by direct design method: ACI code requirements for thickness and shear design in flat plate and |
| 1.5 | 6. RC columns: types of columns; Short columns; behavior of axially loaded short tied and spiral columns under compression. |
| 2 | 7. Analysis and design of Short column under Uni-axial loading; interaction diagrams, investigation of rectangular sections for various failure conditions and ACI code provision design charts and tables; Whitney's |
| 1 | 8. Analysis and design of Short columns under Bi-axial loading. |
| 2 | 9. Analysis and design of slender columns; ACI code provisions; design charts. |
| **14** | **Total** |

## Course Schedule:

Three lecture sessions per week, 50-mintus each.

## Course Contribution to professional Component:

- Eng. Science: 50 %
- Eng. Design: 50 %

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 2 | | | | | | | 2 | 2 | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

## Prepared by:

Prof. Faisal F. Wafa.

**Phone:** 6951814

**Last Updated:** December 2009

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO.</th><th rowspan="2">ENGLISH CODE /NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCU</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>هـمد ٤٤٤</td><td>CE 444</td><td>Advanced Reinforced Concrete Design</td></tr>
<tr><td colspan="5">CE 342: Reinforced Concrete Design I</td><td colspan="2">Pre-requisites</td></tr>
<tr><td colspan="7">Introduction to Prestressed Concrete, ACI provisions. Types of Pre-stressing. Losses, Stresses, Deflection, Flexural and Shear Strengths of P.S.C. Retaining Walls, Types and Forces on R.W., Design of R.W.. Design and Construction of R.C. Water Tanks. Water-Proofing, Loads Detailing of Reinforcements, Joints. Design of Circular and Rectangular Tanks.</td></tr>
</table>

**Textbooks:**

TBA

**Course Learning Objectives:**

1. Analysis and Design of Pre-stressed Concrete Members
2. Analysis and Design of Retaining Walls
3. Design of Circular Tanks
4. Design of Rectangular Tanks

**Course Topics and their Duration:**

| Duration in weeks | Topic No. |
|---|---|
| 3 | 1. Analysis and Design of Pre-stressed Concrete Members<br>• |
| 4 | 2. Analysis and Design of Retaining Walls<br>• |
| 3 | 3. Design of Circular Tanks |
| 4 | 4. Design of Rectangular Tanks |
| 14 | Total |

## Class Schedule:
Lectures: TBA

## Course Contribution to professional Component:

Eng. Science: 50%
Eng. Design: 50%

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 2 | | | | | | | 2 | 3 | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Prof. Faisal F. Wafa

**Phone:** 6951814

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 0 | 3 | هـمد ٤٥١ | CE 451 | Design of Hydraulic Structures |
| CE 352: Hydraulics | | | | | Pre-requisites | |
| Types. Advantages and functions of hydraulic structures. Flow through orifices. Culverts. Under gates. Over weirs and spillways. Energy dissipation below hydraulic structures. Hydraulic design of culverts. Weirs. Spillways. Aqueducts. Syphons. Regulators and dams. Computer applications. | | | | | | |

**Textbooks:**

1. Novak, Moffat, Nalluki, and Nararyanan Hydraulic Structures, 2007, ,Taylor and Francis. (available at Alsheqri Book Store at Students' Affairs Building).
2. Golze, A. R. , Hand book of Dam Engineering, Van Nostrand Reinhold Company.
3. Design of Small Canal Structures, United States Bureau of Reclamation.
4. Hand outs

**Course Learning Objectives:**

1. Analyze and design different dams and select the proper dam for any practical problem he may encounter in his professional life.
2. Analyze and design different spillways.
3. Design and supervise the construction of conveyance structures.
4. Design various protection structures.
5. Design of various energy dissipation structures.

**Course Topics and their Duration:**

| Duration in weeks | Topic |
|---|---|
| 1 | 1- Elements of Dam Engineering |
| 2 | 2- Embankment dam engineering |
| 2 | 3- Concrete Dam Engineering |
| 2 | 4- Spillways and Outlet Works |
| 2 | 5- Energy Dissipations |
| 1 | 6- Dam Safety |
| 2 | 7- Diversion works |

**Class Schedule:**
Lectures: Two lecturer sessions per week

**Course Contribution to professional Component:**

Eng. Science: 20%
Eng. Design: 80%

**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| 1 | 1 | | | | | | | | 2 | | 1 | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Abdullah Alghamdi

**Phone:** 6402000/68237

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| **TCU** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **0** | **0** | **3** | هـ مد ٤٥٧ | **CE 457** | **Water Resources Planning and Management** |
| CE 353: Hydrology and Water Resources Engineering | | | | | **Pre-requisites** | |
| Introduction to planning and management principles; evaluation of alternatives by the principles of engineering economy; levels of planning; planning approach and planning environment; project formulation; project evaluation; Environmental considerations in planning; System analysis in water planning; multipurpose and multi objective projects. | | | | | | |

**Textbooks:**


1- Neil, S. Grigg., Water Resources Planning, McGraw Hill, USA, 1995 .
2- Alvin, S. Goodman, Principles of Water Resources Planning, Prentice-Hall, Inc., USA, 1984.
3- Neil, S. Grigg., Water Resources Management , McGraw Hill, USA,1999.


**Course Learning Objectives:**

1- To introduce senior students in civil engineering to the principles of Water Resources planning and management of basic projects
2- To develop students ability to apply these principles to Water projects.

**Course Topics and their Duration:**

| Duration in weeks | Topic No. |
|---|---|
| 3 | 1- Planning, Management and Public Projects |
| 3 | 2- Elements of Project Formulations and |
| 2 | 3- Organization for Water Projects |
| 2 | 4- Economics and Multi objective Evaluation |
| 3 | 5- Information, Computers , Mathematical System |
| 1 | 6- Analysis of Risk and Uncertainty and other Studies Involving Probabilities |
| 14 | Total |

**Class Schedule:**

Lectures: Two lecturer sessions per week

**Course Contribution to professional Component:**

Eng. Science: 100%
Eng. Design: 0%

**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 3 | 3 | | | | | | 2 | | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Prof. Abdullah M. Mohorjy

**Phone:** 6951411

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 4 | 0 | 3 | 4 | هـمد ٤٦١ | CE 461 | Environmental Engineering |
| CE 352 – Hydraulics | | | | | Pre-requisites | |
| In this course, the physical, chemical, mathematical and biological principles for defining, quantifying, and measuring environmental quality are described. Next, the processes by which nature assimilates waste material are described and the natural purification processes that form the bases if engineering systems are detailed. Finally, the engineering principles and practices involved in the design and operation of conventional environmental engineering works are covered at length. | | | | | | |

**Textbook(s):**
Peavy, Rowe and TCUobanoglous. Environmental engineering, McGraw-Hill, 1985.

**Reference(s):**

1. Warren Viessman, Jr., and Mark. J. Hammer. Water Supply and Pollution Control, 6th edition, Harper Collins, 1998
2. Metcalf& Eddy, Wastewater Engineering: Treatment and Reuse, 4th edition, McGraw-Hill, 2003.
3. Mackenzie L. Davis and Davis A. Cornwell. Introduction to Environmental Engineering, 3rd edition, McGraw-Hill, 1998.

**Course Learning Objectives:**
By the completion of the course, the students should be able to:

1. Define environmental quality
2. Quantify environmental quality
3. Measure environmental quality
4. Understand the principles involved in environmental engineering.
5. Apply engineering principles and practice in the design and operation of environmental engineering works.

**Course Topics and their Duration:**

| Duration in weeks | Topic No. |
|---|---|
| 1 | 1. Environment and Human Interaction |
| 3 | 2. Water Quality: Definitions, Characteristics, and Perspective |
| 3 | 3. Engineered systems for Wastewater Treatment and Disposal |
| 2 | 4. Air Quality: Definitions, Characteristics, and Perspective |
| 2 | 5. Engineered Systems for Air Pollution Control |
| 1 | 6. Solid Waste: Definitions, Characteristics, and Perspective |
| 2 | 7. Engineered Systems for Solid Waste Management |

| Duration in weeks | Topic No. |
|---|---|
| 14 | **Total** |

**Class Schedule:**

Three lectures per week

Laboratory meets once a week , 3 hours

**Course Contribution to Professional Component :**

- Eng. Science: 75 %
- Eng. Design: 25 %

**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 2 | 2 | | | | 1 | | 2 | 2 | 2 | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:**

Dr. Saleh F. Magram

**Last Updated:** Fall 1430-1431 H

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 0 | 3 | هـ مد ٤٦٥ | CE 465 | **Wastewater Reclamation and Reuse** |
| CE 461: Environmental Engineering | | | | | **Pre-requisites** | |

Potential reuse applications. Sources of water for reuse. Treatment technologies suitable for water reuse applications. Criteria for each type of reuse application. The overall procedures for determining the feasibility and planning of water reuse systems as well as the management structure of reuse projects. The management of the biosolids resulting from the treatment of wastewater and related regulations governing their use and disposal. Each student has to prepare and work on a mini-research/project throughout the course and present/submit it at the end of the course.

**Textbooks:**

Handbook of wastewater reclamation and reuse, Donald R. Rowe, Isam Mohammed Abdel-Magid, CRC Press, 1995

Metcalf& Eddy, Wastewater Engineering: Treatment and Reuse, 4th edition, McGraw-Hill, 2003.

**Course Learning Objectives:**

By the completion of the course, the students should be able to:

1. Understand the basic concepts and issues involved in wastewater reclamation, recycling and reuse .
2. Understand major issues involved in developing water and biosolids reclamation criteria .
3. Select appropriate treatment technologies for reclaiming and reusing wastewater .
4. Assess the suitability of reclaimed water for any reuse application .
5. Apply knowledge of water and wastewater engineering for designing water reclamation processes .
6. Understand the procedures for planning and managing water reclamation projects .

**Course Topics and their Duration:**

| **Duration in weeks** | **Topic No.** |
|---|---|
| (5 hr) | 1. Introduction |
| (4 hr) | 2. Water Reclamation and Reuse Criteria: and assessment |
| (3 hr) | 3. Agricultural and Landscape Irrigation |
| (2 hr) | 4. Industrial Water Reuse |
| (2 hr) | 5. Groundwater Recharge with Reclaimed Water |
| (2 hr) | 6. Recreational/Environmental Enhancement. |
| (2 hr) | 7. Water Reclamation Inside Buildings |
| (10 hr) | 8. Treatment Requirements for Water Reuse |
| (8 hr) | 9. Reuse and Disposal of Wastewater Bio-solids |
| (8 hr) | 10. Planning and Managing Water Reuse Projects |
| 48 hr | Total |

**Class Schedule:**
Lectures: Two Lectures per week

**Course Contribution to professional Component:**

Eng. Science: 50%
Eng. Design: 50%

**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 3 | 3 | | | | | | 3 | 2 | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Saleh F. Magram

**Phone:** 6402000/68237

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| **TCU** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **0** | **2** | **3** | هـمد ٤٧١ | **CE 471** | **GPS and GIS Applications** |
| CE 371: Surveying | | | | | **Pre-requisites** | |
| Introduction to the basic for GPS and GIS applications; Geodesy: introduction, the ellipsoid and geoids, geodetic position , geoids undulation ,deflection of the vertical, geodetic coordinate system ; Map Projection : projections used in state plane coordinate systems, UTM projection; GPS : overview of GPS, differential GPS, GPS static survey, GPS kinematic survey; GIS: introduction to GIS, GIS data sources and data format, creating GIS databases, GIS applications, use of surveying software such as GeoMedia and Leica Geo Office. | | | | | | |

**Textbooks:**

ELEMENTARY SURVEYING (Twelfth Edition 2008) by Charles D. Ghilani and Paul R. Wolf.

**Reference:**

Land Navigation Handbook: The Sierra Club Guide to Map, Compass and GPS by W.S. Kals, (Second Edition 2005).

**Course Learning Objectives:**

By the completion of the course, the students should be able to:

1. Explain geodetic principals, and coordinate Systems.
2. Explain map projection and UTM projection.
3. Describe GPS system, software, and applications.
4. Describe GIS system, software, and GIS applications.
5. Integration between GPS and GIS systems.

**Course Topics and their Duration:**

| Duration in Weeks | Course Topics | Sr. No. |
|---|---|---|
| | **Introduction to Geodesy.** | 1 |
| 0.4 | 1. The Ellipsoid and Geoids. | |
| 0.4 | 2. Geodetic Position and Ellipsoidal Radii of Curvature. | |
| 0.3 | 3. Geoids Undulation and Deflection of the Vertical. | |
| 0.4 | 4. Geodetic Position Computations. | |
| 0.5 | 5. Geodetic Coordinate System. | |
| 0.5 | 6. Three-Dimensional Coordinate Computations. | |
| | **Map Projection.** | 2 |
| 0.5 | 7. Projections used in State Plane Coordinate Systems. | |

| | | |
|---|---|---|
| 0.75<br><br>0.75<br><br>0.5 | 8. Lambert Conformal Conic Projection, Direct Problem, and Inverse problem.<br>9. Transverse Mercator Projection, Direct Problem, and Inverse problem.<br>10. Data Reduction to State Plane Coordinate Grids. | |
| <br>0.4<br>0.4<br><br>0.3<br>0.4<br>1.5<br><br>0.5<br>1.5 | **Introduction to GPS.**<br>11. Overview of GPS, and GPS Signal.<br>12. Reference Coordinate Systems for GPS.<br>13. Errors in GPS Observations.<br>14. Differential GPS.<br>15. Field Procedures in GPS Static Surveys, and Sources of Errors in GPS Work.<br>16. GPS Kinematic Surveys, and Errors.<br>17. Data Processing and Analysis. | 3 |
| <br>0.5<br>0.5<br>1.0<br><br>1.0<br><br>2.0 | **Introduction to GIS.**<br>18. GIS Data Sources and Classifications.<br>19. Spatial Data, and Data Format Conversions.<br>20. Creating GIS Databases.<br>21. GIS Analytical Functions and Applications. | 4 |

**Class Schedule:**
Lectures: Two 2 hour sessions per week.
There is 10 laboratory work in this course

**Course Contribution to professional Component:**

Eng. Science: 100%
Eng. Design: 0%

**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| 1 | 2 | | | 1 | | | | | | 2 | 1 | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Adel S. El-komy

**Phone:** 6402000

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 4 | 0 | 3 | 3 | هـمد ٤٨٢ | CE 482 | Highway Design & Construction |

| CE 341: Materials of Construction and<br>CE 381: Transportation Engineering | **Pre-requisites** |
|---|---|
| Characteristics of driver, pedestrian vehicle, and traffic flow affecting highway design; geometric design of highways; layouts of intersections, interchanges and terminals; highway drainage; review of highway paving materials; design of asphalt paving mixtures; pavement design; highway construction and supervision; categorize common pavement surface distress and associated correction activates; introduction to maintenance management system; computer applications on highway geometric design. | |

**Textbook(s):**

Highway Engineering. Paul H. Wright and Karen K. Dixon, 7th Edition, John Wiley & Sons, Inc.

**Reference(s):**

Highway Engineering Handbook. Building and Rehabilitating the Infrastructure. Roger L. Brockenbrough and Kenneth J. Beodecker. McGraw-Hill.

**Course Learning Objectives:**

After successful completion of the course, the students should be able to:

1. Explain the elements of geometric design of highways and use appropriate methods to calculate value of each element.
2. Identify various types of at-grade and grade-separated intersections configurations.
3. Identify method used for pavement drainage and technique used to control erosion in highway drainage.
4. Design a paving mixture according to the local design practice using local materials.
5. Design flexible pavements using the AASHTO design method.
6. Define different types of pavement distresses and maintenance activities, and identify the common causes of pavement distress.

**Course Topics and Their Duration:**

| Duration in Weeks | Course Topics | |
|---|---|---|
| 0.5 | Driver, Pedestrian, and Vehicle Characteristics | 1 |
| 0.5 | Traffic Flow Characteristics | 2 |
| 4.0 | Geometric Design of Highways | 3 |
| 2.0 | Intersections, Interchanges, and Parking Facilities | 4 |
| 1.0 | Highway Drainage | 5 |
| 2.0 | Design of High Quality Paving Materials | 6 |
| 1.5 | Design of Flexible Pavements | 7 |
| 1.0 | Highway Construction | 8 |
| 1.5 | Highway Maintenance and Rehabilitation | 9 |

**Course**

**Schedule:**

- Two 80-minute sessions per week (S T @ 9:300 A.M.)

**Course Contribution to professional Component:**

- Engineering Science: 60%
- Engineering Design: 40%

**Course Relationship to Program Outcomes:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 1 | 1 | 1 | 2 | | | | 1 | 3 | 2 | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared By:** Dr. Shaher Zahran

**Last Updated:** January 2010

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 0 | 3 | هـ مد ٤٨٣ | CE 483 | Traffic Engineering |
| CE 381: Transportation Engineering | | | | | Pre-requisites | |
| Traffic Engineering studies and measurement; traffic flow theory and queuing theory; highway capacity analysis; parking analysis and layout design; traffic signs, marking and channelization; signalized intersection design and operation; roundabout design and management; ITS applications in traffic engineering; computer application in traffic engineering. | | | | | | |

**Textbooks:**

- Traffic Engineering, 3rd Edition, Roger P. Roess, Elena S. Prassas, and William R. McShane, Prentice Hall, 2004.

**References:**

- Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, 2nd Edition, PWS Publishing Company, 1997.
- Highway Capacity Manual, Special Report 209, Transportation Research Board, 2000.
- Manual of Uniform Traffic Control Devices, Federal Highway Administration, Washington, D.C., 2002.

**Course Learning Objectives:**

After successful completion of the course, the students should be able to:

1. Explain traffic system components and functions. Describe the characteristics of traffic stream parameters and analyze their functional implications on traffic operation.
2. Identify different traffic flow parameters and queue characteristics, Explain macroscopic and microscopic relationships among the parameters.
3. Analyze highway capacity for urban and rural roads, Apply the capacity and level of service concepts highway performance analysis, planning and design.
4. Perform speed, volume and delay studies, parking study and Analyze traffic data. Prepare Traffic Study Reports.
5. Describe functional parameters of signalized intersection and, Design signal phases and roundabout.
6. Define application of Intelligent Transport System (ITS) and Demonstrate expertise on usage of computer models in Traffic operation and management.

## Course Topics and their Duration:

| Duration in Weeks | Course Topics | |
|---|---|---|
| 1.0 | Introduction, scope and responsibilities of Traffic Engineering | 1 |
| 1.0 | Characteristics of traffic stream parameters | 2 |
| 2.0 | Analysis of Traffic flow parameters, application of traffic flow theory and queuing theory | 3 |
| 2.0 | Highway Capacity Analysis and application in planning and design | 4 |
| 1.5 | Traffic Study: Speed-Flow-Density data collection and analysis | 5 |
| 1.0 | Parking Study- Demand assessment and facility design | 6 |
| 1.5 | Signalized intersection design and performance analysis | 7 |
| 1.0 | Roundabout design and traffic operation management | 8 |
| 1.0 | ITS Application in Traffic Engineering | 9 |
| 2.0 | Application of computer models – HCS, SIDRA, SYNCHRO, AIMSUN | 10 |

## Class Schedule:

Lectures: Two 80 minute sessions per week

## Course Contribution to professional Component:

Eng. Science: 80%
Eng. Design: 20%

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 1 | 2 | 1 | | 1 | 1 | | 2 | 2 | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Md. Jobair Bin Alam

**Phone:** 6402000

**Last Updated:** December 2009

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCU | Tr. | Pr. | Th. | | | |
| 3 | 0 | 0 | 3 | هـمد ٤٨٦ | CE 486 | **Flexible Pavement Maintenance** |
| CE 341: Materials of Construction and<br>CE 381: Transportation Engineering | | | | | **Pre-requisites** | |
| Essential terminologies and concepts of preservating existing highway asphalt pavements; characterizing flexible pavement distresses and identifying possible cause of distresses; relating pavement distress types and distress severity to cost-effective repair alternatives; simple procedure to inventory pavement conditions and select maintenance methods | | | | | | |

**Textbooks:**

Instructor Lecture presentations and Handouts

**Course Learning Objectives:**

After successful completion of the course, the students should be able to:

1) Define the common. terminologies used in pavement maintenance and rehabilitation
2) Identify various types of maintenance activates and explain the major differences between corrective maintenance activities and rehabilitation concepts
3) Accrue practical information on the subject of surface treatments overview including of crack sealing materials and application methods; and pothole patching decisions
4) Accrue essential information on milling, recycling; and constructing non-structural overlays
5) Accrue practical knowledge on surface treatments for low-volume roads and parking facilities
6) Implement simple procedure to inventory pavement conditions and select maintenance methods

## Course Topics and their Duration:

| Duration in Weeks | Course Topics | |
|---|---|---|
| 1 | INTRODUCTION<br>Definition of Flexible Pavement Maintenance and the concept of serviceability<br>Definition of Preventive Maintenance VS Rehabilitation | 1 |
| 1 | Identification of pavement distresses and Severity | 2 |
| 1 | Characterization of Flexible Pavement Distresses | 3 |
| 1 | Identification of Possible Causes of Flexible Pavement Distresses | 4 |
| 1 | Categorization of Maintenance Activates | 5 |
| 4 | Recommended Treatment Practices For<br>Pothole Patching and Repair<br>Crack Treatments<br>Treatments for Surface Defects | 6 |
| 1 | Milling and surface leveling treatments | 7 |
| 2 | Design of Non-structural overlays and ULTRA-THIN Asphalt Overlay | 8 |
| 2 | Design of overlays to restore the pavement structural capacity (stability) | 9 |

## Class Schedule:

Lectures: Two 80-minute sessions per week

## Course Contribution to professional Component:

Eng. Science: 50%
Eng. Design: 50%

## Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| | 3 | | | | 2 | | 1 | 2 | 3 | | | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Shaher Zahran

**Phone:** 6402000

**Last Updated:** January 2010

<table>
<tr><td colspan="4">CREDITS</td><td rowspan="2">ARABIC CODE/NO.</td><td rowspan="2">ENGLISH CODE /NO</td><td rowspan="2">COURSE TITLE</td></tr>
<tr><td>TCU</td><td>Tr.</td><td>Pr.</td><td>Th.</td></tr>
<tr><td>4</td><td>0</td><td>٤</td><td>٢</td><td>هـ مد ٤٩٩</td><td>CE 499</td><td>Senior Project</td></tr>
<tr><td colspan="5">CE 321: Construction Management,<br>CE 333: Geotechnical Engineering,<br>CE 342: Reinforced Conc. Design- I,<br>CE 352: Hydraulics,<br>CE 382:Transportation Engineering</td><td colspan="2">Pre-requisites</td></tr>
<tr><td colspan="7">Team-work on a civil engineering capstone design project involving comprehensive design experience; exposure to professional practice with practitioner involvement. Preparation of the project report and its presentation.</td></tr>
</table>

**Textbooks:** TBA

**Course Learning Objectives:**

By the completion of the course, the students should be able to:

1. Understand and practice the basic concepts and elements of engineering design for a multidisciplinary civil engineering project.
2. Practice group learning and teamwork by working on a multidisciplinary project.
3. Improve oral and written communication skills.
4. Do integrated project planning, scheduling, and cost analysis for a moderately-sized, civil engineering project.

### Course Topics and their Duration:

| Duration in weeks | Topic No. |
|---|---|
| 1 | 1. Project selection and team |
| 2 | 2. Problem Definition |
| 3 | 3. Literature review and data |
| 3 | 4. Problem formulation: |
| | - Knowledge integration |
| --- | - Operational and realistic constraints |
| | - Design objectives |
| | - Evaluation criteria |
| 2 | 5. Design options and initial layout |
| 1 | 6. Work plan and budgeting |
| 1 | 7. Progress report and oral |
| 7 | 8. Implementation phase |
| 3 | 9. Design refinement |
| 3 | 10. Final report and oral presentation |

### Class Schedule:

2 general audience oral presentations of 30 minutes each

### Course Contribution to professional Component:

Eng. Science: 0%
Eng. Design: 100%

### Course Relationship to Program Outcomes:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | j | h | e | c | b | a | 2 | 1 | ABET and Additional Program Outcomes |
| 2 | 2 | | 2 | 2 | 2 | | | 2 | 3 | 3 | 2 | | | Maximum Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

**Prepared by:** Dr. Mahmoud A. T. Salem (Coordinator)

**Phone:** 6402000/68906

**Last Updated:** January 2010

# DEPARTMENT OF
# ELECTRICAL AND COMPUTER ENGINEERING

## INTRODUCTION

The Department of Electrical Engineering at King Abdulaziz University was established in 1394 H (1975 G). In 1407H, the name of the Department of Electrical Engineering was changed into the Department of Electrical and Computer Engineering. The Department consists of four branches: Electric Power and Machines Engineering, Electronics and Communications Engineering, Computer Engineering, and Biomedical Engineering.

The Department is primarily concerned with the provision of high caliber engineers in the four fields of Electrical and Computer Engineering to work for governmental and industrial agencies in the Kingdom and the Gulf area.

## VISION AND MISSION STATEMENTS

**Vision of the Department of Electrical and Computer Engineering** (ECE) is to be innovative pioneers in effective engineering education, collaborative research, and community service in various fields of electrical engineering.

**Mission of the Department of Electrical and Computer Engineering** (ECE) is to provide high quality education to students that enable them to enhance services to the community through their professional, technical, managerial, communication, team-work, and research competencies in accordance with Islamic teachings.

**Mission of the Electric Power and Machines Engineering (PME)** Program is to provide the students an education to serve the society and to instill in them the attitudes, values, and vision required for life-long learning and leadership in electric power and machines engineering career.

**Mission of the Electronics and Communications Engineering (E&CE) Program** is to provide a high quality engineering education in electronics and communications and equip graduates with the proper technical, research, learning, communication, and managerial skills to contribute to the development of the society.

**Mission of the Computer Engineering (CoE) Program** is to prepare and produce highly qualified computer engineers who can participate effectively in the service and sustainable development of the society through their professional, technical, managerial, team-work, life-long learning and research competencies.

**Mission of the Biomedical Engineering (BME) Program** is to provide a high quality engineering education with lifelong learning skills so that graduates shall enhance the health-care services and participate in sustainable development of the society through their professional, technical, managerial, communication, team-work, and research competencies.

## EDUCATIONAL OBJECTIVES

Educational objectives of all four programs of Department of Electrical and Computer Engineering are phrased to address the career and professional developments envisaged as:

- Graduates will successfully engage in careers in the areas of specializations to serve the needs of industry and academia in both the private and public sectors in Saudi Arabia and Gulf Countries.
- Graduates will engage in active, continuous and lifelong professional development, seek learning and training opportunities including graduate studies, adapt to the rapid changes in work environment, and to attain leadership positions in their business, profession and community.

## ADMISSION AND GRADUATION REQUIREMENTS

### Students Admissions into the Department of Electrical and Computer Engineering

Distribution of students to majors is carried out by the Academic Affairs and Training Unit of Faculty of Engineering at the beginning of the Fall and Spring terms. The distribution is based on the Grade Point Average (GPA) of students, students' demands for particular major, and quotas of academic departments. On average, 20 students are admitted to each academic program in the Department except the BME program that accepts 11 students every term.

### Graduation Requirements

For graduation in any program of Department of ECE, a student must

- complete 155 credit-units with a minimum GPA of 2.75 out of 5.
- take all compulsory courses or their equivalents (53 for PME program and 50 for others)
- 3 courses totaling 9 credit-units for regular and 1 course with 3 credit-units for coop program as technical electives for all programs except the PME program for which the elective requirement is 2 courses (6 credit-units) and no elective course for regular and coop programs respectively
- a 10-week summer training with 2 credit-units for the regular program and a 26 weeks training with 8 credit-units for the coop program.

## CAREER OPPORTUNITIES

The Department of Electrical and Computer Engineering aims at producing high-caliber engineers in various fields of electrical and computer engineering, and qualifying them for work in governmental, military, and industrial institutions in Saudi Arabia and in the rest of Arabian Gulf area. The programs offered by the Department are so strong and efficient as to be considered similar and comparable to programs accredited by the US-based Accreditation Board for Engineering and Technology (ABET). In fact, ABET has certified in October 2003 that each of the four programs offered by the Department at the B.Sc. level is SUBSTANTIALLY EQUIVALENT to the corresponding similar programs in the United States of America. All four programs achieved full accreditation status for ABET in 2009.

It is very difficult to make an exhaustive survey of the career opportunities available to the Department graduates. A few representative examples of these opportunities are outlined below:

- Graduates of the Program of Power and Machines Engineering work in
    - Electric power generation stations
    - Transmission lines and substations for high and medium voltage

    - Load dispatch centers
    - Industrial complexes that are heavily dependent on electric power utilization
    - Safe and effective distribution and consumption of electric power in residential areas and in factories.
    - Energy resource management, and programs for energy conservation.
- Graduates of the Program of Electronics and Communications Engineering work in
    - The installation, operation and maintenance of various communication systems, such as microwave and radar systems, optical communication systems, and mobile communication systems.
    - The design, construction, operation and maintenance of
        - Electronic equipment in various industrial installations.
        - Control systems, telemetry equipment, and associated equipment.
        - Information and network technologies
        - Electronic entertainment devices.
- Graduates of the Program of Computer Engineering work in the design, construction, operation, and maintenance of Computer networks
    - Information technology departments
    - Electronic printing (texts and graphics).
    - Specialized computer laboratories
    - Computer interfacing in control, measurement, and telemetry applications.
    - Computer-driven vehicles and transportation systems.
    - Computer-aided design and manufacturing systems.
    - Administration systems.
    - Special-purpose operating systems
    - Database systems
- Graduates of the Program of Biomedical Engineering work in the following fields:
    - As clinical engineers performing engineering tasks required in medical care units, and cooperating with physicians in the design and implementation of programs needed for enhancing and raising the standards of medical care.
    - As specialists in medical equipment and instrumentation, medical electronics, computer medical applications, and bioinformatics.
    - As electrical engineers concerned with equipment, measurement, control, and signal processing.

## FACILITIES

The Department of Electrical and Computer Engineering has a large number of laboratories that support its educational and research activities. In addition to the specialized equipment that each lab contains, all the labs are equipped with basic utilities such as DC and AC electric sources, voltage regulators, signal (function) generators, oscilloscopes, and analog and digital multimeters for measuring the basic quantities (voltage, current, and resistance). Labs also have a number of integrated personal computer systems to operate educational software. Every student has a good chance to have a hands-on experience and practice experimental work as the number of students per experimental station ranges from two to four only. The current departmental labs are:

- Power system lab.
- Electrical machines lab.
- Power electronics lab.
- Electrical and electronics measurements lab.

- Basic electrical engineering lab.
- Electronics lab.
- Computer lab.
- Communications lab.
- High voltage lab.
- Experimental engineering lab.
- Digital systems lab.
- Control lab.
- Personal computer lab.
- Microwave lab.
- Biomedical instrumentations lab.
- Biomedical systems lab.
- Mobile communications lab.

## PROGRAM REQUIREMENTS AND CURRICULUM

### Key to Course Numbers and Department Code

Each course is referred to by an alphabetical code and a three digits number as follows:

1. Electrical and Computer Engineering Department is referred to by the code "EE"
2. The hundredth digit refers to the school year
3. The tenth digit refers to specialty within the department
4. The ones digit refers to course serial within the same specialty as indicated in the following table.

Key of tenth digits in Electrical and Computer Engineering Department Courses

| Tens Digit | Delicate Specialty |
|---|---|
| 0 | Basic Electrical Engineering Foundation Courses |
| 1 | Electronics Engineering |
| 2 | Communications Engineering |
| 3 | Control Engineering |
| 4 | Electric Power Engineering (Machines and Drives) |
| 5 | Electric Power Engineering (Power Systems) |
| 6 | Computer Engineering (Hardware) |
| 7 | Biomedical Engineering |
| 8 | Biomedical Computing and Computer Engineering (Software) |
| 9 | Training and Research Courses and Occupational Skills |

### Units Required for the B.Sc. Degree

Units required for the B.Sc. degree in the Department of Electrical and Computer Engineering.

#### Conventional Program

| **Requirements** | **Cr. Hrs** |
|---|---|
| University Requirements (including the prep year) | 41 |
| Faculty Requirements | 37 |
| ECE Departmental Requirements | 30 |
| Sub Major Requirements | 45 |
| Summer Training | 2 |
| **Total** | **155** |

## Cooperative Program

| Requirements | Cr. Hrs |
|---|---|
| University Requirements (including the prep year) | 41 |
| Faculty Requirements | 37 |
| Departmental Requirements | 30 |
| Sub Major Requirements | 39 |
| Coop Program | 8 |
| **Total** | **155** |

## Departmental Requirements (32 Cr. Hrs.)

Regular students in all ECE programs are required to take 32 credits (10 courses) as the ECE Departmental requirements as indicated in the table:

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| EE 202 | Object-Oriented Computer Programming | 3 | EE201 |
| IE 256 | Engineering Management | 2 | IE 202, IE 255 |
| EE 300 | Analytical Methods in Engineering | 3 | MATH 203 |
| EE 301 | Electrical Circuits and Systems | 3 | EE250, MATH 204 |
| EE 311 | Electronics I | 4 | EE 250 |
| EE 321 | Introduction to Communications | 4 | EE 301 |
| EE 360 | Digital Design I | 4 | EE 250 |
| EE 366 | Microprocessors and microcontrollers | 3 | EE 360, EE 202 |
| EE 390 | Summer Training | 2 | EE 321, EE 366 |
| EE 499 | Senior Project | 4 | EE 321, EE 366 |
| Total | | 32 | |

EE 390 – the summer training, 400 hours of on-job training distributed over 10 weeks that is included in the counting of training units.

| Coop students are required to take all of the above mentioned 10 courses except EE 390 which is replaced by the following course: | | | |
|---|---|---|---|
| **Course No.** | **Course Title** | **Cr. Hr.** | **Prerequisites** |
| EE 400 | Coop Work Program | 8 | EE 321, EE 366 |

## Sub major Requirements

### *Specialization of Electric Power and Machines Engineering Requirements*

### Compulsory (39 Cr. Hrs.)

| Course No. | Course Title | Cr. | Prerequisites |
|---|---|---|---|

| | | Hr. | |
|---|---|---|---|
| MEP 261 | Thermodynamics I | 3 | MATH 110, PHYS 281 |
| EE 302 | Electromagnetic Fields | 3 | EE 250, MATH 205 |
| EE 303 | Electrical Measurements and Instrumentation | 3 | EE 311, STAT 110 |
| EE 331 | Principles of Automatic Control | 4 | MATH 204, EE 300, EE 301 |
| EE 332 | Numerical Methods in Engineering | 3 | MATH 204, EE 201 |
| EE 341 | Electromechanical Energy Conversion I | 3 | EE 302 |
| EE 351 | Electrical Power Systems I | 3 | EE 250 |
| EE 404 | Power systems lab | 1 | EE 442*, EE 451* and EE 454* |
| EE 405 | Machines lab | 1 | EE 441** |
| EE 441 | Electromechanical Energy Conversion II | 3 | EE 341, EE 351 |
| EE 442 | Power Electronics I | 3 | EE 311 |
| EE 451 | Electrical Power Systems II | 3 | EE 351 |
| EE 453 | Power Transmission and Distribution | 3 | EE 351, STAT 110 |
| EE 454 | Switchgear and Protection of Power System I | 3 | EE 341, EE 351 |
| Total | | 39 | |

*: Can be taken concurrently upon the approval of academic advisor

### Electives (6 Cr. Hrs. for Regular Stream and none for Coop Stream)

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| MEP 369 | Power Plants for Electrical Engineers | 3 | MEP 261 |
| EE 431 | Advanced Control Systems | 3 | EE 331 |
| EE 444 | Power Electronics II | 3 | EE 442 |
| EE 445 | Utilization of Electrical Energy | 3 | EE 341, EE 351 |
| EE 448 | Power System Planning and Reliability | 3 | EE 351, STAT 110 |
| EE 450 | Power System Control | 3 | EE 441, EE 331 |
| EE 452 | High Voltage Techniques I | 3 | EE 351 |
| EE 455 | Economic Operation of Power Systems | 3 | EE 451, STAT 110 |
| EE 458 | Computer Applications in Power Systems | 3 | EE 451 |
| EE 490 | Special Topics in Electrical Engineering | 3 | Approval of the ECE Department |
| EE 491 | Special Topics in Electrical Power Engineering | 3 | EE 451 |
| EE 492 | Special Topics in Electrical Machines | 3 | EE 441 |
| XX XXX | Any Course offered by the Department, Faculty or University and approved by the Department | 2 or 3 or 4 | Approval of the ECE Department |

## *Specialization of Electronics and Communications Engineering Requirements*

### Compulsory (36 Cr. Hrs.)

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| EE 302 | Electromagnetic Fields | 3 | EE 250, MATH 205 |
| EE 306 | Electrical Engineering Technologies | 3 | EE 250, STAT 110 |
| EE 312 | Electronics II | 4 | EE 311 |
| EE 331 | Principles of Automatic Control | 4 | MATH 204, EE 300, EE 301 |
| IE 331 | Probabilities and Engineering Statistics | 3 | MATH 202, STAT 110 |
| EE 332 | Numerical Methods in Engineering | 3 | MATH 204, EE 201 |
| EE 351 | Electrical Power Systems I | 3 | EE 250 |
| EE 413 | Communication Circuits | 4 | EE 312, EE 321 |
| EE 421 | Communication Theory I | 3 | EE 321, IE 331 |
| EE 423 | Electromagnetic Waves | 3 | EE 302, MATH 204 |
| EE 425 | Communication Systems | 3 | EE 421, EE 423* |
| Total | | 39 | |

*: Can be taken concurrently upon the approval of academic advisor

### Electives (9 Cr. Hrs. for Regular Stream and 3 Cr. Hrs. for Coop Stream)

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| EE 411 | Digital Electronics | 4 | EE 311, EE 360 |
| EE 416 | Optoelectronics | 3 | EE 312 |

| | | | |
|---|---|---|---|
| EE 312, EE 423 | 3 | Microwave and Optical Devices | EE 418 |
| EE 312, EE 423 | 3 | Microwave Circuits | EE 420 |
| EE 423 | 3 | Antennas and Propagation | EE 424 |
| EE 421 | 3 | Digital Communications | EE 426 |
| EE 321 | 3 | Introduction to Digital Signal Processing | EE 429 |
| Approval of the ECE Department | 3 | Special Topics in Electrical Engineering | EE 490 |
| EE 312 | 3 | Special Topics in Electronics | EE 493 |
| EE 321 | 3 | Special Topics in Communications | EE 494 |
| Approval of the ECE Department | 2 or 3 or 4 | Any Course offered by the Department, Faculty or University | xx xxx |

## *Specialization of Computer Engineering Requirements*

## Compulsory (36 Cr. Hrs.)

| Prerequisites | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|
| EE 202, MATH 204, IE 202 | 3 | Discrete Mathematics and Its Applications | EE 305 |
| EE 250, STAT 110 | 3 | Electrical Engineering Technologies | EE 306 |
| MATH 204, EE 300, EE 301 | 4 | Principles of Automatic Control | EE 331 |
| MATH 202, STAT 110 | 3 | Probabilities and Engineering Statistics | IE 331 |
| MATH 204, EE 201 | 3 | Numerical Methods in Engineering | EE 332 |
| EE 360, STAT 110 | 3 | Digital Computer Organization | EE 361 |
| EE 202 | 3 | Advanced Programming | EE 364 |
| EE 305, EE 364 | 3 | Data Structures and Algorithms | EE 367 |
| EE 360 | 4 | Digital Design II | EE 460 |
| EE 321 | 3 | Computer Communication Networks | EE 462 |
| EE 361, EE 367 | 4 | Operating Systems | EE 463 |
| 36 | | Total | |

### Electives (9 Cr. Hrs. for Regular Stream and 3 Cr. Hrs. for Coop Stream)

| Prerequisites | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|
| EE 311 | 4 | Electronics II | EE 312 |
| EE 311, EE 360 | 4 | Digital Electronics | EE 411 |
| EE 331 | 3 | Advanced Control Systems | EE 431 |
| EE 331 | 3 | Digital Control Systems | EE 432 |
| EE 361, EE 366 | 3 | Computer Interfacing | EE 466 |
| EE 367 | 3 | Databases | EE 467 |
| EE 361, EE 367 | 3 | Systems Programming | EE 468 |
| EE 367 | 3 | Compiler Construction | EE 469 |
| EE 367 | 3 | Introduction to Artificial Intelligence | EE 482 |
| EE 460, EE 411 | 3 | VLSI Design | EE 484 |
| Approval of the ECE Department | 3 | Special Topics in Electrical Engineering | EE 490 |
| EE 361, EE 367, EE 331 | 3 | Special Topics in Computer Engineering | EE 495 |
| EE 331, IE 331 | 3 | Special Topics in Automatic Control | EE 496 |
| Approval of the ECE Department | 2 or 3 or 4 | Any Course offered by the Department, faculty or University | xx xxx |

## *Specialization of Biomedical Engineering Requirements*

## Compulsory (36 Cr. Hrs.)

| Prerequisites | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|
| EE 250, MATH 205 | 3 | Electromagnetic Fields | EE 302 |
| EE 250, STAT 110 | 3 | Electrical Engineering Technologies | EE 306 |
| EE 311 | 4 | Electronics II | EE 312 |
| CHEM 281 | 3 | Biology for Biomedical Engineers | BIO 321 |
| EE 306, BIO 321 | 4 | Biomedical Engineering Primer | EE 370 |
| BIO 321 | 3 | Physiology for Biomedical Engineers | EE 372 |
| BIO 321, STAT 110 | 3 | Experimentation and Data Analysis in Health Care | EE 374 |
| EE 321, EE 370, EE 374, IE 202 | 4 | Biomedical Signals and Systems | EE 470 |
| EE 370, EE 312, EE 372 | 3 | Biomedical Instrumentation | EE 471 |
| EE 302, EE 370 | 3 | Biomedical Imaging Systems | EE 472 |
| EE 370 | 3 | Safety, reliability and Maintenance in Health Care Facilities | EE 474 |
| 36 | | Total | |

## Electives (9 Cr. Hrs. for Regular Stream and 3 Cr. Hrs. for Coop Stream)

| Prerequisites | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|
| MATH 204, EE300, EE301 | 4 | Principles of Automatic Control | EE 331 |
| EE 302 | 3 | Electromechanical Energy Conversion I | EE 341 |
| CHEM 281 | 3 | Biochemistry for Biomedical Engineers | BIOC 370 |
| Instructor approval | 3 | BioFluid Mechanics | MEP 392 |
| EE 311, EE 360 | 4 | Digital Electronics | EE 411 |
| EE 370 | 3 | Introduction to Rehabilitation Engineering | EE 473 |
| BIO 321 | 3 | Biomolecular Engineering | EE 475 |
| IE 256, EE 370 | 3 | Biomedical Systems Management | EE 476 |
| EE 370 | 3 | Essentials of Medical Informatics | EE 477 |
| EE 370 | 3 | Biosensors and Biochips | EE 478 |
| EE 370 | 3 | Genetic Engineering and Health Diagnostics | EE 479 |
| EE 366 | 3 | Computer Applications in Biomedical Engineering | EE 480 |
| Approval of the ECE Department | 3 | Special Topics in Electrical Engineering | EE 490 |
| EE 370 | 3 | Special Topics in Biomedical Engineering | EE 497 |
| Approval of ECE Department | 2 or 3 or 4 | Any Course offered by the Department, faculty or University and approved by the Department | xx xxx |

- Each one theoretical hour calculated as one credit unit
- Each two or three practical hour calculated as one credit unit
- There is no circumstance for training hour (not counted in credit calculations)

# A TYPICAL PROGRAM FOR ELECTRICAL ENGINEERING

## *ELECTRIC POWER AND MACHINES ENGINEERING GROUP*

### 3rd Year (Regular & Cooperative)

**5th Semester** **6th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Islamic Culture (2) | ISLS 201 | 3 | Arabic Language (2) | ARAB 201 |
| 2 | Introduction to Engineering Design (2) | IE 202 | 3 | Object-Oriented Computer Programming | EE 202 |
| 3 | Thermodynamics I | MEP 261 | 3 | Differential Equations I | MATH 204 |
| 3 | Analytical Methods in Engineering | EE 300 | 3 | Series and Vector Calculus | MATH 205 |
| 3 | Electrical Circuits and Systems | EE 301 | 4 | Basic Electrical Circuits | EE 250 |
| 4 | Electronics I | EE 311 | | | |
| 17 | Total | | ١٦ | Total | |

The student must select Regular or Cooperative track immediately after the sixth semester.

### 4th Year (Regular)

**7th Semester** **8th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Islamic Culture (3) | ISLS 301 | 2 | Engineering Management | IE 256 |
| 4 | Principles of Automatic Control | EE 331 | 3 | Electromagnetic Fields | EE 302 |
| 3 | Numerical Methods in Engineering | EE 332 | 3 | Electrical Measurements and Instrumentation | EE 303 |
| 3 | Electromechanical Energy Conversion I | EE 341 | 4 | Introduction to Communications | EE 321 |
| 3 | Electrical Power Systems I | EE 351 | 4 | Digital Design I | EE 360 |
| 3 | Microprocessors and microcontrollers | EE 366 | | | |
| 18 | Total | | ١٦ | Total | |

## $4^{th}$ Year Summer – Training (Regular)

| | | |
|---|---|---|
| 2 Cr. Hr. | Summer Training | EE 390 |

## $4^{th}$ Year (Cooperative)

**$7^{th}$ Semester** **$8^{th}$ Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Engineering Management | IE 256 | 3 | Electromagnetic Fields | EE 302 |
| 2 | Islamic Culture (3) | ISLS 301 | 3 | Electrical Measurements and Instrumentation | EE 303 |
| 4 | Principles of Automatic Control | EE 331 | 4 | Introduction to Communications | EE 321 |
| 3 | Numerical Methods in Engineering | EE 332 | 3 | Electrical Power Systems I | EE 351 |
| 3 | Electromechanical Energy Conversion I | EE 341 | 4 | Digital Design I | EE 360 |
| 3 | Microprocessors and microcontrollers | EE 366 | | | |
| 17 | Total | | ١٧ | Total | |

## $4^{th}$ Year Summer – Training (Cooperative)

| | | |
|---|---|---|
| 8 Cr. Hr. | Coop Work Program | EE 400 |

## $5^{th}$ Year (Regular)

**$9^{th}$ Semester** **$10^{th}$ Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Islamic Culture (4) | ISLS 401 | 3 | Electromechanical Energy Conversion II | EE 441 |
| 1 | Power systems lab | EE 404 | 3 | Power Electronic I | EE 442 |
| 1 | Machines lab | EE 405 | 3 | Electrical Power System II | EE 451 |
| 3 | Power Transmission and Distribution | EE 453 | 3 | Switchgear and Protection of Power System I | EE 454 |
| 3 | Elective I | xx xxx | 4 | Senior Project | EE 499 |
| 3 | Elective II | xx xxx | | | |
| 13 | Total | | ١٦ | Total | |

## 5th Year (Cooperative)

**9th Semester** **10th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Islamic Culture (4) | ISLS 401 | 4 | Senior Project | EE 499 |
| 1 | Power systems lab | EE 404 | | | |
| 1 | Machines lab | EE 405 | | | |
| 3 | Electromechanical Energy Conversion II | EE 441 | | | |
| 3 | Power Electronic I | EE 442 | | | |
| 3 | Electrical Power System II | EE 451 | | | |
| 3 | Power Transmission and Distribution | EE 453 | | | |
| 3 | Switchgear and Protection of Power System I | EE 454 | | | |
| 19 | Total | | 4 | Total | |

## *ELECTRONICS AND COMMUNICATIONS ENGINEERING GROUP*

### 3rd Year (Regular & Cooperative)

**5th Semester** **6th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Islamic Culture (2) | ISLS 201 | 3 | Arabic Language (2) | ARAB 201 |
| 2 | Introduction to Engineering Design (2) | IE 202 | 3 | Object-Oriented Computer Programming | EE 202 |
| 3 | Analytical Methods in Engineering | EE 300 | 3 | Differential Equations I | MATH 204 |
| 3 | Electrical Circuits and Systems | EE 301 | 3 | Series and Vector Calculus | MATH 205 |
| 3 | Electromagnetic Fields | EE 302 | 4 | Basic Electrical Circuits | EE 250 |
| 3 | Electrical Engineering Technologies | EE 306 | | | |
| 16 | Total | | ١٦ | Total | |

The student must select Regular or Cooperative track immediately after the sixth semester.

### 4th Year (Regular)

**7th Semester** **8th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Islamic Culture (3) | ISLS 301 | 2 | Engineering Management | IE 256 |
| 4 | Electronics II | EE 312 | 4 | Electronics I | EE 311 |
| 4 | Principles of Automatic Control | EE 331 | 4 | Introduction to Communications | EE 321 |
| 3 | Numerical Methods in Engineering | EE 332 | 3 | Probabilities and Engineering Statistics | IE 331 |
| 3 | Microprocessors and microcontrollers | EE 366 | 4 | Digital Design I | EE 360 |
| 16 | Total | | ١٧ | Total | |

### 4th Year Summer – Training (Regular)

| | | |
|---|---|---|
| 2 Cr. Hr. | Summer Training | EE 390 |

## 4th Year (Cooperative)

7th Semester | 8th Semester

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Engineering Management | IE 256 | 4 | Electronics I | EE 311 |
| 2 | Islamic Culture (3) | ISLS 301 | 4 | Introduction to Communications | EE 321 |
| 4 | Electronics II | EE 312 | 3 | Probabilities and Engineering Statistics | IE 331 |
| 3 | Numerical Methods in Engineering | EE 332 | 3 | Electrical Power Systems I | EE 351 |
| 3 | Microprocessors and microcontrollers | EE 366 | 4 | Digital Design I | EE 360 |
| 3 | Communication Theory I | EE 421 | | | |
| 17 | Total | | ١٨ | Total | |

## 5th Year (Regular)

9th Semester | 10th Semester

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Islamic Culture (4) | ISLS 401 | 3 | Electrical Power Systems I | EE 351 |
| 4 | Communication Circuits | EE 413 | 3 | Communication Theory I | EE 421 |
| 3 | Communication Systems | EE 425 | 3 | Electromagnetic Waves | EE 423 |
| 3 | Elective II | xx xxx | 4 | Senior Project | EE 499 |
| 3 | Elective III | xx xxx | 3 | Elective I | xx xxx |
| 15 | Total | | ١٦ | Total | |

## 5th Year (Cooperative)

**9th Semester** **10th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 4 | Principles of Automatic Control | EE 331 | 4 | Senior Project | EE 499 |
| 2 | Islamic Culture (4) | ISLS 401 | | | |
| 4 | Communication Circuits | EE 413 | | | |
| 3 | Electromagnetic Waves | EE 423 | | | |
| 3 | Communication Systems | EE 425 | | | |
| 3 | Elective | xx xxx | | | |
| 19 | Total | | 4 | Total | |

## *COMPUTER ENGINEERING GROUP*

### 3rd Year (Regular & Cooperative)

**5th Semester** **6th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Islamic Culture (2) | ISLS 201 | 3 | Arabic Language (2) | ARAB 201 |
| 2 | Introduction to Engineering Design (2) | IE 202 | 3 | Object-Oriented Computer Programming | EE 202 |
| 3 | Analytical Methods in Engineering | EE 300 | 3 | Differential Equations I | MATH 204 |
| 3 | Electrical Circuits and Systems | EE 301 | 3 | Series and Vector Calculus | MATH 205 |
| 3 | Electrical Engineering Technologies | EE 306 | 4 | Basic Electrical Circuits | EE 250 |
| 3 | Probabilities and Engineering Statistics | IE 331 | | | |
| 16 | Total | | ١٦ | Total | |

The student must select Regular or Cooperative track immediately after the sixth semester.

### 4th Year (Regular)

**7th Semester** **8th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 4 | Introduction to Communications | EE 321 | 2 | Engineering Management | IE 256 |
| 3 | Numerical Methods in Engineering | EE 332 | 3 | Discrete Mathematics and Its Applications | EE 305 |
| 3 | Digital Computer Organization | EE 361 | 4 | Electronics I | EE 311 |
| 3 | Microprocessors and microcontrollers | EE 366 | 4 | Digital Design I | EE 360 |
| 3 | Data Structures and Algorithms | EE 367 | 3 | Advanced Programming | EE 364 |
| 16 | Total | | ١٦ | Total | |

## $4^{th}$ Year Summer – Training (Regular)

| | | |
|---|---|---|
| 2 Cr. Hr. | Summer Training | EE 390 |

## $4^{th}$ Year (Cooperative)

**$7^{th}$ Semester** **$8^{th}$ Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Engineering Management | IE 256 | 3 | Discrete Mathematics and Its Applications | EE 305 |
| 2 | Islamic Culture (3) | ISLS 301 | 4 | Electronics I | EE 311 |
| 4 | Principles of Automatic Control | EE 331 | 4 | Introduction to Communications | EE 321 |
| 3 | Digital Computer Organization | EE 361 | 4 | Digital Design I | EE 360 |
| 3 | Microprocessors and microcontrollers | EE 366 | 3 | Advanced Programming | EE 364 |
| 3 | Data Structures and Algorithms | EE 367 | | | |
| 17 | Total | | ١٨ | Total | |

## $4^{th}$ Year Summer – Training (Cooperative)

| | | |
|---|---|---|
| 8 Cr. Hr. | Coop Work Program | EE 400 |

## $5^{th}$ Year (Regular)

**$9^{th}$ Semester** **$10^{th}$ Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Islamic Culture (4) | ISLS 401 | 2 | Islamic Culture (3) | ISLS 301 |
| 3 | Computer Communication Networks | EE 462 | 4 | Digital Design II | EE 460 |
| 4 | Operating Systems | EE 463 | 4 | Principles of Automatic Control | EE 331 |
| 3 | Elective II | xx xxx | 4 | Senior Project | EE 499 |
| 3 | Elective III | xx xxx | 3 | Elective I | xx xxx |
| 15 | Total | | ١٧ | Total | |

## 5th Year (Cooperative)

**9th Semester** **10th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 3 | Numerical Methods in Engineering | EE 332 | 4 | Senior Project | EE 499 |
| 2 | Islamic Culture (4) | ISLS 401 | | | |
| 4 | Digital Design II | EE 460 | | | |
| 3 | Computer Communication Networks | EE 462 | | | |
| 4 | Operating Systems | EE 463 | | | |
| 3 | Elective | xx xxx | | | |
| 19 | Total | | 4 | Total | |

## *BIOMEDICAL ENGINEERING GROUP*

### 3rd Year (Regular & Cooperative)

**5th Semester** | **6th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Islamic Culture (2) | ISLS 201 | 3 | Arabic Language (2) | ARAB 201 |
| 2 | Introduction to Engineering Design (2) | IE 202 | 3 | Object-Oriented Computer Programming | EE 202 |
| 3 | Analytical Methods in Engineering | EE 300 | 3 | Differential Equations I | MATH 204 |
| 3 | Electrical Circuits and Systems | EE 301 | 3 | Series and Vector Calculus | MATH 205 |
| 3 | Electrical Engineering Technologies | EE 306 | 4 | Basic Electrical Circuits | EE 250 |
| 3 | Biology for Biomedical Engineers | BIO 321 | | | |
| 16 | | Total | ١٦ | | Total |

The student must select Regular or Cooperative track immediately after the eights semester.

### 4th Year (Regular)

**7th Semester** | **8th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Engineering Management | IE 256 | 3 | Electromagnetic Fields | EE 302 |
| 4 | Electronics II | EE 312 | 4 | Electronics I | EE 311 |
| 4 | Introduction to Communications | EE 321 | 4 | Digital Design I | EE 360 |
| 3 | Microprocessors and microcontrollers | EE 366 | 3 | Physiology for Biomedical Engineers | EE 372 |
| 4 | Biomedical Engineering Primer | EE 370 | 3 | Experimentation and Data Analysis in Health Care | EE 374 |
| 17 | | Total | ١٧ | | Total |

### 4th Year Summer – Training (Regular)

| | | |
|---|---|---|
| 2 Cr. Hr. | Summer Training | EE 390 |

## 4th Year (Cooperative)

**7th Semester** / **8th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Engineering Management | IE 256 | 3 | Electromagnetic Fields | EE 302 |
| 2 | Islamic Culture (3) | ISLS 301 | 4 | Electronics I | EE 311 |
| 4 | Introduction to Communications | EE 321 | 4 | Electronics II | EE 312 |
| 3 | Microprocessors and microcontrollers | EE 366 | 4 | Digital Design I | EE 360 |
| 4 | Biomedical Engineering Primer | EE 370 | 3 | Physiology for Biomedical Engineers | EE 372 |
| 3 | Experimentation and Data Analysis in Health Care | EE 374 | | | |
| 18 | Total | | ١٨ | Total | |

## 4th Year Summer – Training (Cooperative)

| | | |
|---|---|---|
| 8 Cr. Hr. | Coop Work Program | EE 400 |

## 5th Year (Regular)

**9th Semester** / **10th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Islamic Culture (4) | ISLS 401 | 2 | Islamic Culture (3) | ISLS 301 |
| 3 | Biomedical Imaging Systems | EE 472 | 4 | Biomedical Signals and Systems | EE 470 |
| 3 | Safety, reliability and Maintenance in Health Care Facilities | EE 474 | 3 | Biomedical Instrumentation | EE 471 |
| 3 | Elective II | xx xxx | 4 | Senior Project | EE 499 |
| 3 | Elective III | xx xxx | 3 | Elective I | xx xxx |
| 14 | Total | | ١٦ | Total | |

## $5^{th}$ Year (Cooperative)

**$9^{th}$ Semester** **$10^{th}$ Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Islamic Culture (4) | ISLS 401 | 4 | Senior Project | EE 499 |
| 4 | Biomedical Signals and Systems | EE 470 | | | |
| 3 | Biomedical Instrumentation | EE 471 | | | |
| 3 | Biomedical Imaging Systems | EE 472 | | | |
| 3 | Safety, reliability and Maintenance in Health Care Facilities | EE 474 | | | |
| 3 | Elective | xx xxx | | | |
| 18 | Total | | 4 | Total | |

- Each one theoretical hour calculated as one credit unit
- Each two or three practical hour calculated as one credit unit
- There is no circumstance for training hour (not counted in credit calculations)

## COURSE DESCRIPTION

### EE 201 Structured Computer Programming (2:1,3)

Introduction to computers. Simple algorithms and flowcharts. Solving engineering and mathematical problems using a mathematically-oriented programming language. Programming concepts: I/O, assignment, conditional loops, functions and subroutines. Programming selected numerical and non-numerical problems of mathematical and engineering nature.

**Prerequisite: MATH 110, CPIT 100**

### EE 202 Object-Oriented Computer Programming (3:2,3)

Object-oriented programming: classes, objects and methods. Object-oriented design. Simple data structures. Best programming practices (structured coding, documentation, testing and debugging).

**Prerequisite: EE 201**

### EE 250 Basic Electrical Circuits (4:3,2)

Electric quantities and circuit elements. Kirchhoff's laws. Mesh and node analyses. Sinusoidal steady-state analysis using phasors. Network theorem and transformations. Ideal transformers. Three-phase circuits.

**Prerequisite: PHYS 202**

### EE 251 Basic Electrical Engineering (4:3,2)

Electrical engineering applications, basic concepts of electricity, electric components, elementary circuit analysis and measurements, balanced three-phase systems, ideal transformers, application-specific circuits, electrical safety, DC generators and the motors, basic operation of sensors and actuators, concept of data acquisition systems.

**Prerequisite: PHYS 202**

### EE 300 Analytical Methods in Engineering (3:3,1)

Linear algebra: matrices and determinants, eigenvalues and eigenvectors. Complex analysis: complex arithmetic , complex algebra, differentiation and integration in the complex plane and residue analysis. Graphs, Fundamental loops and fundamental cutsets.

**Prerequisite: MATH 203**

### EE 301 Electrical Circuits and Systems (3:3,1)

Resonance circuits. Magnetically-coupled circuits. Op-amp circuits. Transient analysis via the conventional and Laplace methods. Fourier analysis with applications to circuits. Two-port networks.

**Prerequisite: MATH 204, EE 250**

### EE 302 Electromagnetic Fields (3:3,1)

Electrostatic fields. Poisson and Laplace equations. Steady Electric Current. Steady Magnetic Field. Time-varying electric and magnetic fields. Maxwell equations.

**Prerequisite: EE 250, MATH 205**

### EE 303 Electrical Measurements and instrumentation (3:2,3)

Fundamental Measurement Concepts, Generalized measurement system, errors in measurements, characteristics of measuring instruments statistical analysis of errors. Oscilloscopes, analog AC and DC instruments, measurement of power, DC and AC bridges, transducers, fundamental of electronic instruments, attenuators, converters, peak and average detectors. RMS detectors. digital instruments, digital display units, digital voltmeter.

**Prerequisite: EE 311, STAT 110**

### EE 305 Discrete Mathematics and their Applications (3:3,1)

Functions, relations and sets. Basic logic. Proof techniques. Basic counting. Graphs and trees. Modeling. Computation. Types of functions and relations. Cartesian products and power sets. Propositional logic, Logical equivalence quantifiers. Mathematical induction, recursive definitions. Pigeonhole principle, permutations, combinations, recurrence relations. Binary trees, traversals. Graph Isomorphism, connectivity, Euler and Hamilton paths. Planar graphs. Graph coloring. Formal languages, grammars, and finite state machines. Turing machines and computability.

**Prerequisite: EE 202, MATH 204, IE 202**

### EE 306 Electrical Engineering Technologies (3:2,3)

Electrical engineering fields of activities. Sources of electrical energy: power supplies, batteries, generators and alternative power sources. Distribution and utilization of electrical energy, commutators and protection devices. Conversion of electrical energy; sensors and actuators. Electrical safety. Principles of electrical and electronic measurements and instrumentation, standards and calibration. Sources of measurement errors, and analysis of measured data.

**Prerequisite: EE 250, STAT 110**

### EE 311 Electronics I (4:3,3)

Conduction in metals and semiconductors, P-N junctions, diode circuits. Field-effect and junction transistors. Low frequency equivalent circuits. Basic amplifiers.

**Prerequisite: EE 250**

### EE 312 Electronics II (4:3,3)

Feedback in amplifiers. Frequency response of amplifiers. Operational amplifiers: design and applications as linear and non-linear analog building blocks, adders, subtractors, differentiators, integrators, analog simulation, and active filters. Logarithmic and exponential amplifiers, precision converters, analog multipliers, wave-shapers, sinusoidal and square wave oscillators.

**Prerequisite: EE 311**

### EE 321 Introduction to Communications (4:3,3)

Fourier Signal Analysis. Linear Modulation: AM, DSBSC, SSB, Frequency Conversion, generation and detection. FDM, Exponential Modulation: FM, PM, NBFM, WBFM. Pulse Modulation, Sampling Theorem, PAM, PDM, PPM, PCM, TDM, Digital Modulation ASK, PSK and FSK.

**Prerequisite: EE 301**

### EE 331 Principles of Automatic Control (4:3,2)

Introduction to control systems with examples from different fields. Transfer functions and block diagram algebra. Stability analysis (Routh-Hurwitz and Nyquist). Design of Control Systems using Bode diagrams and root locus techniques.

**Prerequisite: MATH 204, EE 300, EE 301**

### EE 332 Numerical Methods in Engineering (3:2,2)

Introduction. Solution of non-linear equations. Solution of large systems of linear equations. Interpolation. Function approximation. Numerical differentiation and integration. Solution of the initial value problem of ordinary differential equations.

**Prerequisite: EE 201, MATH 204**

### EE 341 Electromechanical Energy Conversion I (3:3,1)

Theory and modeling of electromechanical devices. Magnetic circuit. Power transformers. Physical construction and applications of D. C. machines. Qualitative introduction to A.C. Machines.

**Prerequisite: EE 302**

### EE 351 Electrical Power Systems I (3:3,1)

Electrical Characteristics and steady state performance of overhead transmission lines. Equivalent Circuit and Power Circle Diagrams. Per-unit Systems and Symmetrical Short-Circuit calculations. Power systems economics. Introduction to Switchgear and Protection.

**Prerequisite: EE 250**

**EE 360 Digital Design I (4:3,2)**

Representation and manipulation of digital information Basic Boolean logic. Elements of digital building blocks. Computer arithmetic unit. Memory unit. Input-Output unit. Basic operation of the computer control unit.

**Prerequisite: EE 250**

**EE 361 Digital Computer Organization (3:3,1)**

Basic structure of computers. Addressing methods and machine programs. Instruction sets and their implementation. Central Processing Unit. Micro programmed control. Input-Output Organization. Arithmetic Unit. Main memory. Computer peripherals and interfacing.

**Prerequisite: EE 360, STAT 110**

**EE 364 Advanced Programming (3:3,1)**

Structured programming concepts and control structure. Systematic program design. Modularization and scope concepts. Use of a variety of data structures and programming techniques. Iteration and recursion. Memory management. Program correctness, informal verification and testing.

**Prerequisite: EE 202**

**EE 366 Microprocessor and Microcontrollers (3:2,3)**

Design of microcontroller-based embedded systems. Overview of a single-chip microcontroller, hardware and software concepts in microcontrollers. System architecture, central processing unit (CPU), internal memory (ROM, EEPROM, RAM, FLASH). Input/ Output ports, serial communication, programmable interrupts. ADC, DAC, interfacing and timers. Microcontroller programming model and instruction set, assembly and C language programming.

**Prerequisite: EE 202, EE 360**

**EE 367 Data Structures and Algorithms (3:3,1)**

Basic concepts of data and their representations inside a computer (scalar, structured and dynamic). Manipulation of arrays, strings, stacks, queues, linear lists, circular lists, orthogonal lists, trees and graphs. Sorting and searching algorithms. File organization and file access methods.

**Prerequisite: EE 305, EE 364**

**EE 370 Biomedical Engineering Primer (4:3,3)**

Biomedical engineering fields of activity. Research, development, and design for biomedical problems, diagnosis of disease, and therapeutic applications. Modular blocks and system integration. Physical, chemical and biological principles for biomedical measurements. Sensors for displacement, force, pressure, flow, temperature, biopotentials, chemical composition of body fluids and biomaterial characterization. Patient safety.

**Prerequisite: EE 306, BIO 321**

**EE 372 Physiology For Biomedical Engineers (3:2,2)**

Body environment, fluids and compartments, digestive system. Metabolism, energetics of glucose metabolism. Respiratory system and artificial respiration. Cardiovascular system and its regulatory mechanism, hemodynamics. Metabolism and body temperature regulation. Endocrinology, reproductive system and renal physiology.

**Prerequisite: BIO 321**

**EE 374 Experimentation and Data Analysis in Health Care (3:3,1)**

Descriptive statistics; elementary probability; discrete and continuous random variables and their distributions; hypothesis testing involving continuous and categorical (nominal and ordinal) variables, two and more treatments; linear regression; analysis of survival data. Design of clinical trials; sample size and selection of samples; selection and preparation of apparatus and preparing experimental protocols. Clinical standards for data collection, organization, summarization and verification; medical sample handling, transporting and disposal; sterilization, cleansing and hygiene. Applications of essential statistical techniques for use in analyzing data from different types of engineering experiments, biological experiments and clinical studies. Term project.

**Prerequisite: BIO 321, STAT 110**

**EE 390 Summer Training (2:0,4)**

10 weeks of training in industry under the supervision of a faculty member. Students have to submit a report about their achievements during training in addition to any other requirements as assigned by the department.

**Prerequisite: EE 321, EE 366**

**EE 400 Cooperative Work (8:0,16)**

Extensive 25 weeks of training in industry under the supervision of a staff member. Students should submit a final report about their training in addition to any other requirements as assigned by the department.

**Prerequisite: EE 321, EE 366**

**EE 404 Power Systems Lab (1:0,3)**

The lab introduces experiments applied to power system analysis, system protection and power electronics courses.

The lab consists of following experiments: thyristor gate control circuit, controlled rectifiers, AC voltage controllers, current transformers, load flow and transient stability, modeling of a balanced three-phase transmission line, over current, differential and distance protections.

**Co-requisite: EE 442, EE 451 and EE 453 with approval academic advisor**

**EE 405 Machines Lab (1:0,3)**

The lab introduces experiments applied to electromechanical energy conversion courses.

The lab consists of following experiments: transformers, DC generators, DC motors, three-phase synchronous generator, alternator synchronization, synchronous motor, wound rotor induction motor and single-phase induction motor.

**Co-requisite: EE 441 and approval academic advisor**

**EE 411 Digital Electronics (4:3,3)**

Switching of electronic devices. Integrated circuit gates, multivibrators, registers, charge coupled device. Memories. Digital to analog and analog to digital converters.

**Prerequisite: EE 311, EE 360**

**EE 413 Communication Circuits (4:3,3)**

Behavior of Transistors at high frequencies. Analysis and design of electronic circuits employed in electronic and communication systems.

**Prerequisite: EE 312, EE 321**

**EE 416 Optoelectronics (3:3,1)**

The optical fiber: Types, effects of dispersion, attenuation, nonlinearities. Coupling between optical sources and waveguides. Optical detectors and noise. Optical sources: Optical radiation and amplification, lasers. Optical devices: Sensors and modulators.

**Prerequisite: EE 312**

**EE 418 Microwave and Optical Devices (3:3,1)**

Structure, Analysis and the principle of operation of some selected Microwave Devices. These Devices can be either in the form of 2-Terminal Devices such as Gunn, Ga N based Gunn, InP Gunn, Impatt, Ga N Impatt,3C SIC Impatt, Dovett, Trapatt,Baritt,Tunnel, Mitatt QWITT, Varactors and Tunnett .Or in the form of 3-Terminal Devices such as MES FET,4H-SiC MESFET, H-FET and HEMTs. Design high quality stable and tunable microwave oscillators. Design a high gain, low FM noise and noise Figure and. low intermodulation distortion microwave amplifiers.

**Prerequisite: EE 312, EE 423**

**EE 420 Microwave Circuits (3:3,1)**

Review of Transmission line Theory, Some of Its Applications and Smith Chart. Brief discussion on various types of transmission lines. Derivation of Microstrip parameters and losses. Distinguish between normal and higher order mode of propagation in Microstrip. Derivation of the Scattering matrix parameters of any given network under review. Filters implemented in Microstrip line. Derivation of all the parameters of Coupled Line Microstrip and its applications .Theoretical Analysis and Design of some selected networks such as Quadrature Couplers, Power Combiner/Divider, Phase Shifter and Magic Tee……etc. Reviewing of Ferromagnetic Material and its applications especially in microstrip circulators, isolator and phase shifters. Design of Microstrip antenna and switches.

**Prerequisite: EE 312, EE 423**

**EE 421 Communication Theory I (3:3,1)**

Autocorrelation function and spectral density. Random signal theory: Continuous and discrete random variables, transformation of random variables, stationary random processes, time averages and ergodicity, power spectral density of stationary random processes. Signal-to-noise ratio and probability of error. Noise equivalent bandwidth. Optimum receivers. Pulse detection and matched filters. Signal distortion in transmission and equalization. Noise in linear and exponential modulation. PCM systems: Uniform and nonuniform quantization, noise in PCM, DPCM and DM. Noise in pulse modulation.

**Prerequisite: EE 321, IE 331**

**EE 423 Electromagnetic Waves (3:3,1)**

Electromagnetic Theory. Plan waves, Maxwell's equations, boundary conditions, Pointing theorem, Wave equation, Plane waves. Transmission lines: Distributed circuit parameters, HF transmission lines, reflections, standing waves. T.L. measurements. Wave guides: TEM, TM and TE transmission, parallel plates waveguides- TE and TM modes,. Cavity resonators. Impedance Transformation and Matching. Smith Chart.

**Prerequisite: EE 302, MATH 204**

**EE 424 Antennas and Propagation (3:3,1)**

Radiation and Antenna Fundamentals. Linear Antennas, Current distribution, Short dipoles And Monopoles/2 dipoles, radiation resistance and gain, longer dipoles, folded dipoles. Antenna Arrays. Aperture Antennas. Special types of antennas. Traveling wave antennas, loop antennas. Frequency independent antennas, helical Antennas, corner reflector, lenses. Space Wave Propagation. Ground Wave Propagation. Tropospheric waves. Ionospheric waves.

**Prerequisite: EE 423**

**EE 425 Communication Systems (3:3,1)**

Detailed description of at least three out of the following systems. Radio broadcasting Systems. TV and Video Systems. Radar Systems. Microwave Links, Telephony, Telegraphy and Telex systems. Satellite Communication Systems. Optical Communication Systems. Aircraft and Ship navigational systems.

**Prerequisite: EE 421, EE 423 (concurrent)**

**EE 426 Digital Communications (3:3,1)**

Sampling theorem, PCM, bandpass digital modulation methods (ASK, FSK and PSK), noise analysis and error probability, digital filters, and digital and discrete-time signal processing, Z transform, digital filter design in frequency domain, digital matched filters, interference and jamming, effects of sampling errors, modern digital modulation methods, chirp modulation, spread spectrum.

**Prerequisite: EE 421**

**EE 429 Introduction to Digital Signal Processing (3:3,1)**

Discrete time signals and systems, Fourier analysis of discrete-time signals and Systems –Fast Fourier Transform- Digital Filter Design- Computer applications - Advanced Topics.

**Prerequisite: EE 321**

**EE 431 Advanced Control Systems (3:3,1)**

State space representation and realization, controllability and observability. Liapunov and popov stability criteria, stochastic and sampled data control theory, optimal control theory.

**Prerequisite: EE 331**

**EE 432 Digital Control Systems (3:3,1)**

Derivation of differential/difference equations for physical systems. The Laplace transform. The Z transform. The transfer function. Stability in the Z plane. System response in the time domain. Controllability and Observability - Design of Closed-loop digital control systems: a) by conventional means: b) by the digital computers.

**Prerequisite: EE 331**

**EE 441 Electromechanical Energy Conversion II (3:3,1)**

Polyphase induction and synchronous machines. Models and performance characteristics for steady-state operations. Fractional horsepower machines, their performance and application.

**Prerequisite: EE 341, EE 351**

**EE 442 Power Electronics I (3:3,1)**

Thyristors, theory of operation, methods of turning on, thyristor limitations, commutation methods. Single and three-phase AC voltage controllers for resistive and inductive loads. Single-phase and three-phase AC-DC converters for resistive and large inductive loads. Analysis of DC-DC converters for resistive, large inductive, and general inductive loads. Single-phase and three-phase inverters for different loads. Single-phase to single-phase cycloconverter, output voltage and frequency control.

**Prerequisite: EE 311**

### EE 444 Power Electronics II (3:3,1)

Static switches. Power supplies. DC drives. AC drives. Traffic Signal Control. Power Transistors. Solid-state temperature and air conditioning control. Light activated thyristor applications. Test and protection of power electronic devices and circuits.

**Prerequisite: EE 441**

### EE 445 Utilization of Electrical Energy (3:3,1)

Fossil fuels and conventional power plants, nuclear power plants, hydroelectric power plants, , power generation from renewable energy resources, environmental impact of power generation and utilization, safety in electrical energy utilization, grounding and shock hazards in electrical energy utilization, power grids and blackouts.

**Prerequisite: EE 341, EE 351**

### EE 448 Power System Planning and Reliability (3:3,1)

Engineering system reliability assessment, Effect of Load Forecasting, Principles of Power Systems Reliability, Generation system modeling, Planning for Future Expansion in Generation Systems.

**Prerequisite: STAT 110, EE 351**

### EE 450 Power System Control (3:3,1)

Power factor Control, Automatic generation control, Load-frequency Control, Economic dispatch, Unit Commitment, reactive power control, Potential Instability and Breakdown, Reactive power distribution.

**Prerequisite: EE 331, EE 441 (concurrent)**

### EE 451 Electrical Power Systems II (3:3,1)

Load Flow Analysis, Solution of Load Flow Equations, Gauss-Seidel and Newton Raphson Techniques, Asymmetrical Faults, Phase Sequence Networks, Use of Matrix Methods. Power System Stability: Steady-State and Transient.

**Prerequisite: EE 351**

### EE 452 High Voltage Techniques I (3:3,1)

Generation of high AC and DC impulse voltages, and impulse currents. Measurement of high voltages and currents. Dielectric loss and capacitance measurements. Traveling waves.

**Prerequisite: EE 351**

### EE 453 Power Transmission and Distribution (3:3,1)

Transmission line parameters, Mechanical design of overhead transmission lines, Underground cables, Distribution Systems. Distribution substation design. Surges on transmission systems, System earthing.

**Prerequisite: EE 351, STAT 110**

### EE 454 Switchgear and Protection of Power Systems I (3:3,1)

Switch gear, busbar systems, couplers, cubicles, auxiliaries, and single line diagram. Relays, electromagnetic, static, thermal relay, and over current, voltage. Distance relays. Differential relays. Feeder protection system. Transformer protection system. Generator protection system.

**Prerequisite: EE 341, EE 351**

### EE 455 Economic Operation of Power Systems (3:3,1)

Operating constraints. Short-term load forecast. Load curve analysis. Economical load sharing between units and between stations. Tariffs. incremental costs. Unit commitment and generator scheduling. Voltage and VAR control. Energy conservation.

**Prerequisite: EE 451, STAT 110**

### EE 458 Computer Applications in Power Systems (3:3,1)

Power network equations and digital solution techniques. Network reduction methods. Computer programs for steady state analysis of power systems; Transmission Line performance, Short-circuit calculations, and, Load flow studies. Digital and analogue simulation of power system component dynamics. Digital evaluation of power system stability. Computer applications in utilities and power industry.

**Prerequisite: EE 451**

### EE 460 Digital Design II (4:3,2)

Analysis and synthesis of gate networks. Elements of minimization techniques. Synthesis using NAND and NOR gates. Analysis of sequential networks. Synthesis of pulse-mode and fundamental mode sequential networks. Flow tables and State diagrams. Hazards. Use of MSI and LSI in the implementation of combinational and sequential circuits.

**Prerequisite: EE 360**

**EE 462 Computer Communication Networks (3:3,1)**

Components of data communication systems. Error detection techniques. Network Protocols including the Open System Inter-connection model. Communication carrier facilities. System planning considerations.

**Prerequisite: EE 321**

**EE 463 Operating Systems (4:3,3)**

Operating systems as resource managers. Process concepts. Synchronous concurrent processes. Concurrent programming monitors and the ADA rendezvous. Real and virtual storage management. Processor scheduling. Disk scheduling. File systems. Some case studies.

**Prerequisite: EE 361, EE 367**

**EE 466 Computer Interfacing (3:3,1)**

Basics of data transfer (Serial and parallel modes, 110 transfer initiation using polling and interrupt schemes, Standard busses), Interface components and their characteristics, (Drivers, receivers, interface chips, Analog-to-digital converters). Designing interface circuits for standard busses.

**Prerequisite: EE 361, EE 366**

**EE 467 Databases (3:3,1)**

The need for the database approach. Storage structures. Basic data structures (relational, hierarchical, and network approaches). The network approach (Architecture of the DBTG system, Set constructs, external level of DBTG, data manipulation commands). The hierarchical approach (IMS data structure, external and internal levels, data manipulation). The Relational approach (relational algebra and calculus. Query-by-example).

**Prerequisite: EE 367**

**EE 470 Biomedical Signals and Systems (4:3,3)**

Models for biomedical systems. Non-deterministic nature of biomedical signals, physiological systems and quantitative analysis. Feedback systems, transfer functions and stability. Frequency response of systems and circuits, and Bode diagrams. A/D conversion, sampling, and discrete-time signal processing. Biomedical amplifiers, filters, signal processors and display devices. Laboratory and computational experiences with biomedical applications. Term project.

**Prerequisite: EE 321, EE 370, EE 374, IE 202**

**EE 471 Biomedical Instrumentation (3:2,3)**

Electrical safety and precautions required in medical applications. Electrocardiography (ECG), analog and digital processing of ECG signals. Measurement of blood pressure, heart sound, flow and volume of blood. Statistical analysis of heart rate and blood pressure measurements. Basic respiratory system measurements. Principles of clinical lab instrumentation. Term project.

**Prerequisite: EE 312, EE 370, EE 372**

**EE 472 Biomedical Imaging Systems (3:3,1)**

Fundamentals of medical imaging physics and systems: X-ray radiography, ultrasound, radionuclide imaging, and magnetic resonance imaging (MRI). Biological effects of each modality. Tomographical reconstruction principles, including X-ray computed tomography (CT), position emission tomography (PET), and single-photon emission computed tomography (SPECT).

**Prerequisite: EE 370, EE 302**

**EE 473 Introduction to Rehabilitation Engineering (3:3,1)**

Concepts of therapy, rehabilitation, prosthesis, orthosis. Therapeutic effects of electrical current. Examples of common devices: pacemakers and defibrillators. Sensory and communication aids. Neuromuscular stimulators. Physical therapy equipment. Electro-surgical equipment. Medical applications of lasers. Ventilators. Artificial kidney. Neonatal care. Radiation therapy.

**Prerequisite: EE 370**

**EE 474 Safety, Reliability and Maintenance in Health Care Facilities (3:3,1)**

Definition of safety. Electrical, gas, and fire safety and how to make safe environment for patients, medical personnel and attendants. Reliability in health care facilities. Training of operators for proper use of equipment. Generation of a computer database for equipment, suppliers, dealers and manufacturers. Preventive maintenance procedures. Corrective maintenance, repair and amendment of existing equipment. Basic troubleshooting principles. Retrieving information from manufacturer's catalogs and technical libraries.

**Prerequisite: EE 370**

**EE 475 Biomolecular Engineering (3:3,1)**

Thermodynamics**,** biomolecular interactions, enzyme kinetics and bioenergetics. Biodesign, molecular modeling and case studies. Cellular warfare, bioreaction networks. Application examples and term project.

**Prerequisite: BIO 321**

**EE 476 Biomedical Systems Management (3:3,1)**

Responsibilities of biomedical engineers working in health-care facilities. Codes, standards and regulations governing clinical engineering practices. Bids preparation and tender evaluation. Designing and layout of medical facilities. Equipment selection and evaluation. Term project.

**Prerequisite: IE 256, EE 370**

### EE 477 Essentials of Medical Informatics (3:3,1)

Electronic Medical Record (EMR), hospital information system (HIS) standards and systems; image data compression, data communication and transmission, security and protection for medical image data. Picture archiving and communication systems (PACS), radiology information system (RIS), lab information system (LIS) and medical imaging informatics (MII) for filmless hospitals. A knowledge-based digital library for retrieving scenario specific medical text documents. Integrated multimedia patient record systems, computer-aided diagnosis (CAD), clinical decision support systems (CDSS). Medical robotics and computer-integrated interventional medicine. Molecular imaging in biology and pharmacology. The evolution of e-health systems and smart medical home.

**Prerequisite: EE 370**

### EE 478 Biosensors and Biochips (3:3,1)

Biosensors: introduction, concepts and applications; biosensors for personal diabetes management; microfabricated sensors and the commercial development of biosensors; electrochemical sensors and chemical fibrosensors. Biochips: introduction, basics of biochips and microarray technology; construction, types of microarrays, data analysis; biochips in health care and diagnostics, other applications; biochips application to genomics. Microfluidics, BIAcore - an optical biosensor, use of microarrays in population genetic and epidemiology, use of microarrays on forensics, DNA chip technology for water quality management; bioagent chip, limitation of biochip technology, commercial aspects of biochip technology, DNA computing.

**Prerequisite: EE 370**

### EE 479 Genetic Engineering and Health Diagnostics (3:3,1)

Introduction to genetic engineering and its role in health diagnosis. Enzymes in genetic engineering. Nucleic acid hybridyzadization and amplification. DNA based diagnosis, biochemical diagnostics, cell based diagnostics and immunodiagnostics. Imaging diagnostics and its relation to genetic expressions.

**Prerequisite: EE 370**

### EE 480 Computer Applications in Biomedical Engineering (3:2,2)

Classification of computer applications in the biomedical field. Available tools and techniques: hardware and software resources in the PC field. Selected application examples: medical record system, lab and pharmacy information system, office practice system, clinical decision support system. Computerized diagnostic and therapeutic equipment.

**Prerequisite: EE 366**

**EE 482 Artificial Intelligence (3:3,1)**

Problem solving methods. Search spaces. Knowledge representation. Reasoning. Natural language understanding. Pattern recognition. Computer vision. Expert systems. AI languages.

**Prerequisite: EE 367**

**EE 490 Special Topics in Electrical Engineering (3:3,1)**

Selected topic to develop the skills and knowledge in a given field.

**Prerequisite: Approval of the ECE Department**

**EE 491 Special Topics in Electrical Power Engineering (3:3,1)**

Selected topic to develop the skills and knowledge in a given field.

**Prerequisite: EE 451**

**EE 492 Special Topics in Electrical Machines (3:3,1)**

Selected topic to develop the skills and knowledge in a given field.

**Prerequisite: EE 441**

**EE 493 Special Topics in Electronics (3:3,1)**

Selected topic to develop the skills and knowledge in a given field.

**Prerequisite: EE 312**

**EE 494 Special Topics in Communications (3:3,1)**

Selected topic to develop the skills and knowledge in a given field.

**Prerequisite: EE 321**

**EE 495 Special Topics in Computer Engineering (3:3,1)**

Selected topic to develop the skills and knowledge in a given field.

**Prerequisite: EE 331, EE 361, EE 367**

**EE 496 Special Topics in Automatic Control (3:3,1)**

Selected topic to develop the skills and knowledge in a given field.

**Prerequisite: EE 331, IE 331**

**EE 497 Special Topics in Biomedical Engineering (3:3,1)**

Selected topic to develop the skills and knowledge in a given field.

**Prerequisite: EE 370**

**EE 499 Senior Project (3:3,1)**

Selection of topic: literature review; project design planning, arranging for data collection, and experimental work. Experimental work and data collection or field study (if any). Data processing analysis and results. Preparation of the first draft of final report. Presentation of the project.

**Prerequisite: EE 321, EE 366**

## Description of Courses from Outside of Faculty of Engineering

**BIO 321 Biology For Biomedical Engineers (3:2,2)**

Introduction to biology, tissues, cells and chemistry of life. Skeleton, joints, muscles. Nervous system, it's organization, division and functions, sense organs. Processing of food. Basic anatomy and physiology of cardiovascular, lymphatic, respiratory and urinary systems.

**Prerequisite: CHEM 281**

**BIOC 370 Biochemistry For Biomedical Engineers (3:2,3)**

Water and its importance to biological systems, pH levels, buffers. Amino acids, peptides, proteins, enzymes, vitamins, carbohydrates, lipids, phospholipids. Metabolism, energetics of glucose metabolism. Nucleic acids. Biochemical tests in blood and urine in hospital labs. & their diagnostic uses.

**Prerequisite: CHEM 281**

# DEPARTMENT OF
# INDUSTRIAL ENGINEERING

## INTRODUCTION

Department of Industrial Engineering (IE) at KAU was established in 1395 A. H. (1975 G) and, thus, became the pioneer in imparting IE education and training in the Kingdom. Some of the areas where our Industrial Engineers have been working in technical or managerial positions include manufacturing industries of all types, banks, hospitals, transportation companies, communications, and defense industries. In the context of Saudi Arabia, scope for Industrial Engineering application is getting vast because (a) The Kingdom is short of manpower and every effort is needed to get engineers to design, install, and maintain automated systems, and (b) The pace of development is very fast and there is considerable scope for improvement in different aspects of working in almost every organization. Currently the Department has 30 faculty members with an undergraduate enrollment of more than 250 students.

## VISION AND MISSION STATEMENTS

### The Vision of the Department

Innovation and leadership in industrial engineering and its applications

### The Mission of the Department

To prepare Industrial Engineering graduates equipped with the world-class professional competencies capable of conducting scientific research and rendering community services allowing for a sustainable development.

.٧

It is published in the webpage of the of Industrial Engineering department:
http://engg.kau.edu.sa/ie/

### Undergraduate Program Mission Statement

The mission of the undergraduate Industrial Engineering Program is 'to prepare graduating industrial engineers equipped with the world-class professional competencies capable of rendering community services allowing for a sustainable development.'
It is published at Department of Industrial Engineering website:
http://engg.kau.edu.sa/ie/aboutus/aboutus.htm

## EDUCATIONAL OBJECTIVES

The educational program of the Industrial Engineering Department at King Abdulaziz University prepares its graduates to:

1. be effective in applying contemporary tools of industrial engineering to cater to the needs of upcoming challenges of the changing industrial world.
2. advance their careers by way of exhibiting their professionalism, leadership qualities and effective oral and written communication skills.
3. function effectively in diverse teams to handle problems pertaining to different industrial and managerial settings.
4. demonstrate professional and ethical responsibilities towards their profession, society, and the environment.
5. apply effectively e-media, computers and software in solving engineering problems.

## Aspects of Development

The success of the IE Program would depend upon the competence and ability of the IE faculty and the support of the Faculty of Engineering in keeping the faculty and the students abreast of the technological advances in the IE field so as to best cater to the needs of the concerned potential employers of the region. Thus, the process of continuous improvement addresses the problem of how well the skills and attributes of our graduating engineers match the needs of the employment market of the regional and global levels. In this context, employers' constituencies are surveyed and a list of their needs in terms of the pertinent job-skills is prepared. In light of these needs the curricula are modified and pre-specified educational objectives are targeted. Presently, Department of Industrial Engineering prepares graduates having ability to design, develop, implement and improve integrated systems comprising of people, equipment, materials, energy and information for serving the community at the local and global levels. These graduates should

1. be effective in applying contemporary tools of industrial engineering to cater to the needs of upcoming challenges of the changing industrial world.
2. advance their careers by way of exhibiting their professionalism, leadership qualities and effective oral and written communication skills.
3. function effectively in diverse teams to handle problems pertaining to different industrial and managerial settings.
4. demonstrate professional and ethical responsibilities towards their profession, society, and the environment.
5. apply effectively e-media, computers and software in solving engineering problems.

Along with the undergraduate program the Department has also been running Masters' level programs since last 27 years or so. The geographical location of the University in Jeddah, that is the hub of industrial activities, provides a highly suitable applied research environment. Most of our faculty members are involved in independent funded researches. Some of these are internally funded by the Faculty of Engineering/King Abdulaziz University, whereas there are many schemes available from external sources also (e.g. from Governmental and industrial sectors). These research programs employ undergraduate or graduate students as research assistants. A large number of papers were published in refereed journals and presented in national and international conferences in the last few years. The faculty members are supported and encouraged by the Department to update their competencies and skills continually. Research proposals submitted by them are awarded with funds based on quality of the proposed work. They are encouraged to attend national and international conferences. In terms of the near future developments, plans are already set by the Department for establishing the following new centers/laboratories to satisfy the educational and research needs of the department and the Kingdom's industrial houses:

1) Industrial Design Laboratory
2) Center for Prototyping Development
3) Simulation Laboratory

4) Quality Control Laboratory and
5) Chemical Environmental Factors Laboratory.

# ADMISSION AND GRADUATION REQUIREMENTS

## Students Admissions into the Aeronautical Engineering Program

The actual policy of the Industrial Engineering department is to accept, each semester, a fixed number of students (normally between 30 and 35) of the highest GPA (normally above 3.75/5) from those expressing their interest to join the department with good standing in mathematics and English.

## Graduation Requirements

In order to qualify for a BS degree in Industrial Engineering, students must successfully complete 155 semester credit hours with an overall GPA of 2.75 out of 5 or better. The student has to complete 49 required courses and two elective courses with a grade of D or better including 10 weeks of Industrial Summer Training and a Capstone B.Sc. design project as detailed in the IE curriculum requirements described below in this report.

**Category (Credit Units)** **Conventional Program**

| Requirements | Units | Math & Basic Sciences | Eng. Topics | General Ed. | Eng. Design |
|---|---|---|---|---|---|
| Preparatory year | 27 | 15 | - | 12 | - |
| University Requirements | 14 | - | - | 14 | - |
| Faculty Requirements | 37 | 25 | 5 | 4 | 3 |
| Departmental Requirements | 77 | 2 | 55 | - | 20 |
| **Total** | **155** | **42** | **60** | **30** | **23** |

**Category (Credit Units)** **Cooperative Program**

| Requirements | Units | Math & Basic Sciences | Eng. Topics | General Ed. | Eng. Design |
|---|---|---|---|---|---|
| Preparatory year | 27 | 15 | - | 12 | - |
| University Requirements | 14 | - | - | 14 | - |
| Faculty Requirements | 37 | 25 | 5 | 4 | 3 |
| Departmental Requirements | 69 | 2 | 47 | - | 20 |
| Coop Program | 8 | - | 8 | - | - |
| **Total** | **155** | **42** | **60** | **30** | **23** |

## Graduates' Employment Opportunities

Although a considerable percentage of the graduates join a variety of entities in the Kingdom both in the private and public sectors, a considerable number of the graduates work as engineers or as researchers, or join military and many of them choose to continue their education by obtaining Master and/or PhD degrees.

# PROGRAM REQUIREMENTS AND CURRICULUM

Each course is referred to by an alphabetical code and a three digit number as follows:

9. Industrial Engineering Department is referred to by the code “IE”.
10. The hundredth digit refers to the school year.
11. The tenth digit refers to a specialty group within the department for the numbers from 1 to 5, 0 refers to courses administered or set by the Faculty of Engineering, and 9 refers to training or project-based courses.
12. The ones digit refers to course serial within the same specialty as shown in The table below.

Key of tenth digits in Industrial Engineering Department

| Tens Digit | Delicate Specialty |
|---|---|
| 1 | Operations Research Group |
| 2 | Information Systems Group |
| 3 | Stochastic Processes Group |
| 4 | Human Factors Group |
| 5 | Engineering Management Group |
| 0 | Administered or set by Faculty of Engineering |
| 9 | Training, research or project-based course |

## Department Compulsory Courses

Regular students are required to take 65 credits (23 courses) as indicated in the table.

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| MENG 130 | Basic Workshop | 2 | MENG 102 |
| MATH 241 | Linear Algebra | 3 | MATH 202 |
| IE 256 | Engineering Management | 2 | IE 202, IE 255 |
| IE 311 | Operations Research I | 3 | MATH 241 |
| IE 321 | Fundamentals of Computer Systems | 3 | EE 201 |
| IE 322 | Computer Applications in Industrial Engineering I | 3 | EE 251, IE 321 |
| IE 323 | Computer Applications in Industrial Engineering II | 3 | IE 322, MENG 130 |
| IE 331 | Probability and Engineering Statistics | 3 | STAT 110, MATH 202 |
| IE 332 | Engineering Statistics | 3 | IE 331 |
| IE 341 | Work Study | 3 | IE 331 |
| IE 342 | Human Factors Engineering | 3 | IE 341 |
| IE 351 | Industrial Management | 3 | IE 256 |
| IE 352 | System Analysis and Design | 3 | MATH 204, IE 321 |
| IE 390 | Summer Training (for regular track) | 2 | IE 422, IE 432 |
| IE 395 | IE Seminar | 1 | IE 351 |
| IE 411 | Operations Research II | 3 | IE 311, IE 332 |
| IE 422 | Industrial Systems Simulation | 3 | IE 323, IE 332 |
| IE 431 | Industrial Quality Control | 3 | IE 332, IE 351 |
| IE 432 | Design of Industrial Experiments | 3 | IE 332 |
| IE 441 | Industrial Safety Engineering | 3 | IE 342, IE 351 |
| IE 451 | Production Planning and Control | 3 | IE 341, IE 351 |
| IE 453 | Facilities Planning | 3 | IE 342, IE 352 |
| IE 499 | Senior Project | 4 | IE 422, IE 432 |
| Total | | 65 | |

IE 390 – the summer training, 400 hours of on-job training distributed over 10 weeks that is included in the counting of training units.

| Coop students are required to take all of the above mentioned 23 courses except IE 390 which is replaced by the following course: | | | |
|---|---|---|---|
| **Course No.** | **Course Title** | **Cr. Hr.** | **Prerequisites** |
| IE 400 | Coop Work Program | 8 | IE 422, IE 432 |

## Department Elective Courses

Regular students select 4 courses (12 credit units) out of those in the table.  For coop students 2 elective courses (6 credit units) are required.

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| IE 412 | Decision Analysis | 3 | IE 255, IE 331 |
| IE 413 | Network Analysis | 3 | IE 311, IE 331 |
| IE 415 | Project Management | 3 | IE 351 |
| IE 421 | Industrial Information Systems | 3 | IE 323 |
| IE 423 | Computer Aided Manufacturing Systems | 3 | IE 323 |
| IE 424 | Data Processing Operations | 3 | IE 323 |
| IE 425 | Industrial Information Security | 3 | IE 322 |
| IE 433 | Reliability Engineering | 3 | IE 332 |
| IE 434 | Industrial Stochastic Systems | 3 | IE 331 |
| IE 435 | Queuing Systems | 3 | IE 331 |
| IE 436 | Dynamic Forecasting | 3 | IE 332 |
| IE 442 | Industrial Hygiene Engineering | 3 | IE 342 |
| IE 443 | Industrial Environmental Engineering | 3 | IE 342 |
| IE 444 | Occupational Biomechanics | 3 | IE 342 |
| IE 450 | Marketing Management and Research | 3 | IE 351 |
| IE 452 | Maintenance and Replacement Policies | 3 | IE 332, IE 351 |
| IE 454 | Engineering Cost Analysis | 3 | IE 255 |
| IE 455 | Material Handling and Packaging | 3 | IE 255, IE 331 |
| IE 456 | Feasibility Studies | 3 | IE 255, IE 352 |
| IE 457 | Supply Chain Management | 3 | IE 351, IE 451 |
| IE 458 | Strategic Management in Industry | 3 | IE 351 |
| IE 459 | Introduction to Entrepreneurship | 3 | IE 351 |
| IE 490 | Special  Topics in Industrial Engineering | 3 | Department Approval |
| IE 491 | Industrial Engineering Practice | 3 | IE 341, IE 351 |
| xx xxx | Course offered by the Faculty or University | 3 | Department Approval |

- Each one theoretical hour calculated as one credit unit
- Each two or three practical hour calculated as one credit unit
- There is no circumstance for training hour (not counted in credit calculations)

# A TYPICAL PROGRAM FOR INDUSTRIAL ENGINEERING

## 3rd Year (Regular & Cooperative)

**5th Semester** **6th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| ISLS 201 | Islamic Culture (2) | 2 | ISLS 301 | Islamic Culture (3) | 2 |
| IE 202 | Introduction to Engineering Design II | 2 | MENG 130 | Basic Workshop | 2 |
| MATH 241 | Linear Algebra | 3 | MATH 204 | Differential Equations I | 3 |
| EE 251 | Basic Electrical Engineering | 4 | IE 256 | Engineering Management | 2 |
| IE 321 | Fundamentals of Computer Systems | 3 | IE 311 | Operations Research I | 3 |
| IE 331 | Probability and Engineering Statistics | 3 | IE 322 | Computer Applications in Industrial Engineering I | 3 |
| | | | IE 332 | Engineering Statistics | 3 |
| | Total | ١٧ | | Total | 18 |

The student must select Regular or Cooperative track immediately after the sixth semester.

## 4th Year (Regular)

**7th Semester** **8th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| ARAB 201 | Arabic Language (2) | 3 | IE 342 | Human Factors Engineering | 3 |
| MATH 205 | Calculus IV | 3 | IE 352 | System Analysis and Design | 3 |
| IE 323 | Computer Applications in Industrial Engineering II | 3 | IE 395 | IE Seminar | 1 |
| IE 341 | Work Study | 3 | IE 411 | Operations Research II | 3 |
| IE 351 | Industrial Management | 3 | IE 422 | Industrial Systems Simulation | 3 |
| | | | IE 432 | Design of Industrial Experiments | 3 |
| | Total | ١٥ | | Total | 16 |

## 4th Year Summer – Training (Regular)

| | | |
|---|---|---|
| IE 390 | Summer Training | 2 Cr. Hr. |

## 4th Year (Cooperative)

| 7th Semester | | | 8th Semester | | |
|---|---|---|---|---|---|
| **Course No.** | **Course Title** | **Cr. Hr.** | **Course No.** | **Course Title** | **Cr. Hr.** |
| ARAB 201 | Arabic Language (2) | 3 | IE 342 | Human Factors Engineering | 3 |
| MATH 205 | Calculus IV | 3 | IE 395 | IE Seminar | 1 |
| IE 323 | Computer Applications in Industrial Engineering II | 3 | IE 411 | Operations Research II | 3 |
| IE 341 | Work Study | 3 | IE 422 | Industrial Systems Simulation | 3 |
| IE 351 | Industrial Management | 3 | IE 432 | Design of Industrial Experiments | 3 |
| IE 352 | System Analysis and Design | 3 | IE 451 | Production Planning and Control | 3 |
| | Total | ١٨ | | Total | 16 |

## 4th Year Summer – Training (Cooperative)

| | | |
|---|---|---|
| IE 400 | Coop Work Program | 8 Cr. Hr. |

## 5th Year (Regular)

**9th Semester** / **10th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| IE 431 | Industrial Quality Control | 3 | ISLS 401 | Islamic Culture (4) | 2 |
| IE 451 | Production Planning and Control | 3 | IE 441 | Industrial Safety Engineering | 3 |
| IE 499 | Senior Project | 4 | IE 453 | Facilities Planning | 3 |
| IE xxx | Elective I | 3 | IE xxx | Elective III | 3 |
| IE xxx | Elective II | 3 | IE xxx | Elective IV | 3 |
| | Total | ١٦ | | Total | 14 |

## 5th Year (Cooperative)

**9th Semester** / **10th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| IE 499 | Senior Project | 4 | ISLS 401 | Islamic Culture (4) | 2 |
| | | | IE 431 | Industrial Quality Control | 3 |
| | | | IE 441 | Industrial Safety Engineering | 3 |
| | | | IE 453 | Facilities Planning | 3 |
| | | | IE xxx | Elective I | 3 |
| | | | IE xxx | Elective II | 3 |
| | | | AE 436 | Aircraft Structural Design | ٣ |
| | Total | 4 | | Total | 17 |

## COURSE DESCRIPTION

### IE 200 Technical Communication Skills (2:0,5)

Communication skills: art of listening, tools of in-depth reading, information gathering, analysing, and criticizing; electronic means of communication. Writing skills: writing strategies, general versus technical writing, technical report writing. Presentation skills: use of spoken English, professional computer-based oral presentations. Project-based course work on technical communication.

**Prerequisite: ELCS 102**

### IE 201 Introduction to Engineering Design I (3:0,6)

Introduction to active learning: team work, team dynamics, team norms and communication, conducting effective meetings and quality assessment. Problem solving procedure: problem definition, generation of solutions, selection methodology, solution implementation, assessment of implementation. Levels of learning and degrees of internalization. Ethical decision. Organization of the work and design notebook. Reverse engineering and design projects.

**Prerequisite: COMM 101, ELCS 102**

<table>
<tr><th rowspan="2">COURSE TITLE</th><th rowspan="2">ENGLISH CODE/NO</th><th rowspan="2">ARABIC CODE/NO</th><th colspan="4">CREDITS</th></tr>
<tr><th>Th.</th><th>Pr.</th><th>Tr.</th><th>TCH</th></tr>
<tr><td>Introduction to Engineering Design II</td><td>IE 202</td><td>هـ ص ٢٠٢</td><td>-</td><td>4</td><td>-</td><td>2</td></tr>
<tr><td>Pre-requisites</td><td colspan="6">IE 200, IE 201</td></tr>
<tr><td colspan="7">Engineering design process. Computer modeling and heuristics for problem solving. Hands-on real life and team–based engineering design project: customer requirements, conceptual design, prototyping, functional testing, preparation of operational manual. Communicating design outcomes.</td></tr>
</table>

***Faculties and departments requiring this course (if any):***

Faculty of Engineering

***Textbooks:***

- Anthony M. Starfield, Karl A. Smith, and Andrew L. Bleloch, HOW TO MODEL IT, PROBLEM SOLVING FOR THE COMPUTER AGE, McGraw Hill, (1994).
- Class notes and handouts material by the instructor (downloadable from the course web site http://engg.kau.edu.sa/ie202

***References:***

None

***Course Leaning Objectives*:**

**By completion of the course, the students should be able to:**

1. Define the problem, identify customer needs, and transform the needs into design requirements.
2. Access information from a variety of sources, and critically evaluate their quality, validity and accuracy.
3. Plan an effective design strategy with manageable subtasks and timelines.
4. Develop and compare alternative solutions to select a baseline design.
5. Consider realistic constraints such as economic, environmental, social, manufacturability, and sustainability.
6. Integrate prior knowledge of science and mathematics with engineering principles, heuristics and modeling techniques to formulate unstructured engineering problems.
7. Effectively use modern engineering tools to carry on design and performance calculations.
8. Evaluate the baseline design and argue suitable improvements and changes.
9. Work in a student team to Build, test, and evaluate a working prototype of the designed artifact.
10. Document the design procedure, communicate design details and express thoughts clearly and concisely, both orally and writing.
11. Demonstrate ability to achieve objectives using independent, well organized, and regularly reported multidisciplinary team management techniques.

## ***Course Topics and Duration*:**

| | |
|---|---|
| (2 weeks ) | 1. Introducing Course Design Project |
| (5 weeks ) | 2. Concept Design Phase |
| (4 weeks) | 3. Drawing and Prototyping Phase |
| (1½ weeks) | 4. Testing and Evaluation |
| (1½ weeks) | 5. Communication of Design Details |

## ***Class Schedule*:**

The class meets twice a week, 110 minutes per class.

## ***Course Contribution to professional Component*:**

- Engineering science: None
- Engineering design: 100 %

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| | 2 | 3 | | 3 | 3 | | | | | | 2 | 3 | | | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٢٥٥ | IE 255 | Engineering Economy |
| MATH 110 | | | | | | Pre-requisite |
| Fundamentals of engineering economy. Time value of money. Evaluation of alternatives. Replacement and retention analysis. Break even analysis. Depreciation methods. Basics of inflation. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Faculty of Engineering

***Textbook:***

Blank, L. T. and Tarquin, A. J., BASICS OF ENGINEERING ECONOMY, McGraw-Hill, (2008), ISBN 978-0-07-128762-3.

***References:***

- Park, C. S., FUNDAMENTALS OF ENGINEERING ECONOMY, (2004), ISBN 0-13-030791-2
- *White, J. A., Case, K. E., Pratt, D. B.* and Agee*, M.* H., *PRINCIPLES OF ENGINEERING ECONOMIC ANALYSIS* , *4th ed.,* John Wiley Sons, Inc., (1998), 491 pp., *ISBN 0-471-11027-2.*

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understand the fundamentals of engineering economy and the basic principles of the time value of money.
2. Draw the cash-flow diagrams (CFD).
3. Identify and Compare different interest rates i.e., Simple, compound, MARR, ROR, nominal and effective.
4. Compute equivalent values for time based cash flows of varying complexities.
5. Compare economic alternatives based on equivalent present worth (PW), future worth (FW), capitalized cost (CC), payback period (PbP), annual worth (AW) values and Benefit cost ratios (B/C).
6. Compute the internal rate of return (IRR) and evaluate an economic alternative on the basis of IRR.
7. Make analytical decisions by replacement and breakeven analysis of different projects / alternatives.
8. Understand and compute depreciations related to machines / projects using straight line (SL), Sum of Year Digits (SYD), Declining Balance (DB) and Double Declining Balance (DDB) method.
9. Understand and compute effects of inflation.
10. Write reports related to engineering economy by using modern engineering tools.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (2 weeks) | 1. Foundation of Engineering Economy: Interest (simple & compound), cash flows, MARR, rate of return (ROR) & CFD |
| (2 weeks) | 2. Factors: How time and interest affect money, combining Factors: Single payment, Uniform Series, Arithmetic & Geometric Gradient, shifting of series, determination of unknown I & n, Interpolation |
| (1 week ) | 3. Nominal And effective Interest Rates: Nominal and effective interest and equivalence relations involving Payment period and Compounding period |
| (4 weeks) | 4. Tools for the evaluation of alternatives: PW, FW, AW, CC, PbP, ROR, B/C Analysis |
| (2 weeks) | 5. Making Decisions on real world. Replacement study & its applications, Break Even Analysis |
| (2 weeks) | 6. Depreciation Methods: SL, SYD, DB, DDB |
| (1 week) | 7. Effects of Inflation, Evaluation of alternatives adjusted for inflation |

## ***Class Schedule:***

The class meets three times in a week. Two times are for regular sessions of 1 hour 20 minutes of lecture times and 2 hours of tutorial time.

## ***Course Contribution to professional Component:***

- Engineering science: 50%
- Engineering design: 50%

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | | | | | | | | | | 2 | 3 | | | 3 | | | **Max. Attainable Level of Learning[*]** |

[*]1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 2 | - | - | 2 | هـ ص ٢٥٦ | IE 256 | Engineering Management |
| IE 202, IE 255 | | | | | | Pre-requisites |
| Role of engineers in management of organizations. Managerial functions related to production, inventory and human resources. Project planning and control. Case studies pertaining to engineering problems. | | | | | | |

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department and Electrical Engineering Department

***Textbook:***

Morse, L. C. and Babcock, D. L., MANAGING ENGINEERING AND TECHNOLOGY, 4th ed., Prentice Hall, (2007), ISBN: 0-13-205026-9.

***References:***

- Chang, C. M., ENGINEERING MANAGEMENT: CHALLENGES IN THE NEW MILLENNIUM, Prentice Hall, (2005), ISBN: 0-13-144678-9.
- Payne, A. C., Chelsom, J. V. and Reavill, L. R. P., MANAGEMENT FOR ENGINEERS, John Wiley, (1996), ISBN: 0-471-95603-1.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Apply knowledge of math, science and engineering in engineering management
2. Work efficiently in Teams
3. Use Managerial Skills in Engineering
4. Learn to Learn (long life learning)
5. Communicate effectively in written/oral communication skills
6. Use the techniques, skills, and modern engineering tools necessary for engineering management practices
7. Use soft skills

***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week) | 1. Introduction to Engineering & Management – ch1 |
| (1 week) | 2. Historical Development of Engineering Management – ch2 |
| (1 week) | 3. Function of Management – handout |
| (2 weeks) | 4. Planning & Forecasting – ch3 |
| (2 weeks) | 5. Organization – ch5 |
| (2 weeks) | 6. Decision Making – ch4 |
| (1 week) | 7. Motivation – ch7 |
| (2 weeks) | 8. Project Management – ch14 |
| (2 weeks) | 9. Planning Production Activities – ch11 |

***Class Schedule*:**

This is a common course. The class meets 3 times a week for some sections each taking 50 minutes, or 2 times a week each taking 80 minutes.

***Course Contribution to Professional Component*:**

- Math and Basic Science: 20 %
- Engineering Science: 20 %
- Engineering Design: 20 %
- Human and Social Science: 40 %

***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | 3 | | | | | | | | | | 2 | | | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـص ٣١١ | IE 311 | Operations Research I |
| MATH 241 | | | | | | Pre-requisite |
| Introduction to Operations Research. Formulation of linear programming problems. Graphical solution. The Simplex algorithm. Duality and sensitivity analysis. Transportation and assignment problems. Integer and Goal programming. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Hillier, F. S. and Lieberman, G. J., INTRODUCTION TO OPERATIONS RESEARCH, 7th edition, McGraw Hill, Singapore, (2001), ISBN: 0-07-232169-5.

***References:***

Taha, H. A., OPERATIONS RESEARCH: AN INTRODUCTION, 7th ed., Pearson Education, Singapore, (2002), ISBN: 81-7808-757-X.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understand the integrated nature of the discipline.
2. Understand the basic principles of linear programming.
3. Comprehend the concepts of Simplex algorithm.
4. Analyze the concept of duality and post optimality analysis.
5. Learn the Assignment model used for solving a linear program.
6. Learn the Transportation problem for solving a linear program.
7. Identify, formulate, and solve basic engineering and managerial problems.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (1 week) | 1. Introduction to Operations Research. |
| (1 week) | 2. Introduction to Linear Programming. |
| (1 week) | 3. The Simplex Method. |
| (2 weeks) | 4. Sensitivity Analysis. |
| (2 weeks) | 5. Duality. |
| (2 weeks) | 6. Transportation, Assignment, and Transshipment Problems. |
| (1 week) | 7. Network Models. |
| (2 weeks) | 8. Examples on Integer Programming |

## ***Class Schedule:***

The class meets three times a week. Sunday and Tuesday, for lectures from 9:30 am to 10:50 am, and on Tuesday for tutorial, from 2:30 to 4:30 pm

## ***Course Contribution to Professional Component:***

- Engineering Science: 50 %
- Engineering Design : 50 %

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | 3 | | | | 2 | | 2 | 2 | 3 | | 3 | 1 | 2 | 3 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO. | ENGLISH CODE /NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٣٢١ | IE 321 | Fundamentals of Computer Systems |
| EE 201 | | | | | | Pre-requisite |
| Fundamentals of computer: hardware, software and computer systems concepts. Introduction to operating systems and data processing. Overview of programming languages. Internet and computer security. Introduction to software packages for Industrial Engineering applications. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Norton P., INTRODUCTION TO COMPUTERS, 6th ed., McGraw Hill, (2004), ISBN13: 978-0-07-297890-2.

***Reference:***

Rainer, R. K. and Turban, E., INTRODUCTION TO INFORMATION SYSTEMS: SUPPORTING AND TRANSFORMING BUSINESS, 1st ed, Wiley (2008), ISBN10: 0471736368
ISBN13: 9780471736363.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Recognize the role information technology in today's life
2. Identify and define the functions of computers
3. Learn how to communicate in the information age
4. Understand the significance of the Internet
5. Identify the usage of different software & packages
6. Function in multi-disciplinary teams
7. Communicate effectively in oral and written presentation

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week) | 1. Introducing Computer Systems |
| (1 week) | 2. Presenting the Internet |
| (1 week) | 3. Interacting with Your Computer |
| (1 week) | 4. Seeing, Hearing, and Printing Data |
| (1 week) | 5. Processing Data |
| (1 week) | 6. Storing Data |
| (1 week) | 7. Using Operating Systems |
| (1 week) | 8. Working with Application Software |
| (1 week) | 9. Networks |
| (1 week) | 10. Working in the Online World |
| (1 week) | 11. Data Base Management |
| (1 week) | 12. Development of Information Systems |
| (1 week) | 13. Software Programming and Development |
| (1 week) | 14. Protecting Your Privacy, Your Computer and Your Data |

## ***Class Schedule*:**

The class meets four times a week; three times as regular sessions of 50 minutes each and a tutorial class for 90 minutes.

## ***Course Contribution to professional Component*:**

- Math and Basic Science: 25%
- Engineering Science: 25%
- Engineering Design: 25%
- Human and Social Science: 25%

## ***Relationship to Program Outcomes*:**

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | 3 | 2 | 3 | 3 | 2 | | 3 | 3 | 2 | 2 | 2 | 3 | | 3 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

.

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٣٢٢ | IE 322 | Computer Applications in Industrial Engineering I |
| EE 251, IE 321 | | | | | | Pre-requisites |
| Basics of computer programming languages. Object oriented programming concepts. Development of application and appropriate algorithms for solving Industrial Engineering problems. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any)*:**

Industrial Engineering Department

***Textbook*:**

Dietel, Dietel, Hoey, Yaeger, SIMPLY C#, Prentice Hall, (2004), ISBN 0-13-142641-9.

***Refrences:***

Michelsen, K., C# PRIMER PLUS, 4th ed., Sams Publisher, (2002), ISBN 0-672-32152-1.

***Course Leaning Objectives*:**

**By completion of the course, the students should be able to:**

1. Explain the fundamentals of C# language.
2. Understand the Visual IDE of C#.
3. Understand and define the real world problem.
4. Develop a problem solving process for the problem.
5. Translate a written problem statement into a mathematical model.
6. Develop flow chart for the process.
7. Develop / select appropriate algorithm for solving the model.
8. Convert mathematical model into C# codes.
9. Solve fundamental engineering problems using C#.
10. Develop and design a software prototype for the envisaged solutions.
11. Understand the importance of lifelong learning.
12. Access information from various online resources.

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week) | 1. Introduction to C#, Visual IDE, its structure and compilation |
| (1 week) | 2. Understanding errors ,debugging and exception handling |
| (1 week) | 3. Defining real world problems |
| (1½ week) | 4. Computer memory concepts & data types and matrices. |
| (1 week) | 5. Flow charting |
| (1 week) | 6. Control structure & Decision making with C# |
| (½ week) | 7. Lifelong learning concept. |
| (1½ week) | 8. Methods and classes in C# |
| (½ week) | 9. File handling |
| (2 weeks) | 10. Arithmetic, logical operators & algorithms. |
| (2 weeks) | 11. Visual IDE and prototype designing |
| (1 week) | 12. Menus and graphics |

## ***Course Schedule*:**

The class meets three times in a week. Two times for regular sessions of 1 hour 20 minutes of lecture time and 2 hours of tutorial time

## ***Course Contribution to professional Component*:**

- Engineering Science: 1 credit for 25%
- Engineering Design: 2 credit for 50%
- Human and social science: 1 credit for 25%

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 2 | 2 | | | | 2 | | | | | | 3 | | | 2 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٣٢٣ | IE 323 | **Computer Applications in Industrial Engineering II** |
| **MENG 130, IE 322** | | | | | | **Pre-requisites** |
| Introduction to computer applications, databases and relational database management systems. Design and development of databases. Management of database users and security. Introduction to front-end and its connectivity with the database. | | | | | | |

***One hour tutorial session**

***<u>Faculties and departments requiring this course (if any)</u>*:**

Industrial Engineering Department

***<u>Textbook</u>*:**

Ahmad, W., ESSENTIALS OF ORACLE, McGraw-Hill, (2009), ISBN: 978-0-077-12586-8.

***<u>References</u>*:**

Oracle Education Press, ORACLE 8: INTRODUCTION TO ORACLE PL/SQL,
Student Guide production 1.1, Volume 1.2,

Course Material is also available on the website www.wahmad.net or www.wahmad.com. You need to register yourself in order to access the resource material. Your computer No. is your user name select your password accordingly

***<u>Course Leaning Objectives</u>*:**

**By completion of the course, the students should be able to:**

1. Understand the concepts of Database and software applications in industrial engineering.
2. Understand concepts of ORDBMS.
3. Understand and work in client / server Environment.
4. Understand the basic principles of Object oriented Technology.
5. Design databases using RDBMS Tools
6. Develop Databases and computer programs for the solution of engineering Problems.
7. Develop and design reports and forms using GUI tools.
8. Research, identify and understand a working knowledge of variety of different latest programming techniques, software's and their applications.
9. Research, write and present technical report using modern engineering tools.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (½ week) | 1. Introduction to Excel 2000 |
| (1 week) | 2. Solving Statistical Problems Using Excel |
| (½ week) | 3. Creating Graphs in Excel 2000 |
| (1 week) | 4. Introduction to SQL / PLSQL |
| (1 week) | 5. DDL Commands |
| (1 week) | 6. DML Commands |
| (1 week) | 7. Function Of SQL Plus |
| (½ week) | 8. Select Statement with all options |
| (1 week) | 9. Creating, Dropping and Altering Tables |
| (½ week) | 10. Introduction to developer 2000 version (2.1) Form designer 5.0 |
| (1½ weeks) | 11. Creating Simple forms |
| (½ week) | 12. Form Properties |
| (1½ weeks) | 13. Canvas and Canvas Properties |
| (1 week) | 14. Introduction to Report designer 3.0 |
| (1½ weeks) | 15. Creating Simple Reports |

## ***Class Schedule:***

The class meets three times in a week. Two times are for regular sessions of 1 hour 20 minutes of lecture times and 2 hours of tutorial time.

## ***Course Contribution to professional Component:***

- Engineering Science: 25 %
- Engineering Design: 50 %
- Human & Social Science: 25 %

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| | 3 | | | | 3 | | | | | | 3 | 3 | | | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٣٣١ | IE 331 | Probability and Engineering Statistics |
| STAT 110, MATH 202 | | | | | | Pre-requisites |
| Descriptive statistics with graphical summaries. Basic concepts of probability and its engineering applications. Probability distributions of random variables. Confidence intervals. Introduction to hypothesis testing. Correlation and linear regression. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Navidi, W., STATISTICS FOR ENGINEERS AND SCIENTISTS, 2nd ed., McGraw-Hill Higher Education, (2008), ISBN: 978-0-07-110222-3.

***References:***

- Walpole, R. E., Myers, R. H., Myers, S. L. and Ye, K., PROBABILITY AND STATISTICS FOR ENGINEERS AND SCIENTISTS, 7th ed., Prentice Hall Inc, (2002), ISBN: 0-13-098469-8.
- Peck, R., Olsen, C., Lay L., INTRODUCTION TO STATISTICS AND DATA ANALYSIS, 2nd ed., Devore; Duxbury Press, (2004), ISBN: 0534467105.
- Hines, W. W., Montgomery, D. C., Golsman, D. M., Borror, C. M., PROBABILITY AND STATISTICS IN ENGINEERING, John Wiley & Sons, Inc., (2003).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Calculate the most important descriptive statistics.
2. Apply fundamental theories of probability.
3. Identify and calculate the statistics of discrete and random variables.
4. Apply some discrete and continuous probability distributions to real life problems.
5. Express statistical results graphically.
6. Perform confidence intervals calculations.
7. Perform statistical hypothesis tests.
8. Perform simple linear regression and correlation.
9. Use some statistical packages, and apply it to real world problems.
10. Interpret the obtained statistical results.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (2 weeks) | 1. Sampling and Descriptive Statistics<br>- Summary Statistics<br>- Graphical Summaries |
| (4 weeks) | 2. Probability<br>- Basic probability theories.<br>- Conditional Probability and Independence<br>- Random Variables |
| (4 weeks) | 3. Commonly Used Distributions<br>- The Binomial Distribution<br>- The Poisson Distribution<br>- The Exponential Distribution<br>- The Normal Distribution<br>- The Central Limit Theorem<br>- The Student's t Distribution |
| (2 weeks) | 4. Confidence Intervals |
| (2 weeks) | 5. Hypothesis Testing |

## ***Class Schedule:***

This is usually multi-section classes and therefore different sections will have different schedules. Each section will meet either three times a week (1 hour duration) or two times a week (1 hour 20 minutes duration) and 2 hours of tutorial time.

## ***Course Contribution to professional Component:***

- Engineering science: 65%
- Engineering design: 35%

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | 1 | | | | | | | | | | 3 | | 1 | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٣٣٢ | IE 332 | Engineering Statistics |
| IE 331 | | | | | | Pre-requisite |
| Basic notions of statistics applicable to engineering problems. Moment generating functions. Random samples and sampling distributions. Parameter estimation. Hypothesis testing. Nonparametric tests. Simple and multiple regression. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

- Walpole, Myers, Myers and Ye, PROBABILITY & STATISTICS FOR ENGINEERS AND SCIENTISTS, 7th ed., Prentice Hall, (2002), ISBN: 0-13-098469-8.

***References:***

- Jiju Antony, DESIGN OF EXPERIMENTS FOR ENGINEERS AND SCIENTISTS, Butterworth-Heinemann, (2003), ISBN: 0-7506-4709-4.
- Hayter, A.J., PROBABILITY AND STATISTICS FOR ENGINEERS AND SCIENTISTS, PWS Publishing Company, New York, NY, (1996), ISBN: 053495610-6.
- Class notes and handouts by instructor

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understand the importance of statistics
2. Identify and define statistical problems related to Industrial Engineering.
3. Demonstrate the ability to set up the procedure for appropriate solutions.
4. Comprehend professional skills and ethics in professional life.
5. Adopt analytical approach to problems faced by individuals or society.
6. Interpret the results and communicate effectively

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (1½ weeks) | 1. Joint Probability Distributions |
| (2 weeks) | 2. Functions of Random Variables |
| (½ week) | 3. Some Important Continuous Distributions |
| (1 week) | 4. Random Samples and Sampling Distributions |
| (2½ weeks) | 5. Parameter estimation |
| (3 weeks) | 6. Tests of Hypotheses |
| (2 weeks) | 7. Simple linear regression and Correlation |
| (½ week) | 8. Multiple Regression |
| (1 week) | 9. Nonparametric Statistics |

## ***Class Schedule*:**

The class meets four times a week. Three times as regular sessions of 1 hour each on Saturday, Monday and Wednesday from 9 AM to 10 AM and a tutorial class for 1.5 hours on Monday from 1:00 PM to 2:30 PM

## ***Course Contribution to professional Component*:**

- Math and Basic Science: 25%
- Engineering Science: 25%
- Engineering Design: 25%
- Human and Social Science: 25%

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | 3 | 2 | 2 | | 3 | | | | | | 3 | | | 3 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 2 | 3 | هـص ٣٤١ | IE 341 | Work Study |
| IE 331 | | | | | | Pre-requisite |

Introduction to Work Study (WS). Productivity and WS. WS approaches. Basic procedure of motion study: job selection, recording facts, critical examination, etc. String diagram, Multiple activity chart, Travel chart. Principles of motion economy. Two-handed chart. Fundamental hand motions. Micro-motion and Memo-motion studies. Cyclegraph and Chrono-cyclegraph. Work Measurement (WM). Work sampling. Time study. Computerized WM. PMTS: MTM, Work factor and Standard data. Wage payment and incentive plans.

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Kanawati, G., (Ed), INTRODUCTION TO WORK STUDY, 4th Rev. ed., (1992), International Labor Office: Geneva, ISBN: 92-2-107108-1.

***References:***

- Lawrence, SA, WORK MEASUREMENT AND METHODS IMPROVEMENT, John Wiley & Sons, (2000), ISBN: 0-471-37089-4.
- Barnes, RM, MOTION AND TIME STUDY: DESIGN & MEASUREMENT OF WORK, 8th ed., John Wiley & Sons Inc., New York, (1980).
- Mundel, ME, MOTION AND TIME STUDY: PRINCIPLES AND PRACTICE, (1989), Prentice Hall, New Jersey.
- Niebel, BW, MOTION AND TIME STUDY, (1972), Illinois, Richard Irwin.
- Class notes/handout material provided by instructor
- Web-page for the Course: Group name: works8;
  Group home page: http:// groups.yahoo.com/group/works8; Group email: works8@yahoogroups. com

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understand meaning and 'Basic Procedure'.
2. Explain/use the tools and techniques of 'method study' (Charts/diagrams, micro-motion studies & Principles of Motion economy).
3. Explain/use the tools and techniques of 'work measurement' (WM), (Basic concept of WM and various Techniques of WM).
4. Design, perform and analyze the studies/experiments related to WS (e. g. Process analysis, operation analysis, time study, Pre-determined motion time system (PMTS), Standard data and work sampling with statistical analysis).
5. Work in a team and communicate effectively in performing the assigned works (Home works/Term Project).

## ***Topics Covered and Duration:***

| | |
|---|---|
| (1½ weeks) | [A] Introduction to Work Study:<br>Definition and scope of Work Study (2)<br>Productivity and Work Study(2)<br>Work Study, the Approach: Value of the Work Study, Techniques, Basic Procedure (3) |
| (5½ weeks) | [B] Method Study:<br>Method study and Job Selection (2)<br>Recording Facts (3)<br>Critical Examination (2)<br>String Diagram (1)<br>Multiple Activity Chart (1)<br>Travel Chart (1)<br>Principles of Motion Economy (2)<br>The Two Handed Chart; Operation Analysis and Fundamental Hand Motions (1)<br>Micro-motion and Memo-motion analysis (1)<br>Cyclegraph and Chrono-cyclegraph (1)<br>Evaluation, Definition, Installation and Maintenance of the new method (2). |
| (7 weeks) | [C] Work Measurement:<br>The Definition, Purpose, Use and Techniques (2)<br>Work Sampling (3)<br>Time Study :Equipment, Forms, Job-selection, Timing, Steps, Sample size (3)<br>Rating (2)<br>Basic time, Selected time, Allowances, Standard Time, Computer-Aided Time study(CAT)(2)<br>PTS: Wok Factor (2)<br>MTM(2)<br>Standard Data(2)<br>Case Studies pertaining to Human Factors, Wage Payment/Incentive plans(2) |

## ***Class Schedule:***

The classes are held thrice per week for lectures (Saturdays, Mondays & Wednesdays 0900-0950 Hours) and once in a week for laboratory (Mondays: 1430-1630 Hours).

## ***Course Contribution to professional Component:***

- Math and Basic Science: 12.5%
- Engineering science: 25%
- Engineering design: 50%
- Human and Social Science: 12.5%

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | | 2 | | | | | 2 | 2 | 2 | | 3 | 2 | 3 | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 2 | 3 | هـ ص ٣٤٢ | IE 342 | **Human Factors Engineering** |
| **IE 341** | | | | | | **Pre-requisite** |
| Introduction to human factors engineering. Muscular work. Nervous control. Work efficiency. Body size and anthropometrics. Work station design. Heavy work. Handling loads. Man-machine systems. Mental activity. Fatigue. Stress and boredom. Vision and lighting. Noise and vibration. | | | | | | |

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Kroemer, KHE & Grandjean, FITTING THE TASK TO THE HUMAN: A TEXT BOOK OF OCCUPATIONAL ERGONOMICS, 5th ed., E. Taylor & Francis Publishers, London, (1997).

***References:***

- Tayyari, F. and Smith, J., OCCUPATIONAL ERGONOMICS, PRINCIPLES & APPLICATIONS, Chapman & Hall, London, (1997), [SITE: www.thomson.com]
- Bridger, R S, INTRODUCTION TO ERGONOMICS, New York: McGraw-Hill, (1995).
- Class notes/handout material provided by instructor.
- Web-page for the Course: Group name: zahid_jmi; Group home page: http:// groups.yahoo.com/group/zahid_jmi; Group email: zahid_jmi@yahoogroups.com

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Explain the Basic Concepts of human factors engineering.
2. Identify, formulate, and solve human factors problems and implement them.
3. Explain basic principles and impact of environmental factors such as illumination, noise, and vibration.
4. Develop verbal and written communication skills through written reports and presentations.
5. Explain and use ergonomic tools/ techniques to conduct experimental and analytical studies.
6. Work in a Team and communicate effectively.

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (3 weeks) | Introduction to human factors engineering (4); Muscular Work: physiological principles, Static effort (4); Nervous Control of Movements (4) |
| (3 weeks) | Work Efficiency (4); Body size and Anthropometrics (4); Workstation Design: Working height, Neck & head, Room to Grasp, sitting at work, Computer work station and Design of the keyboard (6) |
| (2 weeks) | Heavy Work: Physiological principles, Energy consumption, Upper limits, Energy efficiency, Heart rate as a measure of workload; Work and Heat, Case histories (6) |
| (1 week) | Handling loads: Back troubles, ID Pressure, Biomechanical models of Lower Back, IO Pressure, Subjective judgment (4) |
| (2 weeks) | Human-machine Systems: Introduction, Displays, Controls, C/D relationship (6) |
| (½ week) | Mental Activity: Elements of Brain work, Uptake of information, Memory, Sustained alertness (vigilance) (2) |
| (1 weeks) | Fatigue: Muscular, General, Fatigue in industry and Measurement of Fatigue (4) |
| (1½ weeks) | Introduction to Occupational Stress (2), Boredom (2), Vision & Lighting (2), and Noise and Vibration(2) |

## ***Class Schedule*:**

The classes are held three times in a week for lectures (Saturdays, Mondays & Wednesdays: 1000-1050 Hours) and once in a week for laboratory (Wednesdays: 1430-1630 Hours).

## ***Course Contribution to professional Component*:**

- Math and Basic Science: 0 Credit or 0%
- Engineering Science: 1 Credit or 25%
- Engineering Design: 2 Credit or 50%
- Human and social science: 1 Credit or 25 %

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 2 | | 3 | | | | | | | 2 | | 2 | 3 | 3 | 2 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٣٥١ | IE 351 | Industrial Management |
| IE 256 | | | | | | Pre-requisite |
| Introduction to industrial management. Economic concepts in industry. Organizational structure and design. Human resource management. Motivating the work force. Managing information technology. Financial management. Engineers in marketing and services. Job analysis, job description and job specification. Preparation of business plan. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Bovee, Thill, Mescon, EXCELLENCE IN BUSINESS, 3rd ed., Prentice Hall, ISBN: 0-13-187047-5.

***References:***

- Ferrel, H. F., BUSINESS A CHANGING WORLD, 7th ed., McGraw-Hill, (2006), ISBN 0-07-111581-1.
- Boone, L. E. and Kurtz, D. L., CONTEMPORARY BUSINESS, Thomson South-Western, (2006), ISBN: 0-324-33587-7.
- Class notes and handout material by instructor is available on website at http://elearning.alhaque.com. The site requires registration by the students.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Identify and define the functions of management, authority relationship, and ethical responsibilities of business.
2. Compare and contrast the prevalent economic systems.
3. Explain the organization structure and design, methods of departmentalization commonly used.
4. Discuss the significance of Human Resource Management.
5. Compare and contrast the different Motivational approaches available to the managers.
6. Identify and discuss the information technology tools required for managers.
7. Understand and discuss the importance of Financial Management.
8. Identify, define, compare and contrast customer driven marketing Strategies.
9. Analyze and design Job description and specifications.
10. Function in multi-disciplinary teams.
11. Communicate effectively in oral and written presentation.
12. Understanding the importance of Business Plan.

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (2 weeks) | Fundamentals of Business & Economics |
| (1 week) | Forms of Business Ownership |
| (2 weeks) | Information Technology & E-Commerce |
| (1½ week) | The Functions of Management |
| (1 week) | Entrepreneurs and Small Business |
| (1 week) | Organization & Team Work |
| (1½ weeks) | Employees Motivation, Workforce Trends & Labour Relations |
| (1½ weeks) | Managing Human Resource |
| (1 week) | The Art & Science of Marketing |
| (1½ weeks) | Financial Management |

## ***Class Schedule*:**

This is a Departmental Core Course. The class meets 3 times a week for lectures, and tutorial. The lecture is of 80 minutes, and the tutorial is for 110 minutes.

## ***Course Contribution to Professional Component*:**

- Math and Basic Science: 25 %
- Engineering Science: 25 %
- Engineering Design: -
- Human and Social Science: 50 %

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | 3 | 3 | 2 | 3 | | | | | 3 | 2 | 3 | | | 3 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO</th><th rowspan="2">ENGLISH CODE/NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCH</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>-</td><td>1*</td><td>3</td><td>هـ ص ٣٥٢</td><td>IE 352</td><td>System Analysis and Design</td></tr>
<tr><td colspan="6">MATH 204, IE 321</td><td>Pre-requisites</td></tr>
<tr><td colspan="7">System definition, characteristics and concepts. Systems development projects: identification, selection, initiation, planning and managing. System analysis: determining and structuring requirements. System design: overview, forms and reports, interfaces and dialogues, and finalizing design specifications. Designing distributed and internet systems. System implementation and maintenance.</td></tr>
</table>

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Hoffer, J. A., George, J. F. and Valacich, J. S., MODERN SYSTEMS ANALYSIS AND DESIGN, 4th ed., Prentice Hall, (2005), ISBN: 0-13-127391-4.

***References:***

- Kendal and Kendal, SYSTEMS ANALYSIS AND DESIGN, 4th ed., Prentice Hall, ISBN: 0-13-954934-X.
- Deitel, Deitel and Goldberg, INTERNET AND WORLD WIDE WEB: HOW TO PROGRAM, 3rd ed., Prentice Hall, (2004), ISBN: 0-13-124682-8.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Develop and enhance students' understanding of the concepts of systems, systems thinking, systems analysis and design as well as other related concepts and terminology.
2. Develop the analytical and design abilities of the students throughout the system development life cycle with a variety of methodologies, techniques and tools and how to apply them in improving/developing systems in organizational contexts.
3. Develop awareness and understanding of the latest modern technological developments and trends specifically the widespread development and use of internet-based systems and mobile devices and also their impact on work in system analysis and design.
4. Provide learning opportunities for students to know and have hands-on experience in using software for web design, project management and charting as well as CASE tools.
5. Develop the students' abilities to communicate in various media and participate effectively in team work.

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week) | 1. The Systems Development Environment |
| (1 week) | 2. Systems Concepts and Succeeding as a Systems Analyst |
| (1 week) | 3. Sources of Software |
| (1 week) | 4. Managing the Systems Project |
| (1 week) | 5. Identifying and Selecting Systems Development Projects |
| (1 week) | 6. Initiating and Planning Systems Development Projects |
| (1 week) | 7. Determining System Requirements |
| (1 week) | 8. Structuring System Requirements : Process Modeling |
| (1 week) | 9. Structuring System Requirements : Logic Modeling |
| (1 week) | 10.Structuring System Requirements: Conceptual Data Modeling |
| (1 week) | 11. Design Overview |
| (1 week) | 12. Designing Forms and Reports |
| (1 week) | 13. Finalizing Design Specifications |
| (1 week) | 14. Designing Distributed and Internet Systems |
| (1 week) | 15. System Implementation & Maintenance (If Time permits) |
| (1 week) | 16. Object-Oriented Analysis and Design (Optional) |

## ***Class Schedule*:**

The class meets three times in a week. Two times are for regular sessions of 1 hour 20 minutes of lecture times and 2 hours of tutorial time.

## ***Course Contribution to professional Component*:**

- Engineering Science: 50 %
- Engineering Design: 50 %

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | 1 | 2 | | 2 | 2 | | | | 2 | | 3 | 2 | | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO</th><th rowspan="2">ENGLISH CODE/NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCH</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>2</td><td>400</td><td>4</td><td>-</td><td>هـ ص ٣٩٠</td><td>IE 390</td><td>Summer Training</td></tr>
<tr><td colspan="6">IE 422, IE 432</td><td>Pre-requisites</td></tr>
<tr><td colspan="7">On-site industry based training spanning over a period of 10 weeks in a manufacturing or service industry under the supervision of an industry based advisor. Documentation of the training in the form of an Industrial Training report presenting details of the work undertaken. Multimedia presentation illustrating the achievements of training.</td></tr>
</table>

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

None

***References:***

None

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Formulate an objective or mission statement that identify the real problem and describe the expected outcomes of the training activity.
2. Break-down a work environment into its units and work functions, and describe how these units are assembled into a whole entity.
3. Describe a professional organizational structure, its size and how it is related to its main products and to market issues.
4. Exhibit integrity, punctuality, and ethical behavior in engineering practice and relationships.
5. Demonstrate enthusiasm and business focusing.
6. Establish successful relationships with team members, advisors, and clients to understand their needs and to achieve or exceed agreed-upon quality standards.
7. Maintain focus to complete important tasks on time and with high quality, amidst multiple demands
8. Relate practical work to previous knowledge from basic sciences, engineering fundamentals, and discipline related courses.
9. Collect and review related data such as technical information, regulations, standards, and operational experiences from credible literature resources

10 Utilize prior knowledge, independent research, published information, and original ideas in addressing problems and generating solutions.

11. Monitor achievement, identify causes of problems, and revise processes to enhance satisfaction.
12. Communicate, clearly and concisely, training details and gained experience, both orally and in writing, using necessary supporting material, to achieve desired understanding and impact.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (10 weeks) | 1. Acquainting the trainee by the company, its work environment, organizational structure, products, costumers, engineering units, and quality system. |
| | 2. Acquainting the trainee by the company, its work environment, organizational structure, products, costumers, engineering units, and quality system. |
| | 3. Acquainting the trainee by the company, its work environment, organizational structure, products, costumers, engineering units, and quality system. |
| | 4. Familiarizing the trainee of one production or design unit with deep understanding of the work environment, regulations, standards, etc. |
| | 5. Allocating the trainee to a project team and allowing him to study and collect necessary data about the project using internal and external data sources. |
| | 6. Working as a team member to execute assigned tasks with the following objectives:<br>• Apply engineering practices related to his specialization.<br>• Enhance team work skills.<br>• Relate practical work to his engineering knowledge.<br>• Use modern engineering tools such as equipment and computer software.<br>• Use project management techniques.<br>• Complete assigned tasks on time with high quality.<br>• Develop personal communication skills. |

## ***Class Schedule:***

Oral Presentation after submitting a written training report; both evaluated by at least 2 faculty members.

## ***Course Contribution to professional Component:***

- Math and Basic Science: 50 %
- Engineering Science: -
- Engineering Design: -
- Human and Social Science: 50 %

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| | 3 | 3 | 3 | 3 | 3 | | | | 2 | 2 | 3 | 3 | | | 3 | 3 | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 1 | - | 2 | - | هـ ص ٣٩٥ | IE 395 | IE Seminar |
| IE 351 | | | | | | Pre-requisite |
| Literature review methodologies and sources. Review of a recently published IE book or topic pertaining to contemporary social, economic or environmental issues in industrial engineering. Delivering a seminar lecture by a team of students based on a term paper prepared by them. | | | | | | |

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Different Recommended Material will be used for this course.

***References:***

None

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Practice Effective Team Management tools.
2. Prepare effective business communications.
3. Demonstrate the methods of literature review.
4. Analyze recent publication (s) of Industrial Engineering.
5. Identify contemporary issues.
6. Prepare and deliver effective presentation using different computer applications.

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (3 weeks) | 1. Literature Review Methodologies |
| (1 week) | 2. Selection of Area of Industrial Engineering |
| (1 week) | 3. Selection of Field in the Area of Industrial Engineering |
| (2 weeks) | 4. Selection of Topic in the particular area of Industrial Engineering |
| (4 weeks) | 5. Preparation of Business Document |
| (2 weeks) | 6. Preparation of Business Communication |

## ***Class Schedule*:**

As per Schedule

## ***Course Contribution to professional Component*:**

- Math and Basic Science: 25 %
- Engineering Science: 25%
- Engineering Design: -
- Human and Social Science: 50 %

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 2 | 2 | 3 | 3 | 3 | 2 | | 2 | 2 | 2 | 2 | 2 | 2 | | 2 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 8 | 1000 | 16 | - | هـص ٤٠٠ | IE 400 | Cooperative Work Program |
| IE 422, IE 432 | | | | | | Pre-requisites |
| Undertaking practical training for 26 weeks under supervision of an academic advisor and a company supervisor in a company performing industrial engineering activities. Submitting, as per schedule, three coop progress reports. Submitting a coop final report containing matters as specified in the cooperative education program document. Multimedia presentation of achieved work. | | | | | | |

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

None

***References:***

None

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

13. Formulate an objective or mission statement that identify the real problem and describe the expected outcomes of the training activity.
14. Break-down a work environment into its units and work functions, and describe how these units are assembled into a whole entity.
15. Describe a professional organizational structure, its size and how it is related to its main products and to market issues.
16. Exhibit integrity, punctuality, and ethical behavior in engineering practice and relationships.
17. Demonstrate enthusiasm and business focusing.
18. Establish successful relationships with team members, advisors, and clients to understand their needs and to achieve or exceed agreed-upon quality standards.
19. Maintain focus to complete important tasks on time and with high quality, amidst multiple demands
20. Relate practical work to previous knowledge from basic sciences, engineering fundamentals, and discipline related courses.
21. Collect and review related data such as technical information, regulations, standards, and operational experiences from credible literature resources
22. Utilize prior knowledge, independent research, published information, and original ideas in addressing problems and generating solutions.
23. Monitor achievement, identify causes of problems, and revise processes to enhance satisfaction.
24. Communicate, clearly and concisely, training details and gained experience, both orally and in writing, using necessary supporting material, to achieve desired understanding and impact.

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (2 weeks) | 8. Acquainting the trainee by the company, its work environment, organizational structure, products, costumers, engineering units and quality system. |
| (2 weeks) | 9. Familiarizing the trainee of one production or design unit with deep understanding of the work environment, regulations, standards, etc... |
| (2 weeks) | 10. Allocating the trainee to a project team and allowing him to study and collect necessary data about the project using internal and external data sources. |
| (20 weeks) | 11. Working as a team member to execute assigned tasks with the following objectives:<br>• Apply engineering practices related to his specialization.<br>• Enhance team work skills.<br>• Relate practical work to his engineering knowledge.<br>• Use modern engineering tools such as equipment and computer software.<br>• Use project management techniques.<br>• Complete assigned tasks on time with high quality.<br>• Develop personal communication skills.<br><br>N.B.: If the assigned project is to be completed in less than 20 weeks, the student should complete his training period working on several successive projects |
| End of week #6 | 12. Submitting first Progress Report to academic supervisor |
| End of week #12 | 13. Submitting second Progress Report to academic supervisor |
| End of week #18 | 14. Submitting third Progress Report to academic supervisor |

## ***Course Schedule*:**

Oral Presentation after submitting a written training report; both evaluated by at least 2 faculty members

## ***Course Contribution to professional Component*:**

- Math and Basic Science: 50 %
- Engineering Science: -
- Engineering Design: -
- Human and Social Science: 50 %

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| | 3 | 3 | 3 | 3 | 3 | | | | 2 | 2 | 3 | 3 | | | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | ARABIC | ENGLISH | COURSE TITLE |
|---|---|---|---|

| TCH | Tr. | Pr. | Th. | | | |
|---|---|---|---|---|---|---|
| 3 | - | 1* | 3 | هـ ص ٤١١ | IE 411 | **Operations Research II** |
| **IE 311, IE 332** | | | | | | **Pre-requisites** |
| Non-linear programming. Dynamic programming. Inventory models. Waiting line models. Markov analysis. Introduction to Game theory. Applications in industrial, service and public systems. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Render, B., Stair (Jr), R. M. and Henna, M., QUANTITATIVE ANALYSIS FOR MANAGEMENT, 9th ed., Prentice Hall International Inc., (2006).

***References:***

- Taha, H. A., OPERATIONS RESEARCH, 7th ed., John Wiley & Sons, Inc., (2002).
- Hillier, F. S. and Lieberman, G. J., INTRODUCTION TO OPERATIONS RESEARCH, 8th ed., McGraw-Hill Company, (2004).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Develop the knowledge of analytical techniques of OR-II.
2. Understand the basic principles and techniques of OR-II.
3. Comprehend the Nonlinear programming and its applications.
4. Waiting line models and queuing theory.
5. Comprehend the dynamic programming and its applications.
6. Understand and apply Inventory models.
7. Understand and apply Markov analysis.
8. Understand Game Theory and its applications.
9. Analyze & solve a real life problem for Term project with a team.
10. Realize the computer software applications and solve OR-II problems.
11. Interpret the results of OR-II problems after the computer or manual solutions.

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (3 weeks) | 1. Non-linear Programming; graphical illustration, concave and convex functions, unconstraint optimization; one & multi variables, one dimensional search alg., gradient search method, Khun Tucker conditions, Frank Wolfe alg. |
| (2½ weeks) | 2. Waiting Lines and Queuing Theory Models: characteristics of models. Single, multi channel models, constant service time model, finite population model. |
| (2½ weeks) | 3. Dynamic Programming; shortest route problem by DP, terminology, notations, knapsack problem, air transportation service problem, resource allocation problems, distribution of effort problem. |
| (2 weeks) | 4. Inventory models, elements of inventory control, inventory control systems, economic order quantity models, quantity discounts, reorder point, order quantity for a periodic inventory system. |
| (2 weeks) | 5. Markov Analysis: introduction, states & state probabilities, transition matrix, predicting future market share, equilibrium conditions, absorbing states & the fundamental matrix |
| (2 weeks) | 6. Game theory: language of games, the minimax criterion, pure strategy games, mixed strategy games, dominance. |

## ***Class Schedule*:**

50 minutes sessions each per week & Tutorial: one 2 hours per week

## ***Course Contribution to professional Component*:**

- Math and Basic Science: -
- Engineering Science: 25%
- Engineering Design: 75%
- Human and Social Science: -

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | 3 | | | 3 | | | 3 | 3 | | 3 | 3 | | | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤١٢ | IE 412 | Decision Analysis |
| IE 255, IE 331 | | | | | | Pre-requisites |
| Principles of decision making under uncertainty. Decision models: influence diagram and decision tree. Solution and analysis of decision problems. Value of information. Attitudes towards risk. Utility theory. Multi-attribute decision problems. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Clemen, R. T. and Reilly, T., MAKING HARD DECISIONS WITH DECISION TOOLS, Duxbury Press, (2001), ISBN13: 978-495-01508-6.

***References:***

Holloway, C. A., DECISION MAKING UNDER UNCERTAINTY: MODELS AND CHOICES, Prentice Hall, (1979), ISBN 0-13-197749-0.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Explain fundamentals of decision analysis with logical and chronological thinking.
2. Model decision problems under uncertainty.
3. Solve decision problems using the roll-back procedure.
4. Identify structure of decision problems.
5. Perform sensitivity analysis of decision problems.
6. Compute the value of perfect and imperfect information.
7. Explain attitudes towards risk.
8. Do projects in decision analysis, and use various computer skills.
9. Work in teams to solve homework problems and do projects.

***Topics Covered and Duration:***

| | |
|---|---|
| (1 week ) | 1. Introduction to Decision Analysis: Why are decisions hard? Subjective judgments in decision-making, the decision-analysis process, requisite decision models, where is decision analysis used? |
| (1 week ) | 2. Modeling Decisions: Elements of Decision Problems: Values and objectives, making money: a special objective, sequential decisions, uncertain events, consequences, the time value of money: a special kind of trade-off |
| (2 weeks) | 3. Structuring Decisions: Structuring values, structuring decisions: influence diagrams, sequential decisions, intermediate calculations, structuring decisions: decision trees, decision details: defining elements of the decision, defining measurement scales for fundamental objectives |
| (2½ weeks) | 4. Making Choices: decision trees and expected monetary value, solving influence diagrams: overview, risk profiles, dominance: an alternative to EMV, making decisions with multiple objectives, assessing trade-off weights |
| (2½ weeks) | 5. Sensitivity Analysis: one-way sensitivity analysis, Rainbow diagrams, Tornado diagrams, dominance considerations, two-way sensitivity analysis, sensitivity to probabilities, two-way sensitivity analysis for three alternatives |
| (2 weeks) | 6. Value of Information: Value of information: some basic ideas, expected value of perfect information, expected value of imperfect information, value of information and experts |
| (2 weeks) | 7. Modeling Preferences: Risk Attitudes: Risk, risk attitudes, expected utility, certainty equivalents, and risk premiums, utility function assessment, risk tolerance and the exponential utility function, decreasing and constant risk aversion |

***Course Schedule:***

The class meets four times a week. Three times are for regular sessions of 50 minutes of lecture times and 2 hours of tutorial time. Ramadan times are 35 min. of lecture times and 1 hour of tutorial time.

***Course Contribution to professional Component:***

- Engineering science: 50%
- Engineering design: 17%
- Human & social science: 33%

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | 3 | 1 | | 3 | 2 | | | | 2 | | 3 | | | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤١٣ | IE 413 | Network Analysis |
| IE 311, IE 331 | | | | | | Pre-requisites |
| Introduction to network analysis with industrial applications. Systems modeling and analysis using network techniques. CPM with LP formulation, PERT with LP formulation and cost analysis. Other network algorithms: Minimum spanning tree, shortest path and maximal flow problem. Flowgraph theory. GERT: exclusive OR networks. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***
Industrial Engineering Department

***Textbook:***
Whitehouse, G. E., SYSTEMS ANALYSIS AND DESIGN USING NETWORK TECHNIQUES, 2nd ed., Prentice-Hall, Inc., (1973), ISBN 0-13-881474-0.

***References:***
- Moder, J. J. and Phillips, C. R., PROJECT MANAGEMENT WITH CPM AND PERT, 2nd ed., Van Nostrand Reinhold Company, (1970), ISBN 0-442-15666-9.
- Bazaraa, M. S., Jarvis, J. J., and Sherali, H. D., LINEAR PROGRAMMING AND NETWORK FLOWS, 2nd ed., John Wiley & Sons, Inc., (1990), ISBN 0-471-63681-9.
- World Wide Web (The internet).

***Course Leaning Objectives:***
**By completion of the course, the students should be able to:**
1. Comprehend the fundamentals of network analysis and basic notations.
2. Comprehend network models and representations for project management and generate project schedules.
3. Apply various algorithms for solving network problems.
4. Comprehend network problems and know how to solve those using available techniques.
5. Comprehend the logic of introducing uncertainty into network models.
6. Use of computer software in solving network problems.
7. Work in teams to solve network problems.
8. Apply network algorithms to a real life problem using various sources such as the internet and investigate various relevant areas of knowledge.
9. Make clear presentations of network problems and solutions.

***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week) | 1. Introduction: Systems Modeling and Analysis Using Network Techniques, system modeling, types of models to be studied, advantages and disadvantages of network modeling techniques |
| (3 weeks) | 2. Activity Networks: PERT and CPM, arrow diagrams, PERT: Program Evaluation and Review Technique, CPM: Critical Path Method, project control, using Microsoft Office Project, linear programming formulation and using Excel |
| (3 weeks) | 3. Shortest Path Algorithms: Directed acyclic networks, directed cyclic networks, Dijkstra's algorithm, the revised cascade method, some applications, other related algorithms to be obtained from the internet and presented in class such as minimum spanning tree algorithm |
| (2 weeks) | 4. Maximal Flow Analysis: Ford and Fulkerson's labeling procedure, Max-Flow-Min-Cut theorem, the matrix approach, relationship between linear programming and maximal flow problem, other applications |
| (3 weeks) | 5. Flowgraph Analysis: Definition of flowgraph analysis, methods of solution of flowgraphs, topological equivalence, node reduction methods, applications of flowgraphs for system modeling |
| (3 weeks) | 6. Stochastic Networks: GERT – An analytical approach to stochastic networks, Elements of the GERT network, evaluation of Exclusive-OR GERT network, counters and conditional MGF's, applications of Stochastic Networks |

***Class Schedule*:**

The class meets four times a week. Three times are for regular sessions of 1 hour of lecture time and 2 hours of tutorial time.

***Course Contribution to professional Component*:**

- Engineering science: 50 %
- Engineering design: 35 %
- Human & social sciences: 15%

***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | 3 | 2 | 2 | 3 | 2 | | | | | | 3 | | | 3 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO</th><th rowspan="2">ENGLISH CODE/NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCH</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>-</td><td>1*</td><td>3</td><td>هـص ٤١٥</td><td>IE 415</td><td>Project Management</td></tr>
<tr><td colspan="6">IE 351</td><td>Pre-requisite</td></tr>
<tr><td colspan="7">Introduction to engineering project management. Planning successful projects. Specifying, budgeting, implementing, executing, scheduling, delivery options, and closeout. Scheduling tasks and resources. Resource leveling. Common characteristics of projects. Network tools for project planning and monitoring. Cost optimization to meet project objectives. Project crashing, time-cost trade-offs. Risk analysis. Software for project planning and scheduling.</td></tr>
</table>

***One hour tutorial session**

***Faculties and departments requiring this course (if any)*:**

Industrial Engineering Department

***Textbook*:**

Meredith, Jack R. and Mantel, S. J. Jr. PROJECT MANAGEMENT: A MANAGERIAL APPROACH, 7th ed., John Wiley and Sons, (2008), ISBN-13:9780470226216.

***References*:**

- Project Management Institute, A GUIDE TO THE PROJECT MANAGEMENT (2004) BODY OF KNOWLEDGE, 3rd ed., (PMBOK® Guide), An American National Standard ANSI/PMI 99-001-2004 Four Campus Boulevard, Newtown Square, PA 19073-3299 USA, (2004).
- Kerzner, H., PROJECT MANAGEMENT: A SYSTEMS APPROACH TO PLANNING, SCHEDULING, AND CONTROLLING, 7th ed., John Wiley and Sons, New York, (2001).

***Course Leaning Objectives*:**

**By completion of the course, the students should be able to:**

1. Understand the role of project managers in a developing country
2. Learn how to initiate a project determining project goals, deliverables, and process outputs.
3. Acquire practical knowledge on managing project scope, schedule, and resources, document constraints, assumptions.
4. Define budgets, refine time and costs, estimates, and establish project controls.
5. Measure performance, take corrective action, evaluate its effectiveness, and ensure plan compliance.
6. Get acquainted with popular software used by project management professionals.
7. Facilitate closure, preserve product records and tools and release resources.

***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week ) | 1. Introduction to Engineering Project Management. Planning successful projects. |
| (2 weeks) | 2. Specifying, budgeting, implementing, executing, scheduling, delivery options and closeout. |
| (1 week ) | 3. Common characteristics of projects |
| (2 weeks) | 4. Resource leveling. Scheduling tasks and resources. |
| (2 weeks) | 5. Network tools for project planning and monitoring |
| (2 weeks) | 6. Project crashing, time-cost trade-offs. |
| | 7. Cost optimization to meet project objectives. |
| (1 week ) | 8. Project risk management. Risk management planning. Risk Identification. |
| (1 week ) | 9. Qualitative Quantitative Risk Analysis. Risk Response Planning. Risk Monitoring and Control |
| (2 weeks) | 10. Software for project planning, scheduling and cost estimation. MS Project, Prima-Vera, and Timberline. |

***Class Schedule*:**

The classes are held three times in a week for lectures and once in a week for tutorials. The duration of lecture classes will be 50 minutes and 1.30 hours for tutorial.

***Course Contribution to professional Component*:**

- Engineering science: 25 %
- Engineering design: 75 %

***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | 3 | 3 | | | 1 | | | | | | 3 | | 3 | 3 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٢١ | IE 421 | **Industrial Information Systems** |
| IE 323 | | | | | | **Pre-requisite** |
| General concepts. Values and attributes of information. Different types of information systems. Concepts of managerial information systems. Analysis, design and development of industrial information systems. Developing information systems by using microcomputers. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Laudon & Laudon, MANAGEMENT INFORMATION SYSTEMS – MANAGING THE DIGITAL FIRM, Prentice Hall: ISBN: 0-13-153841-1

***References:***

- Thomson, E. O., MANAGEMENT INFORMATION SYSTEMS, ISBN 0-619-21538-0.
- Class notes and handouts material by the instructor is available on website at http://elearning.alhaque.com. The site requires registration by the students.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Explain the importance of Information Systems for business & management.
2. Identify ethical implications of Information Systems.
3. Describe how enterprise applications promote business process integration
4. Identify how to improve organizational performance with Information Systems
5. Explain the Strategic Role of Information Systems in Organizations
6. Analyze how internet technology has changed value propositions and business models
7. Identify the challenges posed by enterprise applications and management solutions
8. Describe how building new systems produce organizational change.
9. Demonstrate harmony by communicating effectively in multi-disciplinary teams
10. Deliver clear oral and written presentation using visual aids
11. Demonstrate Information Systems' fundamentals during class project using computers

## ***Topics Covered and Duration:***

| | |
|---|---|
| (1½ weeks) | 1. Introduction to Information Systems |
| (1 week) | 2. Information Systems for Competitive Advantage |
| (1½ weeks) | 3. Using Information Technology to Engage in Electronic Commerce |
| (1½ weeks) | 4. System Users and Developers |
| (2 weeks) | 5. Systems Development |
| (1½ weeks) | 6. Information in Action |
| (1½ weeks) | 7. Information Security |
| (1½ weeks) | 8. Ethical Implications of Information Technology |
| (2 weeks) | 9. Decision Support Systems |
| (1½ weeks) | 10. Web /HTML Project Using Microsoft FrontPage – I |
| (1½ weeks) | 11. Web/HTML Project Using Microsoft FrontPage - II |
| (1 week) | 12. Class Project |

## ***Class Schedule:***

This is a Departmental Elective Course. The class meets 3 times a week for lectures, and tutorial. The lecture is of 80 minutes, and the tutorial is for 110 minutes.

## ***Course Contribution to professional Component:***

- Engineering science: 25 %
- Engineering design: 50 %
- Human & Social Science 25%

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| | 2 | 3 | 2 | 3 | | | 3 | 3 | | | 3 | | 3 | | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO</th><th rowspan="2">ENGLISH CODE/NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCH</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>-</td><td>1*</td><td>3</td><td>هـ ص ٤٢٢</td><td>IE 422</td><td>Industrial Systems Simulation</td></tr>
<tr><td colspan="6">IE 323, IE 332</td><td>Pre-requisites</td></tr>
<tr><td colspan="7">Basic theory of industrial simulation. Building simulation models. Organization of simulation studies. Simulation modeling and application to medium and large-scale production and service system problems. Output analysis. Variance reduction and optimization. Use of software such as ARENA for discrete and continuous system simulation.</td></tr>
</table>

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Kelton, W. D., Sadowski, R. P. and Sturrock, D. T., SIMULATION WITH ARENA, 3rd ed., McGraw-Hill, (2004).

***References:***

Law, A. L. and Kelton, D., SIMULATION MODELING AND ANALYSIS, 3rd ed., McGraw-Hill, (2000).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Provide a comprehensive understanding of fundamental simulation concepts and ideas in general and the Arena simulation software in particular.
2. Ability to study and analyze systems under investigations, and define the statement of the problem under consideration.
3. Develop a skill to build basic, intermediate, and detailed operation models, analyze input data, verify, validate, well-animate and run these models using Arena simulation software.
4. Develop an ability to design experiments, analyze and interrupt the simulation results, and to present the findings effectively
5. Demonstrate effective communication by working in teams and through writing proficiency at the level expected for a senior engineering student

## ***Topics Covered and Duration:***

| | |
|---|---|
| (½ week) | 1. What is Simulation? |
| (1 week) | 2. Fundamental Simulation Concepts |
| (2 weeks) | 3. 3A Guided Tour through Arena |
| (2 weeks) | 4. Modeling Basic Operations and Input |
| (3 weeks) | 5. Modeling detailed Operations |
| (1 week) | 6. Statistical Analysis of Output from Terminating Simulations |
| (1 week) | 7. Intermediate Modeling and Steady-State Statistical Analysis |
| (1 week) | 8. Entity Transfer |
| (1 week) | 9. Further Statistical Issues |
| (1 week) | 10. Conducting Simulation Studies |

## ***Class Schedule:***

- *Lecture*: Two 1.5 hour sessions per week.
- *Tutorial*: One 2 hours session per week.

## ***Course Contribution to professional Component:***

- Engineering science: 25 %
- Engineering design: 25 %
- Mathematical science: 25 %
- Human and social science: 25 %

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| | 3 | | | | | | | | | | 3 | 3 | 3 | | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٢٣ | IE 423 | Computer Aided Manufacturing Systems |
| IE 323 | | | | | | Pre-requisite |
| Foundation of CAD/CAM. Fundamentals of CAM. Computer graphics software and data. Computer aided manufacturing: numerical control, NC part programming, NC, DNC and CNC systems. Industrial robots and applications. Computer Integrated manufacturing systems (CIMS). | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Valentino, J., and Goldenberg J., INTRODUCTION TO COMPUTER NUMERICAL CONTROL, 3rd ed., Prentice Hall, (2003).

***References:***

- iWeatherall A. and Butterworth, H., COMPUTER INTEGRATED MANUFACTURING, (1985).
- Seamens, W.S., COMPUTER NUMERICAL CONTROL – CONCEPTS AND PROGRAMMING, Delmar, (1983).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Develop the knowledge of CNC Machines
2. Understand the basic principles and techniques of CAM
3. Comprehend the different types of CNC machines especially milling and lathe machines
4. Understand the different machining operations and tooling used for these operations
5. Explore the advanced features of the modern CNC machining centers
6. Understand and write NC part programs
7. Understand the preparatory functions
8. Understand the auxiliary functions
9. Analyze & solve a real life problem for Term project with a team
10. Understand the basic elements of APT programming language
11. Comprehend the advantages of using the latest CAD/CAM technology

***Topics Covered and Duration*:**

| | |
|---|---|
| (2 weeks) | 1. Introduction to CNC machines: advantages of CNC machines, different CNC machines, different machining operations, tooling for milling and lathe operations, cutting fluids for CNC operations, automatic tool changing systems, pallet loading systems. |
| (3 weeks) | 2. Programming hole operations: programming language format, preparatory functions, dimensional functions, miscellaneous functions, fixed cycles, hole operation commands. |
| (3 weeks) | 3. Programming linear profiles: linear interpolation commands, writing linear profiling programs, determining cutter offsets for inclined line profiles. |
| (2 weeks) | 4. Programming circular profiles: specifying the plane, circular interpolation commands, profiling at constant feed rate. |
| (2 weeks) | 5. CNC lathe programming: lathe axes of motion, basic lathe operations, lathe setup commands, preparatory functions, miscellaneous functions. |
| (2 weeks) | 6. Introduction to Computer-Aided-Part-Programming: basic elements of APT programming language, geometry commands, setup commands, tool motion commands. |

***Class Schedule*:**

The classes to be held twice per week for lectures of 80 minutes (Sundays & Tuesdays: 8.00 -9.20 am) and tutorial once in a week for 120 minutes (Sundays: 2.30 - 4.30 pm).

***Course Contribution to professional Component:***

- Math and Basic Science: 0.75 credit or 25%
- Engineering Science: 0.90 credit or 30%
- Engineering Design: 0.75 credit or 25%
- Human and Social Science: 0.60 credit or 20%

***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 2 | 3 | 3 | | | | | | | 1 | | 2 | | | 2 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـص ٤٢٤ | IE 424 | Data Processing Operations |
| IE 323 | | | | | | Pre-requisite |
| Concepts of advanced database management system design, principles and techniques. Entity relationship diagram. Normalization. Object oriented and object relational databases. Data warehousing. Data mining. Web and semi structural data. Data Security. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Connolly, T. and Begg, C., DATABASE SYSTEMS, 4th ed., Addison-Wesley, (2005), ISBN: 9780321294012.

***References:***

- Price, J. and Price, J., iORACLE DATABASE 10g CERTIFICATION SQL EXAM GUIDE, ISBN: 0072229810.
- Snevely, R., ENTERPRISE DATA CENTER DESIGN AND METHODOLOGY, Prentice Hall, (2002), ISBN: 0-13-047393-6.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understand two important stages of a database development project: data modelling and database design
2. Understand and demonstrate popular design methods of a relational database such as normal forms and entity relationship diagrams.
3. Demonstrate and understand the backup and restore procedures and disaster recovery methods.
4. Develop and implement a SQL/PLSQL relational database system.
5. Management of Data warehousing, Data Mining , and distributed systems
6. Research, write and present technical report using modern engineering tools

## ***Topics Covered and Duration:***

| | |
|---|---|
| (1 week) | 1. Introduction to Databases |
| (1 week) | 2. Database Theory |
| (1 week) | 3. Database Application Lifecycle |
| (3 weeks) | 4. Oracle Forms and Triggers |
| (1 week) | 5. Data Modeling |
| (1 week) | 6. Database Users and Administration |
| (2 weeks) | 7. PLSQL control structures and loops |
| (1 week) | 8. Database Security, Integrity and Recovery |
| (1 week) | 9. Object Databases |
| (1 week) | 10. Client Server, Distributed and Internet Databases |
| (1 week) | 11. Data Warehousing, Mining and Web Tools |

## ***Class Schedule:***

This is a Departmental Elective Course. The class meets 2 times a week for lectures, and tutorial. The lecture is of 80 minutes, and the tutorial is for 110 minutes.

## ***Course Contribution to professional Component:***

- Engineering Science: 2 Credits or 50%
- Engineering Design: 1 Credit or 25%
- Human and Social science: 1 Credit or 25%

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| | 3 | | | | 3 | | | | | | 3 | 3 | | | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO</th><th rowspan="2">ENGLISH CODE/NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCH</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>-</td><td>1*</td><td>3</td><td>هـ ص ٤٢٥</td><td>IE 425</td><td>Industrial Information Security</td></tr>
<tr><td colspan="6">IE 322</td><td>Pre-requisite</td></tr>
<tr><td colspan="7">Introduction to information security. Assessment of threats, vulnerabilities and risk exposure. Models for estimating risks and optimizing return on information security investment. Computer forensics, electronic evidence, frauds, cyber terrorism and computer criminal laws.</td></tr>
</table>

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Volonino, L., Robinson, S. R., PRINCIPLES AND PRACTICE OF INFORMATION SECURITY, Prentice Hall, ISBN-10: 0131840274, ISBN-13: 9780131840270.

***References:***

Boyle, R., APPLIED INFORMATION SECURITY, ISBN-10: 0136122035, ISBN-13: 9780136122036.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understand basic terminology associated with information security.
2. Learn common information security threats including viruses, worms, Trojan horses etc.
3. Identify and rank organization's information assets.
4. Recognize vulnerabilities and security threats in organization's information network and prioritize them for remediation.
5. Determine methods used to verify the identity and authenticity of an individual.
6. Learn basic essentials of security in transmission and security in infrastructure.
7. Learn the concept and importance of information security audit.
8. Learn operational /organizational security.
9. Understand how policies and procedures play important role in addressing the security needs of an organization.
10. Know the laws and standards that govern information security.
11. Implement an appropriate information protection scheme to meets organization's requirement.
12. Investigate and analyze the computer system for compliance with organizational policies.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (1½ weeks) | 1. Importance of information security management , definitions and terms associated with information security |
| (2 weeks) | 2. Information security basics, access controls and authentication. |
| (2½ weeks) | 3. Vulnerability, threats and risk exposure including hacking, viruses, worms, Trojan horses etc. |
| (2 week) | 4. An overview of security in transmission and security in infrastructure |
| (2 weeks) | 5. Information security auditing |
| (2 weeks) | 6. Information security standards, policies and procedures. |
| (2 weeks) | 7. Computer forensic, electronic evidence and computer crime laws. |

## ***Class Schedule:***

The class meets three times in a week. Two times are for regular sessions of 1 hour 20 minutes of lecture times and 2 hours of tutorial time.

## ***Course Contribution to professional Component:***

- Engineering Science: 1.5 credits for 50%
- Human and social science: 1.5 credits for 50 %

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| | 2 | 3 | | | | | | | | | | 2 | | | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | ٤٣١ هـ ص | IE 431 | Industrial Quality Control |
| IE 332, IE 351 | | | | | | Pre-requisites |
| Introduction to quality systems. Cost of quality. Total quality management. Quality systems and standards: six sigma and ISO. Reengineering. Statistical quality control: control charts for variables and attributes, process capability analysis, acceptance sampling plans. Quality function deployment. Quality circles. Quality loss functions. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Montgomery, D. C., INTRODUCTION TO STATISTICAL QUALITY CONTROL, 4th ed., John Wiley & Sons, (2001), ISBN: 0-471-31648-2.

***References:***

- Juran, J. M. and Gryna, F. M., QUALITY PLANNING & ANALYSIS, McGraw-Hill International Editions, (1993).
- Class notes and handout material are provided by instructor

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understand principles and the basic notations of probability and probability distribution.
2. Do point and interval estimation of quality parameters.
3. Do statistical hypothesis testing from the quality engineering viewpoint
4. Understand the basic methods of statistical process control (SPC) as problem solving tools and methods for process capability analysis and statistical inferences
5. Describe the statistical basis of Control charts for variables and attributes outcomes
6. Develop team work for meeting challenges in professional life
7. Build professional skills and ethical behavior in professional life
8. Develop ability to adopt a scientific approach to any type of problems faced by individuals or society
9. Develop and extend the students knowledge of analytical techniques and application of statistical methods

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (½ week) | 1. Introduction to quality – Cost of Quality. |
| (½ week) | 2. Review of statistical concepts/ methods. |
| (1 week) | 3. Process control. |
| (2½ weeks) | 4. Control charts. |
| (2½ weeks) | 5. Acceptance sampling. |
| (1 week) | 6. Operating characteristics curves. |
| (1 week) | 7. Process capability. |
| (3 weeks) | 8. Quality Systems:<br>- Total Quality Management<br>- Reengineering concepts<br>- ISO systems<br>- Taguchi – Loss function |
| (1 week) | 9. Introduction to quality – Cost of Quality. |
| (1 week) | 10. Review of statistical concepts/ methods. |

## ***Class Schedule*:**

The class meets three times a week. Twice as regular sessions of 1hour 20 minutes lecture each on Sunday and Tuesday from 8:00 to 9:20 AM and once for tutorial for 2 hours on Sunday from 14:30 to 16:30 PM.

## ***Course Contribution to professional Component*:**

- Math and Basic Science: 0.8 Credits or 20%
- Engineering Science: 2.4 Credits or 60%
- Engineering Design: 0.8 Credits or 20%
- Human and Social Science: -

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | 3 | 3 | 3 | | | | | | | | | 3 | 3 | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٣٢ | IE 432 | **Design of Industrial Experiments** |
| IE 332 | | | | | | **Pre-requisite** |
| Principles of experimental design. Randomized complete block designs. Latin square and Graeco-Latin square designs. General factorial designs. $2^k$ Factorial designs. Response surface methodology and robust design. Planning, performing and analysing industrial experiments. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Montgomery, D. C., DESIGN AND ANALYSIS OF EXPERIMENTS, 6th ed., John Wiley and Sons, New York, (2005).

***References:***

- Antony, J. DESIGN OF EXPERIMENTS FOR ENGINEERS AND SCIENTISTS, 1st ed., Butterworth-Heinemann, (2003).
- Hines and Montgomery, PROBABILITY AND STATISTICS FOR ENGINEERS, John Wiley and Sons, NY, (1990).
- Moen, R. D., Nolan, T. W. and Provost, L. P., QUALITY IMPROVEMENT THROUGH PLANNED EXPERIMENTS, 2nd ed., McGraw-Hill, New York, (1999).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Comprehend the fundamentals of experimental designs and basic notations
2. Understand the basic differences between types of experiments
3. Use appropriate methods for representing and analyzing experiments
4. Recognize the role of standards in society and their impact on experiments and results
5. Interpret results of experiments and draw meaningful conclusions and recommendations
6. Use computer skills to analyze experiments
7. Design and conduct experiments as well as to analyze and interpret data
8. Make clear presentation of experiments results and conclusions

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week) | 1. Some typical applications of experimental designs, basic principles, using statistical techniques in experimentation |
| (2½ weeks) | 2. Basic statistical concepts, sampling and sampling distributions, inferences about differences in means, randomized designs, inferences about differences in means and variances of normal distributions |
| (2½ weeks) | 3. The Analysis of variance: Analysis of the fixed effects model, model adequacy checking, practical interpretation of results, non-parametric methods in the analysis of variance |
| (1½ weeks) | 4. Randomized Blocks, Latin Squares & Related designs: Randomized complete block designs, Latin Square design, the Graeco-Latin Square design, balanced incomplete block designs |
| (3½ weeks) | 5. Factorial Designs: The advantage of factorials, the two factor factorial designs, the general factorial designs, fitting response surface curves and surfaces, blocking in factorial designs |
| (3 weeks) | 6. $2^k$ Factorial Designs: The $2^2$ design, the $2^3$ design, the General $2^k$ factorial design, confounding the $2^k$ factorial design in $2^p$ blocks |

## ***Class Schedule*:**

The class meets three times a week. Twice as regular sessions and 50 minutes lecture each on Saturday, Monday and Wednesday from 8.00 to 9.00 a.m. and once for Tutorial on Saturday from 2.30 to 4 pm.

## ***Course Contribution to professional Component*:**

- Engineering science: 25 %
- Engineering design: 75 %

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | 3 | 3 | | | 3 | | 2 | 2 | | | 3 | | 3 | 3 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٣٣ | IE 433 | Reliability Engineering |
| IE 332 | | | | | | Pre-requisite |
| Introduction to reliability analysis. Reliability measures: reliability function, expected life, hazard function of important distribution functions. Hazard models and product life. Extreme value distribution. Static reliability models. Dynamic reliability models. System effectiveness measures. Reliability allocation and optimization. Introduction to fault tree analysis and human reliability. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

- Kapur, K.C. and Lamberson, L. R., RELIABILITY IN ENGINEERING DESIGN, John Wiley & Sons, Inc., (1977), ISBN 0-471-51191-9.
- Smith, C. O. and Robert, E., INTRODUCTION TO RELIABILITY IN DESIGN, Krieger Publishing Company, Inc., Malabar, Florida, (1983), ISBN 0-89874-553-5.

***References:***

أبو النور، ع. ع. ، الجفري، م. ع.، الباسوسي، م. م. ، رشدي، ع. م.، **أسس الهندسة الصناعية**، مركز النشر العلمي، جامعة الملك عبد العزيز ، جدة ، ١٤٢٠هـ ~ ١٩٩٩م.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Explain fundamentals of reliability analysis.
2. Model and analyze reliability problems.
3. Study static reliability models and solve various static reliability problems.
4. Study dynamic reliability models and solve various dynamic reliability problems.
5. Study and analyze extreme value problems in relation to reliability systems.
6. Apply system effectiveness measures.
7. Explain reliability optimization and fault tree analysis.
8. Effectively use computer packages to solve reliability problems.
9. Search the internet for being updated with recent developments in reliability studies

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (2 week) | 1. Introduction to reliability and Reliability Measures: Reliability Function, the expected life, the failure rate and hazard function, Reliability and hazard function for well-known distribution functions. |
| (3 week) | 2. Hazard models and product life: constant, linearly increasing, bathtub, power function and exponential model, Estimating the hazard function, Distribution selection: exponential, Weibull, and geometric distributions, the extreme value distribution and applications. |
| (2 weeks) | 3. Static Reliability Models: Series systems, parallel systems, combinations, complex system analysis, Reliability considerations in design, |
| (2 weeks) | 4. Dynamic Reliability Models: The series system, series chain, parallel system, parallel redundant systems, and standby redundant systems. Perfect switching and imperfect switching. Shared load parallel models. |
| (1 weeks) | 5. System Effectiveness Measures: Maintainability, operational readiness, availability, intrinsic availability. |
| (2 weeks) | 6. Introduction to life testing. Reliability allocation and optimization algorithms and approaches. |
| (2 weeks) | 7. Introduction to fault Tree Analysis and its engineering applications. |

## ***Class Schedule*:**

The class meets four times a week. Three times are for regular sessions of 50 minutes of lecture times and 2 hours of tutorial time. Ramadan times are 35 min. of lecture times and 1 hour of tutorial time.

## ***Course Contribution to professional Component:***

- Math and Basic Science: 1.0 Credit or 33%
- Engineering Science: 1.0 Credit or 33%
- Engineering Design: 1.0 Credit or 33 %

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | 3 | 2 | | 3 | 2 | | | | 1 | | 3 | 3 | 1 | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـص ٤٣٤ | IE 434 | Industrial Stochastic Systems |
| IE 331 | | | | | | Pre-requisite |
| Deterministic and stochastic processes. Poisson process and related distributions. Birth and death processes. Markov processes with continuous state space. Renewal process and theory. Markovian decision processes in industry. Markovian and non-Markovian systems. Stochastic models for transportation and maintenance systems. Introduction to simulation modeling of stochastic systems. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Tijms, H. C., A FIRST COURSE IN STOCHASTIC MODELS, Wiley New York, (2003).

***References:***

- Gross, D. and Harris, C. M., FUNDAMENTALS OF QUEUING THEORY, 3rd ed., John Wiley and Sons, New York, (1998).
- Tijms, H.C, STOCHASTIC MODELS – AN ALGORITHMIC APPROACH, Wiley New York, (1994).
- Barlette, M.S, AN INTRODUCTION TO STOCHASTIC PROCESSES, Cambridge University Press, London, (1978).
- Wong, E. and Hajek, B., STOCHASTIC PROCESSES IN ENGINEERING SYSTEMS, Springer Verlag, New York, (1985).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Realize and identify the fact that most of the natural processes are stochastic in nature
2. Apply engineering sciences and theory related to processes of stochastic nature
3. Identify, formulate, analyze and solve engineering problems
4. To provide professional expertise in solving problems in industrial systems of society.
5. To provide expertise in using appropriate modern techniques, skills and engineering tools, in classroom, laboratories, and other educational settings.
6. Function effectively in multidisciplinary teams, in a wide range of organizations,
7. Communicate effectively in written and oral media,
8. To provide students with the necessary education to understand the impact of engineering solutions in local and global societal contexts

## ***Topics Covered and Duration:***

| | |
|---|---|
| (1 week) | 1. Stochastic and deterministic processes, Poisson process and related distributions, birth and death processes |
| (1 week) | 2. Markov processes with discrete state space, definition and examples of Markov chains |
| (1 week) | 3. Transition probabilities, statistical inference on Markov chains |
| (1 week) | 4. Markov processes with continuous state space, Renewal process and theory |
| (1½ weeks) | 5. Time series models, statistical analysis of time series |
| (1½ weeks) | 6. Markovian decision processes in industry and service sectors |
| (1½ weeks) | 7. Modeling and design and queuing systems, steady state and transient behavior in queuing systems, Non-Markovian queuing systems |
| (1½ weeks) | 8. Probabilistic inventory models, single period and multi-period inventory models, perishable inventory system modeling |
| (2 weeks) | 9. Stochastic modeling of transportation systems |
| (2 weeks) | 10. Simulation modeling of stochastic systems |

## ***Class Schedule:***

The class meets three times a week. Twice as regular sessions and 50 minutes lecture each on Saturday, Monday and Wednesday from 8.00 to 9.00 a.m. and once for Tutorial on Saturday from 2.30 to 4 pm.

## ***Course Contribution to professional Component:***

- Engineering science: 25 %
- Engineering design: 75 %

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | 3 | 3 | | | 3 | | 2 | 2 | | | 3 | | 3 | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٣٥ | IE435 | **Queuing Systems** |
| **IE 331** | | | | | | **Pre-requisite** |
| Characteristics of queuing systems. General arrival and service patterns. Poisson process and Erlangian models. Birth and death processes in queuing systems. Markovian and non-Markovian queuing models. Steady state and transient solutions. Optimization in queuing systems. Queuing applications in production, transportation, communication and public service systems. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Gross, D. and Harris, C. M., FUNDAMENTALS OF QUEUING THEORY, John Wiley & Sons, (2002).

***References:***

- Bose, S. K., AN INTRODUCTION TO QUEUING SYSTEMS, Kluwer Academic /Plenum Publishers, New York, (2002), ISBN 0-306-46734-8.
- Saaty, T. L., ELEMENTS OF QUEUING THEORY WITH APPLICATIONS, McGraw-Hill, NY, (1961).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understand formulation of queuing systems of different types.
2. Learn the concepts of analytical modeling techniques.
3. Get exposed to the converting real life systems into mode ls.
4. Be trained to use these models for analyzing and predicting responses of real life systems to changing factors that influence their behavior.
5. Develop ability to adopt a scientific approach to any type problems faced by individuals or society.
6. Improve their overall outlook of facing difficult situations in life.
7. Learn the use of advanced software packages needed in professional life.
8. Acquire an overall improvement in analytical and computing power.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (1 week) | 1. Basic concepts of waiting line theory. |
| (1 week) | 2. Analysis of Queuing systems and Performance measures. |
| (1 week) | 3. Markovian Queues. Birth-Death Process Modeling. |
| (1 week) | 4. Steady state and Transient behaviour. |
| (1½ weeks) | 5. Non-Markovian Queuing systems. |
| (1½ weeks) | 6. Optimization problems in queuing. |
| (1½ weeks) | 7. Simulation of Queuing Systems. |
| (1½ weeks) | 8. Applications of Queuing Theory in industry and service organizations, Communication, Computer Networks etc. |
| (2 weeks) | 9. Applications and case studies in production, transportation communication and public service systems. |
| (2 weeks) | 10. Software Applications. |

## ***Class Schedule:***

The class meets three times a week. Twice as regular sessions and 50 minutes lecture each on Saturday, Monday and Wednesday from 8.00 to 9.00 a.m. and once for Tutorial on Saturday from 2.30 to 4 pm.

## ***Course Contribution to professional Component:***

- Mathematics and Basic Science: 1 Credit or 25%
- Engineering Science: 2 Credits or 50%
- Engineering Design: 1 Credit or 25%

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | 3 | 2 | | | 3 | | 3 | 3 | | | 3 | 3 | | 3 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO</th><th rowspan="2">ENGLISH CODE/NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCH</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>-</td><td>1*</td><td>3</td><td>٤٣٦ هـ ص</td><td>IE 436</td><td>Dynamic Forecasting</td></tr>
<tr><td colspan="6">IE 332</td><td>Pre-requisite</td></tr>
<tr><td colspan="7">Time series and forecasting. Forecasting accuracy. Monitoring and controlling forecasts. Linear and multiple regression with forecasting applications. Box-Jenkins (ARIMA) methodology. Introduction to fundamental and technical analysis with applications in financial markets. Introduction to neural networks. Judgmental forecasting.</td></tr>
</table>

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

- Hanke, J. E. and Wichern, D. W., BUSINESS FORECASTING, 8th ed., Pearson/Prentice Hall, New Jersey, (2005), ISBN 0-13-122856-0.
- Russell, R. S. and Taylor, B. W., OPERATIONS MANAGEMENT, 4th ed., Pearson Prentice Hall, (2005).

***References:***

None

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understand the difference between time series forecasting and causal (regression) forecasting.
2. Compute forecasts using the various methods and tools presented in the course outline.
3. Measure forecast accuracy.
4. Learn how to use forecasting packages (Minitab and Excel) for various forecasting.
5. Apply Box-Jenkins (ARIMA) methodology for forecasting.
6. Work in a group for case studies analysis and reporting.
7. Develop & use power-point for case studies oral presentation.

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week) | 1. Introduction to Forecasting |
| (1 week) | 2. Exploring data Patterns |
| (½ week) | 3. Choosing a Forecasting Technique |
| (½ week) | 4. Measures of forecasting accuracy |
| (1 week) | 5. Moving averages |
| (1 week) | 6. Exponential smoothing |
| (2 weeks) | 7. Trend, Seasonal & cyclic variations in data |
| (1 week) | 8. Simple Linear regression |
| (1 week) | 9. Multiple Regression Analysis |
| (2 weeks) | 10. Introduction to Box-Jenkins (ARIMA) Methodology |
| (1 week) | 11. Judgmental Forecasting |
| (2 weeks) | 12. Case Study |

## ***Class Schedule*:**

The class meets 3 times a week for lectures and tutorial. The lecture is of 80 minutes and the tutorial is for 110 minutes.

## ***Course Contribution to professional Component*:**

- Engineering Science: 1 credit or 33 %
- Math and Basic Sciences: 2 credits or 67%

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | 3 | 1 | | | | | | | | | 3 | | 2 | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO</th><th rowspan="2">ENGLISH CODE/NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCH</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>-</td><td>1*</td><td>3</td><td>هـ ص ٤٤١</td><td>IE 441</td><td>Industrial Safety Engineering</td></tr>
<tr><td colspan="6">IE 342, IE 351</td><td>Pre-requisites</td></tr>
<tr><td colspan="7">Accident: causes and costs. Appraising safety performance and risk assessment. Analysis of accident causes. Accident reports and records. Job safety analysis. Plant inspection. Accident investigation. Plant layout and arrangement. Plant housekeeping. Maintenance and safety. Material handling and safety. Machine guarding. Explosion and fire prevention. Personal protection. First aid. Planning for emergencies.</td></tr>
</table>

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Asfahl, C.R., INDUSTRIAL SAFETY AND HEALTH MANAGEMENT, 5th ed., Prentice Hall Upper Saddle River, New Jersey, (2005).

***References:***

Krieger, G. R. (Ed), ACCIDENT PREVENTION MANUAL FOR BUSINESS AND INDUSTRY: Administration and Programs (Vol. I), Engineering and Technology (Vol. II), 11th ed., National Safety Council, Itasca, Ill, USA, (1997).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Anticipate and recognize work hazards and accident causes, analyze them and assess their impact on productivity.
2. Initiate and maintain a safety program for an organization.
3. Comprehend safety aspects and control of work accidents.
4. Improve communication skills with industry for solving industrial safety problems.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (½ week) | 1. Safety instructions |
| (1 week) | 2. Accident during work: cost and causes |
| (1 week) | 3. Appraising safety performance and risk assessment |
| (1 week) | 4. Analysis of accident causes |
| (½ week) | 5. Accident report and records |
| (1 week) | 6. Job safety analysis |
| (½ week) | 7. Plant inspection |
| (1 week) | 8. Accident investigation |
| (1 week) | 9. Plant layout and arrangement |
| (½ week) | 10. Plant housekeeping |
| (1 week) | 11. Maintenance and safety |
| (1 week) | 12. Material handling and safety |
| (½ week) | 13. Machine guarding |
| (1 week) | 14. Explosion and fire prevention |
| (1 week) | 15. Personal protection |
| (½ week) | 16. First aid |
| (1 week) | 17. Planning for emergencies |

## ***Class Schedule:***

The class meets three times in week. Two times are for regular sessions of 1 hour 20 minutes of lecture times and 3 hours of laboratory time

## ***Course Contribution to professional Component:***

- Math and Basic Science: 15%
- Engineering science: 50 %
- Engineering design: 20 %
- Human and Social Science: 15%

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 1 | | 1 | | | | | | | 2 | 3 | 3 | 3 | 2 | 1 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٤٢ | IE 442 | Industrial Hygiene Engineering |
| IE 342 | | | | | | Pre-requisite |
| Occupational exposure: permissible levels and legal aspects. Hazards' anticipation and recognition. Physical hazards particularly heat, noise and vibration, light, non-ionizing and ionizing radiations: assessment and control. Chemical agents: assessment and control. Industrial ventilation. Design of local exhaust systems. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

- Di Nardi, S.R. (Ed), THE OCCUPATIONAL ENVIRONMENT: ITS EVALUATION AND CONTROL, American Industrial Hygiene Association, Fairfax, VA, (1997).
- Class notes and handouts by the instructor

***References:***

- Harris, R. (Ed), PATTY'S INDUSTRIAL HYGIENE, Vol. 1, 2, 3 & 4, 5th ed., American Industrial Hygiene Association, Fairfax, VA, (2000).
- Plog, B. A., Niland, J. and Quinlan, P. J., FUNDAMENTALS OF INDUSTRIAL HYGIENE, National Safety Council, Itasca, III, USA.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Anticipate effects of environmental conditions on human health and productivity, and in particular as related to developing countries.
2. Anticipate and recognize environmental hazards arising from or during work.
3. Evaluate environmental hazards and assess risk.
4. Solve environmental and work problems, eliminate hazards and abate and control work hazards.
5. Communicate with industry and community for solving industrial environmental problems (case studies).

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (½ week) | 1. Introduction and background: philosophy and history of industrial hygiene |
| (1½ weeks) | 2. Occupational exposure limits and legal aspects |
| (1 week) | 3. Occupational hazards: anticipation and recognition |
| (5 weeks) | 4. Physical hazards: recognition, assessment and control: heat, noise,<br>light, non-ionizing and ionizing radiations |
| (3 weeks) | 5. Chemical agents in industry: recognition, assessment and control:<br>i. Particulates: fate of industrial particles<br>ii. Non-particulates: entry, absorption, detoxification, elimination and effects |
| (1 week) | 6. Permissible levels: development and application |
| (2 weeks) | 7. Industrial ventilation: general ventilation vs. local exhaust, design of local<br>exhaust system: operating and maintenance |

## ***Class Schedule*:**

The class meets three times in week. Two times are for regular sessions of 1 hour 20 minutes of lecture times and 3 hours of laboratory time.

## ***Course Contribution to professional Component*:**

- Engineering Science: 1.5 credit or 50%
- Engineering Design: 1.0 credit or 33%
- Human and Social Science: 0.5 credit or 17%

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| | | | 2 | | | | 1 | 1 | 2 | 3 | 3 | 2 | 3 | | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٤٣ | IE 443 | Industrial Environmental Engineering |
| IE 342 | | | | | | Pre-requisite |
| Basics of natural systems. Industrial environment as part of the ecological system. Water quality management. Waste water treatment. Air pollution. Noise pollution. Solid waste management. Hazardous waste management. Ionizing radiation. Case studies. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Davis, M. L., Masten, S. J., PRINCIPLES OF ENVIRONMENTAL ENGINEERING AND SCIENCE, 1st ed., McGraw-Hill, (2004).

***References:***

Koren, H., Bisesi, M., I HANDBOOK OF ENVIRONMENTAL HEALTH, Vols. I & II, 4th ed., CRC Press, (2002).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Anticipate the impact of natural and man-made factors on the ecosystem and on human health, activity and productivity.
2. Anticipate and recognize environmental hazards arising from or during human activities.
3. Evaluate environmental hazards and assess risks.
4. Solve environmental and human activities problems, eliminate hazards and abate and control environmental hazards.
5. Communicate with governmental agencies, industry and community for solving environmental problems (case studies).

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (½ week) | 1. Introduction to environmental engineering and science |
| (½ week) | 2. Environmental legislation, regulation and ethics |
| (½ week) | 3. Basics of natural systems |
| (½ week) | 4. Industrial environment as a part of ecological system |
| (½ week) | 5. Risk assessment and management |
| (½ week) | 6. Materials and energy balances |
| (1½ weeks) | 7. Water quality management |
| (1 week) | 8. Water treatment |
| (1½ weeks) | 9. Waste water treatment |
| (1½ weeks) | 10. Air pollution |
| (1½ weeks) | 11. Air pollution control |
| (1 week) | 12. Solid waste management |
| (1 week) | 13. Hazardous waste management |
| (1 week) | 14. Noise pollution |
| (1 week) | 15. Ionizing radiation |

## ***Class Schedule*:**

The class meets three times a week. Two times are for regular sessions of 1 hour 20 minutes of lecture times and 2 hours of tutorial and laboratory time.

## ***Course Contribution to professional Component*:**

- Engineering Science: 1.50 credit or 50%
- Engineering Design: 1.00 credit or 34%
- Human and Social Science: 0.50 credit or 16%

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 2 | 2 | | 2 | | | | | | 1 | 3 | 3 | | | 2 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO.</th><th rowspan="2">ENGLISH CODE/NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCH</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>-</td><td>1*</td><td>3</td><td>هـ ص ٤٤٤</td><td>IE 444</td><td>Occupational Biomechanics</td></tr>
<tr><td colspan="6">IE 342</td><td>Pre-requisite</td></tr>
<tr><td colspan="7">Introduction to Occupational Biomechanics. Kinematics and kinetics. Anthropometry. Mechanical work-capacity evaluation. Bio-instrumentation for Occupational Biomechanics. Biomechanical models. Methods of classifying and evaluating manual work. Manual material handling limits. Biomechanical considerations in machine control and workplace design. Hand tool design guidelines. Guidelines for seated work.</td></tr>
</table>

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Chaffin, D. B., Andersson, G. B. J. and Martin, B. J., OCCUPATIONAL BIOMECHANICS, 3rd ed., John Wiley, New Jersey, (2006), ISBN 978-0-471-72343-1.

***References:***

- Kroemer, K. H. E., Kroemer, H. B. and Kroemer-Elbert, K. E., ERGONOMICS: HOW TO DESIGN FOR EASE AND EFFICIENCY, 2nd ed., Prentice Hall, New Jersey, (2000), ISBN 978-0137524785.
- Tayyari, F. and Smith, J., OCCUPATIONAL ERGONOMICS: PRINCIPLES & APPLICATIONS, Chapman & Hall: London. (1997), [SITE: www.thomson.com].
- Bridger, R. S., INTRODUCTION TO ERGONOMICS, New York, McGraw-Hill, (1995).
- Class notes/handouts materials provided by instructor.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Explain the Basic Concepts of Occupational Biomechanics.
2. Solve for forces, moments and/or moment arms for a given free body diagram that is said to be in static equilibrium.
3. Estimate all required anthropometric values necessary in the equations of motion.
4. Model a given joint with appropriate anatomical structures and then calculate the muscular and joint reaction forces which are required to maintain static equilibrium in the joint.
5. List the risk factors for occupational low back, neck, hand/wrist, elbow, shoulder etc. injuries and be able to identify them in a given work situation.
6. Work in a Team and communicate effectively.

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week) | 1. Definition of Occupational Biomechanics. Historical Development of Occupational Biomechanics. The Need for an Occupational Biomechanics Specialty. Who Uses Occupational Biomechanics? |
| (1 week) | 2. Connective Tissue, Skeletal Muscle, Joints. |
| (1 week) | 3. Measurement of Physical Properties of Body Segments, Anthropometric Data for Biomechanical Studies in Industry, Summary of Anthropometry in Occupational Biomechanics. |
| (1 week) | 4. Joint Motion: Methods and Data, Muscle Strength Evaluation, Summary and Limitations of Mechanical Work-Capacity Data. |
| (2 weeks) | 5. Why Model? Planar Static Biomechanical Models, Three-dimensional Modeling of Static Strength Dynamic Biomechanical Models, Special-purpose Biomechanical Models of Occupational Tasks |
| (2 weeks) | 6. Traditional Methods of classifying and evaluating manual work, Traditional Work Analysis System, Contemporary Biomechanical Job Analysis |
| (1 week) | 7. Lifting Limits in Manual Material Handling, Pushing and Pulling Capabilities, Recommendations for improving Manual Materials Handling Tasks |
| (1 week) | 8. Practical Guidelines for Workplace and machine Control Layout, Maintaining the Facilities Plan |
| (2 weeks) | 9. The Need for Biomechanical Concepts in Design, Shape and Size considerations, Hand-Tool Weight and Use Considerations, Force Reaction Considerations in Powered Hand-tool Design Keyboard Design Considerations |
| (2 weeks) | 10. General Considerations Related to Sitting Postures, Anthropometric Aspects of Seated Workers, Comfort, The Spine and Sitting The Shoulder and Sitting, The Legs and Sitting, The Sitting Workplace |

## ***Class Schedule*:**

The class meets three times a week. Two times are for regular sessions of 1 hour 20 minutes of lecture times and 2 hours of tutorial and laboratory time.

## ***Course Contribution to professional Component*:**

- Math and Basic Science: 1 Credit or 25%
- Engineering Science: 1 Credit or 25%
- Engineering Design: 1 Credit or 25%
- Human and social science: 1 Credit or 25 %

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | | 2 | | 3 | | | 2 | 2 | | 2 | 2 | 2 | | 3 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| **TCH** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **-** | **1*** | **3** | **هـ ص ٤٥٠** | **IE 450** | **Marketing Management and Research** |
| **IE 351** | | | | | | **Pre-requisite** |
| Study of marketing theory. Methods of marketing. Interrelationship of the different phases of marketing strategies. Consumer decision processes through behavioral sciences. Theories and techniques of planning, analyzing and presenting market studies. Methodologies of marketing research with emphasis on primary research including questionnaire design. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Kotler, P. and Armstrong, G., PRINCIPLES OF MARKETING, 13th ed., Pearson, (2010), ISBN: 978-0-13-700669-4.

***References:***

- Peter, J. P. and Donnelly, J. H., Jr., MARKETING MANAGEMENT, 9th ed., McGraw Hill, (2009), ISBN: 978-0-07-128076-1.
- Class notes / handout material provided by instructor
- Web-page http://elearning.alhaque.com Username and password on registration and authenticity

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Define, describe and demonstrate method of marketing.
2. Compare and contrast different phases of marketing strategies.
3. Identify the customer decision process.
4. Identify and analyze the techniques of planning, analyzing and presenting market studies.
5. Compare and contrast different methodologies of market research.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (1½ weeks) | 1. Marketing: Creating and capturing Customer Values |
| (1½ weeks) | 2. Company and Marketing Strategy |
| (1½ weeks) | 3. Analyzing the Marketing Environments |
| (1½ weeks) | 4. Managing Marketing Information to Gain Customer Insight |
| (1½ weeks) | 5. Consumer Markets and Consumer Behavior |
| (1½ weeks) | 6. Customer Driven Marketing |
| (1½ weeks) | 7. Pricing Understanding and capturing values |
| (1½ week) | 8. Pricing Strategies |
| (3 weeks) | 9. Marketing Plan |

## ***Class Schedule:***

This is a Departmental Elective Course. The class meets 3 times a week for lectures, and tutorial. The lecture is of 80 minutes, and the tutorial is for 110 minutes.

## ***Course Contribution to Professional Component:***

- Math and Basic Science: 25 %
- Engineering Science: 25 %
- Engineering Design: -
- Human and Social Science: 50 %

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 2 | 3 | 3 | 2 | 3 | | | 2 | 2 | | | 3 | | 2 | 2 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٥١ | IE 451 | **Production Planning and Control** |
| **IE 341, IE 351** | | | | | | **Pre-requisites** |
| Basic concepts of Production and Operations Management (POM). Design of products and services. Processes and technologies. E-commerce and operations management. Inventory management. Supply-Chain management. Just-in-time and lean production. Forecasting. Material Requirements Planning (MRP). Introduction to Enterprise Requirement Planning (ERP). Capacity and Aggregate planning. Scheduling. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Heizer J., and Render B. OPERATIONS MANAGEMENT, 8th ed., Pearson Prentice Hall, (2007).

***References:***

- Russell R. and Taylor III, B.W., OPERATIONS MANAGEMENT, 4th ed., Pearson Prentice Hall, (2003).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understand basic concepts of production and operations Management (POM): Various production processes including JIT (Just-in-Time), Aggregate production planning (APP), Material requirement planning (MRP), Capacity Requirement Planning (CRP),Inventory management, Supply chain management system (SCM), Forecasting and Scheduling
2. Design of products and services, techniques for improving design process, technology in design.
3. Explain/use the tools and techniques of various forecasting methods to calculate product demands, different inventory models to calculate reorder points and safety stock
4. Develop/compute aggregate production planning, MRP structure, Master production schedule (MPS), Bill of materials (BOM), Capacity requirement planning (CRP), and Perform Scheduling and loading, and sequencing jobs
5. Work within a team and communicate efficiently to perform the assigned tasks (Home works/Group Project)

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week) | 1. Production and operations management,(POM): Introduction, why study POM, Categories of E-commerce, competitiveness, and productivity |
| (1 week) | 2. Design of products and services: Introduction, techniques for improving design process, technology in design |
| (1 week) | 3. Processes and technologies: Types of production processes, Process planning e-manufacturing |
| (2 weeks) | 4. Inventory management: Periodic inventory system, ABC classification system, EOQ models, Quantity discounts, Reorder points, Safety stock |
| (1 week) | 5. Supply-Chain management: What is SCM, Information in SCM, Distribution and Warehouse management, Transportation methods, Global supply chain |
| (2 weeks) | 6. Forecasting: Strategic role of forecasting, Time series methods (Moving average, Weighted moving average, Exponential smoothing, Regression method |
| (1 week) | 7. Just-in-time (JIT) and Lean production: Elements of JIT, The pull system, Kanban production system |
| (2 weeks) | 8. Capacity and Aggregate planning: What are Capacity planning and Aggregate production planning (APP), Inputs and Outputs to APP, APP using pure and mixed strategies, APP by linear programming model, Available-to-Promise (ATP), Aggregate Planning for Services, Yield Management |
| (2 weeks) | 9. Material Requirements Planning (MRP) and Enterprise Resource Planning (ERP): MRP structure, Master production schedule (MPS), Bill of materials, Lot-sizing techniques, and ERP fundamentals |
| (1 week) | 10. Scheduling: Objectives, Loading and sequencing jobs in work centers |

## ***Class Schedule*:**

The classes to be held twice per week for lectures of 80 minutes (Sundays & Tuesdays: 8.00 -9.20 am) and tutorial once in a week for 150 minutes (Sundays: 2.30 - 4.30 pm).

## ***Course Contribution to professional Component*:**

- Engineering Science: 0.75 credit or 25%
- Human and social science: 0.75 credit or 25%
- Engineering Design: 0.60 credit or 20%
- Math and Basic Sciences: 0.90 credit or 30%

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 2 | 3 | 3 | | | 3 | | | | 3 | | 2 | | | 2 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| **TCH** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **-** | **1*** | **3** | **هـ ص ٤٥٢** | **IE 452** | **Maintenance and Replacement Policies** |
| **IE 332, IE 351** | | | | | | **Pre-requisites** |
| Maintenance systems. Maintenance operation and control. Preventive Maintenance: concepts, modeling, and analysis. Maintenance planning and scheduling. Maintenance material control. Computerized Maintenance Management Systems. Replacement studies. Case studies. | | | | | | |

***One hour tutorial session**

***<u>Faculties and departments requiring this course (if any)</u>:***

Industrial Engineering Department

***<u>Textbook</u>:***

Duffuaa, S. O., Raouf, A. and Campbell, J. D., PLANNING & CONTROL OF MAINTENANCE SYSTEMS, Modeling and Analysis, John Wiley & Sons, New York, USA , (1999)ISBN: 0-471-17981-7.

***<u>References</u>:***

- J D, STRATEGIES FOR EXCELLENCE IN MAINTENANCE MANAGEMENT CAMPBELL, Productivity Press, Portland, 1995.
- British Standard Institute, GLOSSARY OF GENERAL TERMS IN MAINTENANCE MANAGEMENT: BS 3811.
- Smith, A. M., RELIABILITY CENTERED MAINTENANCE, McGraw Hill, New York, (1993).
- Palmer, D., MAINTENANCE PLANNING AND SCHEDULING HANDBOOK, McGraw-Hill, New York, (1999).
- Class notes/handout material provided by instructor
- Web-page for the Course, Group name: mrp2

  Group home page: http://groups.yahoo.com/group/mrp2

  Group email: mrp2@yahoogroups.com

***<u>Course Leaning Objectives</u>:***

**By completion of the course, the students should be able to:**

1. Explain maintenance-function as a system.
2. Operate and control a maintenance system.
3. Explain the mechanism of the breakdown repair.
4. Explain and design complete maintenance system based on maintenance planning, scheduling and control, and also demonstrate how to handle and evaluate various computerized maintenance management systems (CMMS s)

***Topics Covered and Duration*:**

| | |
|---|---|
| (2 weeks) | 1. Maintenance systems |
| (2 weeks) | 2. Maintenance operation and control |
| (2 weeks) | 3. Preventive maintenance, concepts, modeling and analysis |
| (2 weeks) | 4. Maintenance planning and scheduling |
| (2 weeks) | 5. Maintenance material control |
| (2 weeks) | 6. Computerized maintenance management systems |
| (2 weeks) | 7. Replacement studies |
| | 8. Case studies |

***Class Schedule*:**

The classes are held twice per week for lectures (Sundays & Tuesdays during 0930-1050 Hours) and once in a week for Tutorials (Tuesdays: 1430-1600 Hours).

***Course Contribution to professional Component*:**

- Engineering science: 1 Credit
- Engineering design: 2 Credits

***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | 3 | 2 | | | | | | | | | 3 | 3 | | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO</th><th rowspan="2">ENGLISH CODE/NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCH</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>-</td><td>1*</td><td>3</td><td>هـ ص ٤٥٣</td><td>IE 453</td><td>Facilities Planning</td></tr>
<tr><td colspan="6">IE 342, IE 352</td><td>Pre-requisites</td></tr>
<tr><td colspan="7">Fundamentals of facilities planning. Facilities design. Flow, space and activity relationships. Material handling systems. Layout planning models. Warehouse operations. Quantitative facilities planning models. Preparing, presenting, implementing and maintaining facilities plan.</td></tr>
</table>

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Tompkins, W. et al., FACILITIES PLANNING, 3rd ed., John Wiley, New Jersey, (2003), ISBN: 0-471-41389-5.

***References:***

Sule, D. R., MANUFACTURING FACILITIES: LOCATION, PLANNING, AND DESIGN, 3rd ed., Publisher: CRC, USA, (2008), ISBN: 1420044222.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understand the integrated nature of the discipline.
2. Acquire the knowledge of flow process analysis to develop the material movement strategies.
3. Identify and develop different facilities layouts and solve real life industrial problems
4. Emphasize the importance and role of facilities planning in cost reduction and increased productivity
5. Work individually or within a team and communicate effectively to perform the assigned tasked (Homework/Group Project).

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week) | 1. Introduction to Facilities Planning<br>Objectives of Facilities Planning; Strategic Facilities Planning<br>Examples of Inadequate Planning |
| (1 week) | 2. Product, Process, and Schedule Design<br>Scrap Estimates; Equipment Fractions; Facilities Design |
| (2 weeks) | 3. Flow, Space, and Activity relationships<br>Departmental Planning; Activity Planning; Flow Patterns;<br>Measuring Flow; Space Requirements |
| (1 week) | 4. Material Handling<br>Scope and Definitions of Material Handling; Material Handling Principles; Designing Material Handling Systems Unit Load Design; Estimating Material Handling Costs |
| (2 weeks) | 5. Facilities Layout<br>Basic Layout Types; Layout Procedures; The impact of Change;<br>Developing Layout Alternatives; Commercial Facility Layout Packages |
| (2 weeks) | 6. Warehouse Operations<br>Missions of a Warehouse; Functions in the Warehouse; Receiving and Shipping Operations; Dock Locations; Storage Operations |
| (2 weeks) | 7. Facilities Planning Models<br>Facility Location Models; Location Allocation Model; Linear Assignment Model |
| (2 weeks) | 8. Implementing and Maintaining the Facilities Plan<br>Preparing the Facilities Plan; Implementing the Facilities Plan<br>Maintaining the Facilities Plan |

## ***Class Schedule*:**

The classes to be held twice per week for lectures of 80 minutes (Saturdays & Mondays: 1.00 -2.20 pm) and tutorial once in a week for 110 minutes (Mondays: 5.00 - 6.50 pm).

## ***Course Contribution to professional Component:***

- Engineering Science: 67%
- Engineering Design: 17%
- Human and Social Science: 16%

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 2 | 3 | 3 | | | | | | | 1 | | 2 | | | 2 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـص ٤٥٤ | IE 454 | Engineering Cost Analysis |
| IE 255 | | | | | | Pre-requisite |
| Importance of cost analysis in engineering. Cost terms and concepts. Cost estimation for decision making: cost-volume-profit analysis, measuring relevant costs and revenues, cost assignment and activity-based costing. Cost evaluation of engineering alternatives. Case studies. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Drury, C., MANAGEMENT ACCOUNTING FOR BUSINESS, Thomson Learning, (2005), ISBN: 1-84480-152-7.

***References:***

Resources Material: All Material is available on the website www.wahmad.net /www.wahmad.com. You need to register yourself in order to access the resource material. Your computer No is your user name select your password accordingly

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understand the concepts of cost analysis, cost terms and management accounting.
2. Calculate and apply Cost-Volume-Profit Analysis
3. Make decisions by Measuring relevant cost and revenues.
4. Calculate and explain the cost assignment.
5. Compute and explain Activity based costing.
6. Use the techniques, skills, and modern engineering tools necessary for cost decision practices.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (1 week) | 1. Introduction to Cost Analysis and Management Accounting |
| (1½ weeks) | 2. Introduction to Cost Terms |
| (1½ weeks) | 3. Cost-Volume-Profit Analysis |
| (2 weeks) | 4. Measuring Relevant Costs and Revenues for Decision-Making |
| (2½ weeks) | 5. Cost Assignment |
| (2½ weeks) | 6. Distinguish between cause-and-effect and arbitrary cost |
| (3 weeks) | 7. Activity Based costing |

## ***Class Schedule:***

The classes are held twice per week for lectures (Sundays & Tuesdays during 0930-1050 Hours) and once in a week for Tutorials (Wednesday: 1430-1600 Hours).

## ***Course Contribution to professional Component:***

- Math and Basic Science: 1 Credit or 25%
- Engineering Science: 2 Credits or 50%
- Engineering Design: 1 Credit or 25%

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | 3 | | | | | | | | | | 3 | | | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٥٥ | IE 455 | **Material Handling and Packaging** |
| **IE 255, IE 331** | | | | | | **Pre-requisites** |
| Historical development of material handling and packaging. Objectives and principles of material handling. Material handling concepts: unit load, containerization, ASRS. Types of material handling equipment and their economics. Role of packaging in material handling. Areas of special importance to packaging. Package design. Economics of packaging. Package research and testing. Management of the packaging function. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

- Kulwiec, R. A., MATERIAL HANDLING, John Wiley, New Jersey, (1985).
- Soroka, K. and Warrington, R., FUNDAMENTALS OF PACKAGING TECHNOLOGY, (1995).

***References:***

- Rudenko, N., MATERIALS HANDLING EQUIPMENT, Mir Publications, Moscow, (1969).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Learn fundamental principles of material handling systems.
2. Develop understanding of special concepts in material handling.
3. Learn analytical procedures for the study of different material handling equipment.
4. Learn fundamental principles of packaging.
5. Improve presentation and team work skills.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (1 week) | 1. Basis for material handling analysis |
| (2 weeks) | 2. Principles of material handling |
| (1 week) | 3. The unit load concept |
| (2 weeks) | 4. Packaging principles |
| (2½ weeks) | 5. Materials used for Packaging |
| (2 weeks) | 6. Equipment selection Procedure |
| (2 weeks) | 7. Material handling cost concepts |
| (1½ weeks) | 8. Storage and Warehousing |

## ***Class Schedule:***

The class meets three times a week. Two times are for regular sessions of 1 hour 20 minutes of lecture times and 2 hours of tutorial and laboratory time.

## ***Course Contribution to professional Component:***

- Math and Basic Science: 1 Credit or 25%
- Engineering Science: 1 Credit or 25%
- Engineering Design: 1 Credit or 25%
- Human and social science: 1 Credit or 25 %

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 2 | | 3 | | 2 | 3 | | | | | | 3 | | | 2 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٥٦ | IE 456 | **Feasibility Studies** |
| **IE 255, IE 352** | | | | | | **Pre-requisites** |
| Introduction to feasibility studies: project identification, product mix and scope. Marketing feasibility: present and future market study, demand, pricing, and revenue. Technical feasibility: site selection, material, labor, equipment, knowhow, and shipping. Financial feasibility: project financing, production cost, break-even analysis, profitability analysis Organizational and administrative feasibility: Organizational structure, governmental regulations, safety and environmental standards, patents and human relations. Reporting and presentation. Case studies. | | | | | | |

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

PCH Publications (Editors), FEASIBILITY STUDY: PREPARATION AND ANALYSIS, ASIN: B000VFH16K

***References:***

- Behrens, W. and Hawranek, P. M., MANUAL FOR THE PREPARATION OF INDUSTRIAL FEASIBILITY STUDIES, (2007, rev. ed.), Published by United Nations Industrial Development Organization, (UNIDO), Order No.ID/372.
- Bentley, L. and Whitten, J., SYSTEM ANALYSIS & DESIGN FOR THE GLOBAL ENTERPRISE, 7th Edition, (2007).
- Stevens, R. R., HOW TO PREPARE A FEASIBILITY STUDY: A STEP-BY-STEP GUIDE INCLUDING 3 MODEL STUDIES, Prentice-Hall, (1982), ISBN-10: 0134292413, ISBN-13: 978-0134292410
- Lesonsky, R., START YOUR OWN BUSINESS, 4th ed., Entrepreneur Press, (2007), ISBN-10: 1599180812, ISBN-13: 978-1599180816.
- Taha, A., FEASIBILITY STUDIES, Aldaar Alhandsyh, (2003).
- Lotfi, A., THE FEASIBILITY STUDY OF CAPITAL PROJECTS, Aldaar Aljamyh, (2005).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Create a technically and economically feasible concept.
2. Present an idea or project to secure the required funding and support and convince stakeholders.
3. Present problems in a way which does not prejudice the project's prospects.
4. Accurately analysis and properly assess the potential and viability of the venture.
5. Study a project and optimize it before starting to save time and money.
6. Effectively plan and schedule projects.
7. Comprehensively analyze market, prepare cash flow projections.
8. Do critical and sensitivity analysis.
9. Use COMFAR, UNIDO's Computer Model for Feasibility Analysis and Reporting.

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week) | 1. Introduction to feasibility studies |
| (1 week) | 2. Basic aspects of pre-investment studies and the investment project |
| (1½ weeks) | 3. Project / product identification, determining product portfolio |
| (2 weeks) | 4. Financial feasibility, marketing research, breakeven analysis |
| (1½ weeks) | 5. Implementation planning and financial analysis and investment appraisal |
| (2 weeks) | 6. Technical feasibility, raw materials, engineering and technology, organization and overhead costs, human resources |
| (1 week) | 7. Profitability analysis, administrative feasibility |
| (1 week) | 8. Organizational structure, governmental regulations, safety and environmental standards |
| (1 week) | 9. Software for feasibility study preparation, COmputer Model for Feasibility Analysis and Reporting (COMFAR) and PROPSPIN |
| (2 weeks) | 10. Case studies |

## ***Class Schedule*:**

The classes are held three times in a week for lectures and once in a week for tutorials. The duration of lecture classes will be 50 minutes and 1.30 hours for tutorial.

## ***Course Contribution to professional Component*:**

- Math and Basic Science: 0.45 Credit or 15%
- Engineering Science: 0.75 Credit or 25%
- Engineering Design: 1.50 Credits or 50%
- Human and social science: 0.30 Credit or 10%

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | 3 | 3 | | | 1 | | 2 | 2 | | 2 | 3 | | 3 | 3 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

<table>
<tr><th colspan="4">CREDITS</th><th rowspan="2">ARABIC CODE/NO</th><th rowspan="2">ENGLISH CODE/NO</th><th rowspan="2">COURSE TITLE</th></tr>
<tr><th>TCH</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>-</td><td>1*</td><td>3</td><td>هـ ص ٤٥٧</td><td>IE 457</td><td>Supply Chain Management</td></tr>
<tr><td colspan="6">IE 351, IE 451</td><td>Pre-requisites</td></tr>
<tr><td colspan="7">Introduction to Supply Chains (SC). Flow across SC of products, information and revenue. SC operations: issues, opportunities, tools, approaches, inter-corporate relationships, incentives and risk factors. SC design: customer service, quality, logistics, inventory, business processes, system dynamics, control, design, and re-engineering. Integrated SC management: forecasting, global sourcing, and virtual integration. Technology as an SC tool: internet technologies and digital coordination of decisions and resources. Case studies.</td></tr>
</table>

*One hour tutorial session

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Meredith, Chopra, S. and Meind, P., SUPPLY CHAIN MANAGEMENT, 4th ed., Prentice Hall,(2010). ISBN-10: 0136080405 / ISBN-13: 9780136080404.

***References:***

Simchi-Levi, D., Kaminsky, P. and Simchi-Levi, E., DESIGNING AND MANAGING THE SUPPLY CHAIN, 2nd ed., McGraw-Hill.

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Understating the fundamental concepts of Supply Chain Management.
2. Design the Supply Chain Network.
3. Model the planning demand and supply in supply chain network.
4. Determine the optimal capacity and product availability.
5. Determine the Sourcing, Transportation, and Pricing.
6. Identify the competition and coordination in Supply Chains.
7. Solve real case studies.
8. Work in group to solve homework problems and do projects.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (1 week) | 1. Understanding the Supply Chain |
| (½ week) | 2. Supply Chain Performance: Achieving Strategic Fit and Scope |
| (1½ weeks) | 3. Designing Distribution Networks |
| (1 week) | 4. Network Design in the Supply Chain |
| (1 week) | 5. Designing Global Supply Chain Networks |
| (1 week) | 6. Sales and Operations Planning: Planning Supply and Demand in a Supply Chain |
| (½ week) | 7. Supply Chain Performance: Achieving Strategic Fit and Scope |
| (2 weeks) | 8. Managing Economies of Scale and Uncertainty in a Supply Chain; Cycle, and Safety Inventory |
| (1½ weeks) | 9. Managing Uncertainty in a Supply Chain: Safety Inventory |
| (½ week) | 10. Determining the Optimal Level of Product Availability |
| (2 weeks) | 11. Sourcing Decisions, Pricing and Revenue Management in a Supply Chain |
| (½ week) | 12. Information Technology in a Supply Chain |

## ***Class Schedule:***

The class is held three times per week for lectures and once in a week for tutorials.

## ***Course Contribution to professional Component:***

- Math and Basic Science: -
- Engineering Science: 60%
- Engineering Design: 30%
- Human and social science: 10 %

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | 2 | 3 | | | 2 | | | | | | 3 | | 2 | 3 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
| --- | --- | --- | --- | --- | --- | --- |
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٥٨ | IE 458 | Strategic Management in Industry |
| IE 351 | | | | | | Pre-requisite |
| Overview of operations strategy for competitive advantage. Evaluation of a firm's external environment using Porter Five Forces Model. Evaluation of a firm's internal capabilities using the VRIO framework. Cost leadership versus product differentiation strategies. Vertical integration and corporate diversification. Strategic alliances, mergers and acquisitions. Real life examples and case studies from industry. | | | | | | |

***One hour tutorial session**

***<u>Faculties and departments requiring this course (if any)</u>*:**

Industrial Engineering Department

***<u>Textbook</u>*:**

Barney, J. and Hesterly, W., STRATEGIC MANAGEMENT AND COMPETITIVE ADVANTAGE, 2nd ed., Prentice Hall Inc., (2007), ISBN-ISBN-10: 013613520X, ISBN-13: 978-0136135203.

***<u>References</u>*:**

None

***<u>Course Leaning Objectives</u>*:**

**By completion of the course, the students should be able to:**

1. Comprehend the fundamentals of Strategic Management
2. Understand various types of strategic planning and management in industry
3. Organizing framework (VRIO)
4. Recognize the role of strategic management in industry at various organizational levels and their impact on organizational development and success
5. Identify the key differences between strategic planning and long term planning
6. Study the industrial environment in the region and analyze the extent of application of strategic management principles in various industrial organizations.
7. Learn how strategic plans are developed and implemented

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (1 week) | 1. What Is Strategy and the Strategic Management Process? |
| (1½ weeks) | 2. Evaluating a Firm's External Environment |
| (1½ weeks) | 3. Evaluating a Firm's Internal Capabilities |
| (1 week) | 4. Cost Leadership |
| (2 weeks) | 5. Product Differentiation |
| (4 weeks) | 6. Vertical Integration<br>Corporate Diversification<br>Organizing to Implement Corporate Diversification |
| (3 weeks) | 7. Strategic Alliances<br>Mergers and Acquisitions |

## ***Class Schedule*:**

The class meets three times a week. Twice as regular sessions and 50 minutes lecture each on Saturday, Monday and Wednesday from 9.00 to 10.00 a.m. and once for Tutorial class.

## ***Course Contribution to professional Component*:**

- Engineering science: 25 %
- Engineering design:  75 %

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| 3 | 3 | 3 | | | 1 | | | | | | 3 | | 3 | 3 | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٥٩ | IE 459 | Introduction to Entrepreneurship |
| IE 351 | | | | | | Pre-requisite |
| Basic framework for understanding the process of entrepreneurship, principles of management and related techniques in decision making, planning, marketing, and financial control. Exercises in product design and prototype development, preparation of workable project feasibility reports, practical ideas about launching own enterprises. Classroom lectures are combined with field study and exercises supplemented with guest lectures and case studies on small and medium scale industries. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

- Timmons, J. A. and Spinelli, S., NEW VENTURE CREATION: ENTREPRENEURSHIP FOR THE 21ST CENTURY, 6th ed., Irwin/McGraw-Hill, (2004), ISBN: 0072498404.
- Kuratko, D. F. and Hodgetts, R. M., ENTREPRENEURSHIP: THEORY, PROCESS, AND PRACTICE (WITH INFOTRAC), 6th ed., South-Western College Pub, (2003), ISBN: 0324258267.
- Kaplan, J. M., GETTING STARTED IN ENTREPRENEURSHIP, John Wiley, (2001), ISBN: 0-471- 9456-X.
- Class notes/handout material provided by instructor.
- Web-page for the Course: Group name: ent1-kau; Group home page: http://groups.yahoo.com/group/ent1-kau ; Group email: ent1-kau1@yahoogroups.com

***References:***

None

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Explain the entrepreneurial traits and skills.
2. Select and evaluate a business idea against a personal vision involving lifestyle, and professional and financial goals.
3. Manage a small/medium scale industry in terms of human resource management (HRM), marketing, finance and project management, and successfully interact with experts in the field for developing an understanding of the practical aspects of the entrepreneurship.
4. Apply analytical and critical thinking skills to determine the feasibility of a business concept and build an effective and persuasive case for the feasibility of a selected business concept.
5. Prepare a technically and financially viable project proposal for submission to financial institutions for approval to start an entrepreneurial venture.

## ***Topics Covered and Duration***:

| | |
|---|---|
| (½ week) | 1. Introduction to entrepreneurship |
| (½ week) | 2. Introduction to small & medium scale industries |
| (1 week) | 3. Product selection |
| (1 week) | 4. Management of small/medium scale industries: human resource management |
| (1 week) | 5. Management of small/medium scale industries: marketing |
| (3 weeks) | 6. Management of small/medium scale industries: financial management |
| (1½ weeks) | 7. Project management |
| (1 week) | 8. Feasibility studies: operational aspects |
| (½ weeks) | 9. Feasibility studies: technological aspects |
| (4 weeks) | 10. Prototype development |

## ***Class Schedule***:

The classes are held twice per week for lectures and once in a week for tutorials.

## ***Course Contribution to professional Component:***

- Engineering science: 2 Credits
- Engineering design: 1 Credit

## ***Course Relationship to Program Outcomes***:

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| | 2 | 3 | 3 | 3 | | | 3 | 3 | | 2 | | | | | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 1* | 3 | هـ ص ٤٩٠ | IE 490 | **Special Topics in Industrial Engineering** |
| **Department Approval** | | | | | | **Pre-requisite** |
| In-depth study of relevant industrial engineering topics not covered in other courses of the program in order to enhance students' knowledge in the field of industrial engineering. | | | | | | |

***One hour tutorial session**

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

- Class notes/handout material provided by instructor.
- Web-page for the Course: Group name: ent1-kau; Group home page: http://groups.yahoo.com/group/ent1-kau ; Group email: ent1-kau1@yahoogroups.com

***References:***

None

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Explain the entrepreneurial traits and skills.
2. Select and evaluate a business idea against a personal vision involving lifestyle, and professional and financial goals.
3. Manage a small/medium scale industry in terms of human resource management (HRM), marketing, finance and project management, and successfully interact with experts in the field for developing an understanding of the practical aspects of the entrepreneurship.
4. Apply analytical and critical thinking skills to determine the feasibility of a business concept and build an effective and persuasive case for the feasibility of a selected business concept.
5. Prepare a technically and financially viable project proposal for submission to financial institutions for approval to start an entrepreneurial venture.

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (½ week) | 1. Introduction to entrepreneurship |
| (½ week) | 2. Introduction to small & medium scale industries |
| (1 week) | 3. Product selection |
| (1 week) | 4. Management of small/medium scale industries: human resource management |
| (1 week) | 5. Management of small/medium scale industries: marketing |
| (3 weeks) | 6. Management of small/medium scale industries: financial management |
| (1½ weeks) | 7. Project management |
| (1 week) | 8. Feasibility studies: operational aspects |
| (½ weeks) | 9. Feasibility studies: technological aspects |
| (4 weeks) | 10. Prototype development |

## ***Class Schedule*:**

The classes are held twice per week for lectures and once in a week for tutorials.

## ***Course Contribution to professional Component:***

- Math and Basic Science: 1 Credit or 25%
- Engineering Science: 1 Credit or 25%
- Engineering Design: 1 Credit or 25%
- Human and social science: 1 Credit or 25 %

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **f** | **d** | **i** | **n** | **m** | **l** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET and additional Program Outcomes** |
| | 2 | 3 | 3 | 3 | | | 3 | 3 | | 2 | | | | | | | **Max. Attainable Level of Learning*** |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 3 | - | 2 | 3 | هـ ص ٤٩١ | IE 491 | Industrial Engineering Practice |
| IE 341, IE 351 | | | | | | Pre-requisites |

Overview of all areas of Industrial Engineering (IE). Identification of specific IE tools for industrial and business enterprises. Brainstorming sessions of several pre selected industrial and business enterprises. Visiting the sites and conducting walk-through surveys. On-site studies of IE applications and practices. Preparation of visit reports containing findings, comments and recommendations pertaining to every visit. Multimedia-based presentation of visit-reports.

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

Heizer, J. and Render, B., PRODUCTION AND OPERATION MANAGEMENT, 7th ed., Pearson Prentice Hall, (2005).

***References:***

- Tompkins, W. et al., FACILITIES PLANNING, 3rd ed., John Wiley & Sons, (2003).
- Kanawati, G. (Ed), INTRODUCTION TO WORK STUDY, 4th ed., International Labour Organization, Geneve, (1992).
- Asfahl, C.R., INDUSTRIAL SAFETY AND HEALTH MANAGEMENT, 5th ed., Prentice Hall, (2005).

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Use industrial engineering knowledge in actual life situations, in general, and in particular as related to the following aspects.
2. Apply the skills of "productivity-enhancement" in industrial and non-industrial environments of work; as well as comparing and contrasting the prevalent economic systems, verifying the significance of human resource management, the organization structure and design in professional life.
3. Understand the strategic role of Information Systems in organizations, and their application for promoting business process integration and improving organizational performance.
4. Anticipate, recognize and suggest controls for work and environmental hazards, as well as accident causes.
5. Work efficiently in multidisciplinary team, and work efficiently in assigned work.
6. Communicate effectively in written/oral communication skills.

## ***Topics Covered and Duration*:**

| | |
|---|---|
| (14 weeks) | The students visit selected industrial and business enterprises (twelve visits during one semester) with the following objectives:<br>1. Walk-through survey of the industrial operations, reviewing:<br>a) Facility layout and general design of workplace and workstations.<br>b) Job design and performance.<br>2. Discussion with key manager(s) as related to the application of IE principles in:<br>a) Operation planning and control.<br>b) Management systems design.<br>c) Work measurement and design.<br>d) Application of information systems.<br>e) Quality control.<br>f) Financial and personnel management(s).<br><br>The students are divided into 5-6 teams, who are rotating their interest in the field visits towards the different IE aspects. The teams prepare and present in one class outlines and basic information for the forthcoming visit, as well as present reports in class for the previous visit, including students' observation, comments, recommendations, and have discussion among each other, directed by the coordinator(s), of all their technical interests in the visit. |

## ***Class Schedule*:**

The class meets twice weekly. One for regular session of 1 hour 20 minutes for preparation of the forthcoming field visit, and presentation and discussion as related to the previous one; the second session of 4-6 hours for the field visit of the selected industrial, service and/or business enterprise.

## ***Course Contribution to professional Component*:**

- Engineering Science: 1.50 credit or 50%
- Engineering Design: 0.75 credit or 25%
- Human and Social Science: 0.75 credit or 25%

## ***Course Relationship to Program Outcomes*:**

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| | 3 | 2 | 1 | 3 | | | | | 2 | | 2 | | | | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

| CREDITS | | | | ARABIC CODE/NO | ENGLISH CODE/NO | COURSE TITLE |
|---|---|---|---|---|---|---|
| TCH | Tr. | Pr. | Th. | | | |
| 4 | - | 4 | 2 | هـ ص ٤٩٩ | IE 499 | **Senior Project** |
| **IE 422 and IE 432** | | | | | | **Pre-requisites** |
| Technical writing skills. Project work: a team-based capstone design work involving a practical, open ended, real life unstructured problem having a set of alternative solutions; emphasis on synthesis of knowledge and skills to assimilate and demonstrate a professional attitude and ethics in problem solving with assessment of environmental, cultural and social impacts; final output in the form of written report based on specified standard format, followed by a multimedia presentation of the work undertaken in the project. | | | | | | |

***Faculties and departments requiring this course (if any):***

Industrial Engineering Department

***Textbook:***

- Dieter, E., ENGINEERING DESIGN, P edition, McGraw-Hill, (2000).
- Fogler, and LaBlanc, STRATEGIES FOR CREATIVE PROBLEM SOLVING, Prentice Hall, (1995).
- Software manuals

***References:***

(Web-page for the Course)
Group name: Project-ie-499
Group home page: ;
Group email: project-ie-499@yahoogroups.com

***Course Leaning Objectives:***

**By completion of the course, the students should be able to:**

1. Apply the fundamentals developed in the curriculum to an actual design project.
2. Foster and develop creative, conceptual and analytical thinking skills.
3. Create proficiency with modem design tools including statistical tools and software systems' applications.
4. Develop teamwork concepts and understand the importance of developing good team dynamics.
5. Enhance written and oral communication skills, and
6. Implant a sense of ethics and professionalism.

## ***Topics Covered and Duration:***

| | |
|---|---|
| (1 week) | 1. Design Methodology, Synthesis, Creativity and Conceptualization |
| (1 week) | 2. Project Management Techniques |
| (1 week) | 3. Problem Solving Heuristic |
| (2 weeks) | 4. Teamwork Skills |
| (1 week) | 5. Communication Skills; Written and Oral |
| (2 weeks) | 6. Use of standards and design codes |
| (1 week) | 7. Software Tutorials (e.g. MS Info Path, Mind Manager, MS Project, Arena etc.) |
| (2 weeks) | 8. Cost Analysis |
| (2 weeks) | 9. Engineering profession Ethics |

## ***Class Schedule:***

The classes are held twice per week for lectures (Technical Report Writing part) and once in a week while meeting with the advisor(s) (Project part).

## ***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | f | d | i | n | m | l | j | h | e | c | b | a | 2 | 1 | ABET and additional Program Outcomes |
| 3 | 3 | 3 | 2 | 2 | 2 | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | | Max. Attainable Level of Learning* |

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

# DEPARTMENT OF
# MINING ENGINEERING

## INTRODUCTION

Mining Engineering involves the extraction of mineral matter out of the earth's crust. This includes metallic ores, industrial minerals, precious and ornamental stones, solid fuels and radioactive minerals. Mineral production in the past has contributed to the prosperity or decline of civilizations. Nowadays, one of the measures of the prosperity of a nation is its per capita consumption of minerals. The existence of basic and secondary industries is dependent on available resources. Extraction, processing, and utilization of the mineral resources contribute to the economic development and self-reliance of a nation which may be of strategic importance.

As a result of a massive exploration effort in the past three decades, a large number of mineral deposits of gold, silver, copper, zinc, iron, phosphate, bauxite, silica, magnesite, etc., has been discovered and delineated in the Kingdom of Saudi Arabia. Additionally, a large variety of elegant granites and marbles is being exploited for local consumption and export. In order to diversify its economic base, the Ministry of Petroleum and Mineral Resources is entrusted with the task of promoting the development of these resources. The Department of Mining Engineering at King Abdulaziz University endeavors to produce Saudi mining engineers capable of planning and exploiting projects related to the mining and mineral industry.

## VISION

To be a leader in the field of Mining Engineering, Applied Research and Community Services.

## MISSION

To prepare motivated and qualified mining engineers and promote research applied to the exploitation of the indigenous mineral resources as a contribution to national wealth.

## OBJECTIVES

Mining Engineering Program prepares its graduates to achieve the following career and professional accomplishments:

1. Engage in productive career in the mining industry in Saudi Arabia as well as government and academic settings
2. Demonstrate responsible, professional, and ethical behavior integrated with a commitment to serve the needs of the society.
3. Pursue personal professional development and contribute to the development of the profession
4. Advance in responsibility and leadership in the fields of mining engineering.

## PROGRAMS OFFERED

The Department of Mining Engineering offers the degree of Bachelor of Science in Mining Engineering and has recently offered graduate studies in Mining Engineering Sciences. The program is intended to provide the graduating students with a good background in the field of specialization in addition to basic sciences such as physics, chemistry, mathematics and geology. The main objectives of the curriculum of the Mining Engineering program can be summarized as follows:

- To prepare mining engineers capable of working in the field of mining and minerals engineering.
- To prepare the program of study so as to include essential courses of the specialization in addition to the essential basic physical sciences.
- To offer elective courses covering various fields of mining engineering such as Tunneling Engineering, Mineral Processing, Experimental Rock Mechanics, Mine

Environment, and Mine Data Analysis, so as to assist students to gain additional knowledge in various aspects of the specialization.
- To cover relevant experimental work for all the essential courses of the program.

## CAREER OPPORTUNITIES

The Department of Mining Engineering offers degree of Bachelor of Science in Mining Engineering. This program has been accredited as Substantially Equivalent to the accredited programs in the USA by the Accreditation Board for Engineering and Technology Inc. (ABET). It offers opportunities for graduates of the program to work as engineers in surface and underground mining operations and related fields such as tunneling and quarrying, covering the technologies of mineral exploration, mining economics, rock fragmentation, minerals extraction, stability of rock structures, minerals and rock processing, mine ventilation, safety, environment and management..

## FACILITIES

The Department has the following laboratories:

***Mineral Processing Laboratory***: The functions of this laboratory include crushing and grinding of raw ores, and separation of useful minerals from worthless (gangue) minerals associated with them.
***Rock Mechanics Laboratory***: This laboratory has equipment and instruments for testing strength and other mechanical properties of rocks in compression, tension and other modes of loading. This is needed for the evaluation of deformation behavior of rocks and assessment of the means of rock support in the ground excavations.
***Mine Ventilation Laboratory***: This laboratory is specifically used for the evaluation of the (conventionally) adequate quantities of air required for the ventilation of mine openings and stops underground. This laboratory is equipped with devices related to the analysis of gases and soil, determination of moisture content, heat and air flow rate.
***Chemical Analysis Laboratory***: This lab is equipped with an XRF and XRD instruments for analyzing specimens to determine mineralogical and metallic contents of ores and rocks.

## PROGRAM REQUIREMENTS AND CURRICULUM

Requirements for the B.Sc. degree from Mining Engineering Department

### Conventional Program

| Requirements | Cr. hrs |
|---|---|
| Preparatory Year Requirements | 27 |
| University Requirements | 14 |
| Faculty Requirements | 37 |
| Departmental Requirements | 77 |
| **Total** | **155** |

### Cooperative Program

| Requirements | Cr. hrs |
|---|---|
| Preparatory Year Requirements | 27 |
| University Requirements | 14 |
| Faculty Requirements | 37 |
| Departmental Requirements | 69 |
| Coop Program | 8 |
| **Total** | **155** |

## Departmental Requirements Core Courses (71 hrs)

| Course No. | Course Title | Cr. hrs | Prerequisite |
|---|---|---|---|
| IE 256 | Engineering Management | 2 | IE 202, IE255 |
| MEP 290 | Fluid Mechanics | 3 | PHYS 281, MATH 202 |
| CE 201 | Engineering Mechanics (Static) | 3 | PHYS 281, IE 200 |
| MENG 270 | Mechanics of Materials | 3 | CE 201 |
| CE 371 | Surveying | 3 | MATH 202, MENG 102 |
| EMR 201 | Physical Geology | 4 | --- |
| MinE 300 | Ore Deposit Characteristics | 3 | EMR 201 |
| MinE 301 | Principles of Mining & Metallurgical Engineering | 3 | EMR 201 |
| MinE 302 | Mining Field Practice | 4 | IE 200, MinE 301 |
| MinE 303 | Mining Operation System | 3 | IE 202, MATH 204 |
| MinE 311 | Rock Mechanics | 4 | MENG 270, MinE 300 |
| MinE 312 | Drilling & Blasting in Mining | 3 | MinE 301, MinE 311 |
| MinE 322 | Surface Mining | 3 | MinE 301, MinE 303 |
| MinE 323 | Underground Mining | 3 | MinE 301, MinE 303 |
| MinE 330 | Ore Transportation & Handling | 3 | EE 251, MinE 303 |
| MinE 342 | Mineral Processing | 3 | CHEM 281, MinE 330 |
| MinE 390 | Summer Training | 2 | MinE 302 |
| MinE 401 | Mine Surveying | 3 | CE 371, MinE 301 |
| MinE 402 | Mining & Metallurgical Economics | 3 | IE 255, MinE 301 |
| MinE 422 | Mine Ventilation & Safety | 3 | MEP 290, MATH 205 |
| MinE 423 | Mine Law, Planning & Management | 3 | IE 256, MinE 312 |
| MinE 451 | Extractive Metallurgy & Alloys Production | 3 | MinE 301, MinE 342 |
| MinE 499 | Senior Project | 4 | MinE 322, MinE 323 |
| **Total** | | **71** | |

## Departmental Requirements Elective Courses (6 Cr.hr)

The student has to choose two out of courses listed below.

| Course No. | Course Title | Cr. hrs | Prerequisite |
|---|---|---|---|
| MinE 405 | Computer Application in Mining & Metallurgy | 3 | EE 201 |
| MinE 411 | Applied Rock Mechanics | 3 | MinE 311 |
| MinE 412 | Rock Blasting | 3 | PHYS 202, CHEM 281 |
| MinE 421 | Tunnels Engineering | 3 | EE 201 |
| MinE 424 | Mine Environment | 3 | CHEM 281 |
| MinE 425 | Analysis of Mining & | 3 | EE 201 |

| | | | |
|---|---|---|---|
| | Metallurgical Data | | |
| MinE 433 | Methods of Ore Analysis | 3 | CHEM 281 |
| MinE 441 | Applied Mineral Processing | 3 | MinE 342 |
| MinE 452 | Powder Metallurgy | 3 | CHEM 281 |
| MinE 470 | Special Topics in Mining Engineering | 3 | EE 201 |
| MinE 471 | Special Topics in Metallurgical Engineering | 3 | IE 255 |
| xx xxx | Out of Department Course | 3 | Advisor Approval |

**Total credit hours required for graduation is 155.**

# A TYPICAL PROGRAM FOR MINING ENGINEERING STUDENTS

## 3rd Year (Regular & Cooperative)

| 5th Semester Courses | | | 6th Semester Courses | | |
|---|---|---|---|---|---|
| Course No. | Course Title | Cr.hrs | Course No. | Course Title | Cr.hrs |
| ISLS 201 | Islamic Culture (2) | 2 | MENG 270 | Mechanics of Materials | 3 |
| EE 251 | Basic Electrical Engineering | 4 | MATH 205 | Series & Vector Calculus | 3 |
| EMR 201 | Physical Geology | 4 | ARAB 201 | Writing Skills | 3 |
| MATH 204 | Differential Equations I | 3 | MEP 290 | Fluid Mechanics | 3 |
| CE 201 | Engineering Mechanics (Statics) | 3 | MinE 300 | Ore Deposits Characteristics | 3 |
| IE 202 | Introduction to Engineering Design II | 2 | MinE 301 | Principles of Mining and Metallurgical Engg. | 3 |
| **Total** | | **18** | **Total** | | **18** |

## 4th Year (Regular)

| 7th Semester Courses | | | 8th Semester Courses | | |
|---|---|---|---|---|---|
| Course No. | Course Title | Cr.hrs | Course No. | Course Title | Cr.hrs |
| ISLS 301 | Islamic Culture (3) | 2 | MinE 312 | Drilling & Blasting in Mining | 3 |
| CE 371 | Surveying | 3 | MinE 322 | Surface Mining | 3 |
| MinE 302 | Mining Field Practice | 4 | MinE 323 | Underground Mining | 3 |
| MinE 303 | Mining Operation System | 3 | MinE 330 | Ore Transportation & Handling | 3 |
| IE 256 | Engineering Management | 2 | ISLS 401 | Islamic Culture: Work Ethics | 2 |
| MinE 311 | Rock Mechanics | 4 | | | |
| **Total** | | **18** | **Total** | | **14** |

## 4th Year (at summer)

| Summer Training (Regular) | | | Summer Training (Cooperative) | | |
|---|---|---|---|---|---|
| Course No. | Course Title | Cr.hrs | Course No. | Course Title | Cr.hrs |
| MinE 390 | Summer Training | 2 | MinE 400 | Cooperative Work Program | 8 |

## 5th Year (Regular)

| 9th Semester Courses | | | 10th Semester Courses | | |
|---|---|---|---|---|---|
| Course No. | Course Title | Cr.hrs | Course No. | Course Title | Cr.hrs |
| ISLS 301 | Islamic Culture (3) | 2 | MinE 312 | Drilling & Blasting in Mining | 3 |
| CE 371 | Surveying | 3 | MinE 322 | Surface Mining | 3 |
| MinE 302 | Mining Field Practice | 4 | MinE 323 | Underground Mining | 3 |
| MinE 303 | Mining Operation System | 3 | MinE 330 | Ore Transportation & Handling | 3 |

| | | | | | |
|---|---|---|---|---|---|
| IE 256 | Engineering Management | 2 | ISLS 401 | Islamic Culture: Work Ethics | 2 |
| MinE 311 | Rock Mechanics | 4 | | | |
| **Total** | | **18** | **Total** | | **14** |

## 5th Year (Regular)

| 9th Semester Courses | | | 10th Semester Courses | | |
|---|---|---|---|---|---|
| **Course No.** | **Course Title** | **Cr.hrs** | **Course No.** | **Course Title** | **Cr.hrs** |
| MinE 342 | Mineral Processing | 3 | Mine 402 | Mining and Metallurgical Economics | 3 |
| MinE 401 | Mine Surveying | 3 | MinE 423 | Mine Law, Planning & Management | 3 |
| MinE 422 | Mine Ventilation & Safety | 3 | MinE 451 | Extractive Metallurgy & Alloys Production | 3 |
| MinE 499 | Senior Project | 4 | MinE xxx | Elective (2) | 3 |
| MinE xxx | Elective (1) | 3 | | | |
| **Total** | | **16** | **Total** | | **12** |

## 5th Year (Cooperative)

| 9th Semester Courses (Cooperative) | | | 10th Semester Courses (Cooperative) | | |
|---|---|---|---|---|---|
| **Course No.** | **Course Title** | **Cr.hrs** | **Course No.** | **Course Title** | **Cr.hrs** |
| MinE 499 | Senior Project | 4 | MinE 342 | Mineral Processing | 3 |
| | | | MinE 401 | Mine Surveying | 3 |
| | | | Mine 402 | Mining and Metallurgical Economics | 3 |
| | | | MinE 422 | Mine Ventilation & Safety | 3 |
| | | | MinE 423 | Mine Law, Planning & Management | 3 |
| | | | MinE 451 | Extractive Metallurgy & Alloys Production | 3 |
| **Total** | | **4** | **Total** | | **18** |

## COURSE DESCRIPTION

## COURSE DESCRIPTION

**MinE 300 Ore Deposit Characteristics (3:2,2)**
Economic mineral deposits: Origin, Types, Properties, Characteristics, etc. Economic ores in Saudi Arabia. Primary and secondary ore deposits. Forming of economic mineral deposits. Geological mapping. Computer Applications in ore deposit characteristics.
**Prerequisite: EMR. 201**

**MinE 301 Principles of Mining & Metallurgical Engineering (3:2,2)**
Basic definition. Mining history - Mining contribution to civilization - Common minerals and their uses - Mineral resources in Saudi Arabia. Stages of mine operations (prospecting, exploration, drilling, blasting, supporting, development and exploitation) - Ore reserve estimation - Types of mining - Important terms of surface mining & some examples - Important terms of underground mining & some examples. Mine ventilation& safety - Mineral Processing & Smelting Operations - An introduction to metallurgical engineering - Metallurgy of pig iron - Blast furnace - Manufacture of steel - Production of copper and alumina - Recovery of gold, silver, lead and zinc - Computer application in mining and metallurgy.
**Prerequisites: EMR 201**

**MinE 302 Mining Field Practice (4:2,4)**
Because of the special nature of mine operations, student will stay for two weeks at the mine field "operation" with faculty member(s) to participate at running the mine unit operations e.g. surveying, blasting, loading and hauling, stability assessment and mineral processing. The student will submit and orally defend a field practice report.
**Prerequisites: IE 200, MinE 301**

**MinE 303 Mining Operation System (3:2,2)**
Application of mathematics to the solution of management, operations and engineering decision making problems in order to attain some predefined goal or optimum condition. Using computer programs e.g., spreadsheets to solve common operations research problems. Solution techniques in OR such as Linear Programming, network formulations, project scheduling and Monte Carlo simulation will be discussed in their relation to problems in the minerals industries.
**Prerequisite: IE 202, MATH 204**

**MinE 311 Rock Mechanics (4:3,2)**
Physical and mechanical properties of rocks - Stress and strain analysis and their distribution around openings - Criteria of rock failure - Deformation behavior of rock - Introduction to slope stability - Rock mass& discontinuities behavior - Geological and engineering classification of rock- Rock testing - Computer applications in rock mechanics.
**Prerequisites: Meng 270, MinE 300**

**MinE 312 Drilling & Explosive in Mining (3:3,2)**
Applications of Rock Drilling - Drilling Theory - Drill ability - Types of Drilling. Drilling mechanism - Drilling Machines - Drilling bits - Drilling fluids - Properties of explosives - Blasting agent - Types of cuts – Pattern Design - Application of computer programs in drilling and blasting..
**Prerequisites: MinE 301, MinE 311**

**MinE 322 Surface Mining Engineering (3:2,3)**

Current and future status of surface mining - Prospecting and exploration- Land and water acquisitions - Preliminary evaluation - Planning and engineering design of open-pits, quarries, and alluvial mining operations - Unit operations (drilling, blasting, excavation; Loading, haulage & transportation, etc) - Design and planning of mine operations with emphasis on the design and planning of surface layouts - Auxiliary operations - Organization management and economics - Applying computer programs.

**Prerequisites: MinE 301, MinE 303**

**MinE 323 Underground Mining Engineering (3:2,3)**

Underground Mining Terms - Geological Consideration - Prospecting& Exploration stages - Development& Exploitation Stages - Drilling & Blasting of Underground Mine - Loading and Haulage Operations in Underground Mining - Types of Roof Mine Supports - Different Types of Underground Mining Methods – Selection and design of a Suitable Mining Methods - Application of computer methods.

**Prerequisites: MinE 301, MinE 303**

**MinE 330 Ore Transportation & Handling (3:3,2)**

A review of applied mechanics principles - A review of material & ore handling - Classification of mine plant and equipment - Design parameters and selection of machines and other miscellaneous underground equipments - Design of haulage systems: locomotives, conveyors, elevators, trucks and fluid transport - Design of hoisting and rope haulage systems, including monorails and aerial ropeways - Applying computer-aided design programs.

**Prerequisites: EE 251, MinE 303**

**MinE 342 Mineral Processing (3:3,3)**

Introduction to mineral processing - Efficiency of operations – Liberation- Concentration and Metallurgical balances – Comminution and classification - Sampling. Sizing. Gravity concentration - Heavy medium separation - Magnetic and electrostatic separation - Dewatering and tailings disposal - Examples of flow sheets and computer applications in mineral processing - Introduction to brief flotation.

**Prerequisites: CHEM 281, MinE 330**

**MinE 390 Summer Training (2:2,0)**

10 weeks of supervised hands-on work experience at a recognized firm in a capacity which ensures that the student applies his engineering knowledge and acquires professional experience in his field of study at KAU. The student is required to communicate, clearly and concisely, training details and gained experience both orally and in writing. The student is evaluated based on his abilities to perform professionally, demonstrate technical competence, work efficiently, and to remain business focused, quality oriented, and committed to personal professional development.

**Prerequisites: MinE 302 + 120 Hrs.**

**MinE 401 Mine Surveying (3:3,2)**

Triangulation net works. Underground traverses - Connecting an underground traverse with triangulation net work - Theory of errors and probability - Computer application in mine survey data analysis and mine maps plotting - Application of surveying in mine and quarry development for optimum extraction of ore deposits

**Prerequisites: CE 371, MinE 301**

**MinE 402 Mining & Metallurgical Economics (3:3,3)**

An overview of mining economics - The economic minerals: Resources and reserve - Patterns of production, consumption, transportation, and marketing etc. - Perspective of the past, present and future supplies of minerals worldwide and in Arab countries - Finance and economic analysis and interpretation of economic data - The concept of cash flow and time value - Sensitivity and risk analysis techniques etc. - Introduction to writing of technical reports and preliminary feasibility study reports using spreadsheet computer applications.

**Prerequisites: IE 255, MinE 301**

**MinE 405 Computer Application in Mining & Metallurgy (3:2,3)**

Application of computer in mine layouts design. Estimation of ore reserves utilizing both AutoCAD and specialized mining softwares. Mine stability assessment using computer modeling. Ventilation circuits modeling via Vensim® program. Examine economical merits of mining operation via spread sheets. Modeling of mineral processing unit operation and metallurgical unit processes using commercial softwares.

**Prerequisite: EE 201**

**MinE 411 Applied Rock Mechanics (3:3,3)**

In situ strength of rocks and its measurements. Design, supporting and reinforcement of underground openings. Roof control and pillar design Rock hazards and risk assessment. Design, monitoring and protection of slopes. Computer applications in applied rock mechanics.

**Prerequisite: MinE 311**

**MinE 412 Blasting Engineering (3:3,2)**

Fragmentation principles - Strength characteristics of rock - Properties of explosives - High explosives - Blasting agent. Initiation devices safety fuse, electric shotfiring and detonating cords - Primers and boosters. Sequential firing - Practical usage of explosives - Blast-hole drilling. Blasting theory - Types of cuts. Application of computer programs in designing drill patterns for blasting in tunnels and other main headings - Blasting in stope operations and in mines.

**Prerequisites: PHYS 202, CHEM 281**

**MinE 421 Tunnels Engineering (3:2,3)**

Classification of tunnels - Preliminary studies including economic - Geological and geo-technical parameters and their influence on tunnelling - Route survey and alignment of tunnels - Stress distribution around tunnels - Methods and techniques employed in tunnelling in hard and medium rocks as well as in weak rock and soils - Tunnelling under water - Application of computer programs.

**Prerequisite: EE 201**

**MinE 422 Mine Ventilation & Safety (3:3,3)**

General introduction - Nature and importance of ventilation and its control - Sources of heat and humidity in mines - Heat conduction in rocks - Mine hygrometry and psychrometry - Temperature and humidity control - Mine cooling systems. Mine ventilation: Quality control. Normal air. Mine air. Gas flow through strata. Gas adsorption - Physiological effects and permissible limits - Methane drainage system - Mine dusts: Sources of dust. Dust suppression. filtration etc. - Physiological effects and permissible limits - Mine fires and explosions - Principle of ventilation flow and its laws. Natural ventilation. Artificial ventilation. Ventilation systems - Ventilation ducts & Airways - Occupational diseases of miners - Mine drainage and pumping. Application of computer

programs.
**Prerequisites: MEP 290, MATH 205**

**MinE 423 Mine Law, Planning and Management (3:2,3)**

Mine layout for surface & underground operations- Surface & underground accesses - Selection of a suitable mining method and equipment for a certain ore body - Pit and stope optimization performance - Plan & schedule mine development and production. Select a suitable mineral processing plant - Estimate capital/operation cost & productivity - Use a mining software & spreadsheets for mine planning - Management structure of a modern mining industry - Co-ordination and control - Human relations - Principles of Operations research and its application in mining, using a computer software, PERT, CPM, and other deterministic methods.
**Prerequisites: IE 256, MinE 312**

**MinE 424 Mine Environment (3:3,2)**

Gas & Dust pollution in mining & related industries - Dust measurements, characterization, and control techniques - Impact of mining on environment - Mine surface vegetation control - Air, water and noise pollution and their control - Planning, methods, and costs - Legislative regulations and implementation - Public relations - Mine land. Reclamation and regional restoration - Safety rules to avoid hazards - Mine accidents causes of physical accidents and their nature - Accidents statistics frequency and severity rates - The international mine safety rating scheme - General aspects of mine safety - Safety organizations - Industrial hygiene - Personal protective equipment - Safety first aid programs - Mine health and safety laws - Mine rescue and recovery operations/procedures - Applications of computer programs.
**Prerequisites: CHEM 281**

**MinE 425 Analysis of Mining & Metallurgical Data (3:2,3)**

Introduction to principles of statistics-random variables. Sampling & distributions. Statistical analysis. Principles of geostatistics. Krigging method. Geostatistical simulation for mineral prospecting. Ore grade and ore reserve estimation. Geostatistical applications in Mining Engineering. Utilizing computer program.
**Prerequisites: EE 251**

**MinE 433 Methods of Ore Analysis (3:3,3)**

Ore composition - Mineralogical analysis of ores - Instruments of mineralogical analysis (Theory and practice- quantative and qualitative) - Elemental analysis of mineral and rocks - Classical elemental analysis (Instruments, Theory and, Applications) - Advanced elemental analysis of mineral and rocks (Instruments, Theory and, Applications).
**Prerequisites: CHEM 281**

**MinE 441 Applied Mineral Processing (3:3,3)**

Introduction to the theory of flotation- Reagents in flotation - Contact angle at solid/liquid/air interface - Gibbs adsorption equation as applied to flotation - Adsorption of collectors on minerals - The importance of pH in flotation - Activation and depression in flotation - Theories of the electrical double layer at mineral-water interfaces - Flotation circuits and machines - Concentration of iron, phosphates, copper, lead, zinc, and other ores, by flotation- Application of computer programs in concentration of some ores by flotation and other mineral processing techniques.
**Prerequisite: MinE 342**

**MinE 451 Extractive Metallurgy & Alloys Production (3:3,3)**

Extraction and production of iron ore by blast furnace and direct reduction processes - Batch and continuous steel– making - Extraction of non–ferrous metals, e.g. aluminum, copper, titanium, uranium and manganese. Metals refining. Melting and solidification of metals - Design of some units and role of transport phenomena in metallurgical processes. Site and layout of metallurgical plants - Production economic - Pollution control - Waste heat recovery - Production of alloys and alloys characterization.

**Prerequisites: MinE, 301; MinE 342**

**MinE 452 Powder Metallurgy (3:3,2)**

Introduction and historical background - Production and characterization of metallic powders - Pressing technology - Sintering theory of metallic compacts and its application - Mechanical properties of sintering parts - Investigation and quality control of products - Properties and applications fields of some powder systems.

**Prerequisite: CHEM 281**

**MinE 470 Special Topics in Mining Engineering (3:3,2)**

Selected topics in major to specialize in one of the Mining Engineering areas.

**Prerequisite: EE 201**

**MinE 471 Special Topics in Metallurgical Engineering (3:3,2)**

Selected topics in major to specialize in one of the Metallurgical Engineering areas

**Prerequisite: IE 251**

**MinE 499 Senior Project (4:2,5)**

The student is required to function on multidisciplinary team to design a system, component, or process to meet desired needs within realistic constraints. A standard engineering design process is followed including the selection of a client defined problem, literature review, problem formulation (objectives, constraints, and evaluation criteria), generation of design alternatives, work plan, preliminary design of the selected alternative, design refinement, detailed design, design evaluation, and documentations. The student is required to communicate, clearly and concisely, the details of his design both orally and in writing in several stages during the design process including a final public presentation to a jury composed of several subject-related professionals.

**Prerequisites: MinE 322, MinE 323 +120 hrs**

# DEPARTMENT OF NUCLEAR ENGINEERING

# INTRODUCTION

The Department of Nuclear Engineering was established in the year 1977 to meet the current and future needs of Saudi Arabia for graduates in the fields of Nuclear Reactors and Nuclear power, Radiation Safety, Radioisotope Applications in Medicine and Industry .
In the year 2007, the Department of Nuclear Engineering introduced two new tracks in addition to Nuclear Power Engineering track, namely, (i) Medical Physics track, and (ii) Radiation Protection tracks. The new tracks have broadened the curriculum to include radiological engineering, and health physics, and further broadened the appeal of the program. Accordingly, the undergraduate enrollment trend in the Department shows consistent increase every year. The trend of renewed interest in nuclear education among students was also evident through improved student retention as a result of exposure to nuclear technologies other than nuclear power technologies.

# VISION AND MISSION STATEMENTS

## The Vision of the Department

To be on the leading edge of technology, teaching and research in the field of nuclear engineering.

## The Mission of the Department

To prepare highly qualified nuclear engineers, medical physicist, health physicist and faculty who are capable of serving the community to a level that meet international standards and the demands of the century.

# EDUCATIONAL OBJECTIVES

The NE Program Educational Objectives are statements that describe what graduates of the NE program should be able to do by graduation time and during the first several years of their engineering profession careers following graduation. The following are the educational objectives of the program as published in the departmental bulletin and the departmental web site.

1. *Take up careers as nuclear engineers and work efficiently in industries, health sectors, nuclear power facilities, environmental protection agencies, and research centers or excel in higher studies, to meet the requirements of Saudi Arabia.*

2. *Engage professionally, update effectively, demonstrate quality, to earn the recognition of their employers and/or professional societies and advance in their positions in all related hierarchies.*

3. *Contribute to the service of the society as professional members and enable it to reap the benefits of modern technologies and values as and when needed.*

## Aspects of Development

The department of the Nuclear Engineering has most of the necessary resources needed to implement the new plan, however, some improvements and extra resources are needed to increase the ability of the department to accommodate more students considering the increase in demand for nuclear engineers and medical and health physicists. Future plans should consider the followings:

19. Modernization and upgrading of the Radiation Detection Lab
20. Modernization and upgrading of the Medical and Health Physics lab
21. Providing appropriate equipment for expanding and upgrading of the imaging lab
22. Recruiting additional faculty members in high demand specialties (medical physics)
23. Recruiting highly qualified medical physics technicians

## ADMISSION AND GRADUATION REQUIREMENTS

### Students Admissions into the Aeronautical Engineering Program

The actual policy of the Department of Nuclear Engineering is to accept, each semester, a reasonably predetermined number of students (normally between 20 and 30) of the highest GPA from those interested in joining the program.

### Graduation Requirements

Students eligible for a B.Sc. degree in Nuclear Engineering must successfully complete 155 credit hours with an overall GPA of 2.0-5.0 on a 0.0-5.0 scale. The 155 credit hours are distributed as follows:

University requirements: 41 credit hours
Faculty requirements: 37 credit hours
Department requirements: 77 credit hours

## FACILITIES

The facilities of the department include eight laboratories and a library.

### Laboratories

The laboratories of the department are:

- Radiation Detection Laboratory
- Radiation Protection Laboratory
- Low Counting Laboratory
- Non-Destructive testing Laboratory I & II
- Radioisotopes Application Laboratory
- Computation and Computer Laboratory
- Radio-analysis Laboratory
- Electronics and Maintenance Laboratory
- Diagnostic Radiography Laboratory
- Calibration Laboratory

A brief description of each laboratory is given in the following sections:

**Radiation Detection Laboratory**

The Radiation Detection Laboratory provides a background to the students in the various processes and techniques used to detect, identify and measure the different types of nuclear radiation. Equipment includes various types of radiation detectors like GM tubes, scintillation detectors, BF3 neutron detectors, high resolution high purity Ge detectors for gamma ray spectroscopy, surface barrier detectors and other types of detectors. A portable high purity germanium detector is also utilized for more precise gamma and X-ray measurements along with multichannel analyzers for spectral analysis. Students learn handling of these instruments and conduct experiments in radiation detection and measurements as required by the course NE 340. Several new equipments such as detectors and up-to-date multichannel analyzers are being ordered to update this laboratory.

**Radiation Protection Laboratory**
The radiation protection laboratory deals with all aspects of radiation protection and safety. This laboratory enables students to study and apply the principles of radiation protection, radiation shielding, decontamination and proper use and handling of radiation sources. The laboratory has different kinds of dose rate-meters, one neutron monitor and several TLD readers for dose readout using thermo-luminescence technique. There is also an air monitor setup, a modern “ionex” dose measurement system, and one hand and foot radiation contamination monitor in addition to other protective accessories like lead apron and spectacles. The laboratory has also several radioactive reference point sources (alpha, beta, and gamma emitters) for students’ use in various experiments. These equipments help the students through different experiments to acquire a thorough knowledge of various factors related to radiological health physics like radiation dose assessment, radiation safety measures, radiation shielding, decontamination, and proper handling of radiation sources and calibration of radiation measurement devices. The laboratory fully facilitates the requirements of courses NE 351 and NE 451.

**Low Counting Laboratory**
The laboratory provides experiments and equipments for measuring low concentration of radioactivity in soil, water, food samples, etc. The lab has three high purity germanium detectors for gamma and X-ray detection, one sodium iodide detector, three multichannel analyzers for spectral analysis, one "phoswich" detector for gross alpha and beta measurement and one liquid scintillation analyzer for precise counting of low level alpha and beta radiations, in addition to several different liquid standard radioactive sources. Students practicing measurements in this lab acquire practical knowledge of standard source preparation, and more sophisticated analysis techniques through modern PC-based Multichannel analyzers (PCMCA). Moreover, students learn in this lab measurement of different radionuclides present in our environment and their concentrations. The lab serves students of NE340 as well as research projects.

**Non-Destructive testing Laboratory I & II**
Students using this facility learn Non-Destructive Testing (NDT) techniques used for detection of minute cracks, flaws, corrosion and welding defects in materials using radiation. The lab has a diagnostic X-ray unit, an industrial X-ray machine, human body phantoms and a facility to develop exposed X-ray films. X-ray and gamma-ray radiography, neutron radiography, eddy current and ultra sonic testing are the basic NDT techniques taught students in the lab. The students learn the operation of the X-ray unit, radiography techniques, developing radiography films, and reading the exposed films. Also they learn the properties of scattered X-ray beams and evaluation of dose arising from exposure to x-rays. Students of NE455 utilize the lab for various experiments.

**Radioisotopes Application Laboratory**
The main purpose of the Isotope Application laboratory is to familiarize the students with the uses of radioisotopes in various fields. Experiments on activation analysis, neutron capture gamma-ray for mineral exploration, thickness and level gauges etc. are demonstrated. The laboratory contains a neutron source (Americium-Beryllium), two multichannel analyzers, two isotope calibrators and several low and high activity standard

radioactive sources. Students learn the neutron activation analysis technique, neutron radioactive capture phenomenon, radiation attenuation, shielding design, and the use of calibrators. Students of NE360 utilize the lab for their entire course related and/or design project experiments.

**Computation and Computer Laboratory**
Students use modern simulation software to understand different aspects of nuclear reactors' dynamic behavior. Ten modern networked personal computers are utilized in the lab used by students to solve nuclear computational problems. The laboratory has a number of useful software packages like Matlab, MCNP, nuclear reactor neutronics computer codes, thermal hydraulics, and shielding computer codes. Students of NE402 and NE411 utilize this lab. The lab also serves as a general computer lab and its workstations are loaded with productivity software like MS Office and internet connectivity. Workstations are available to all students and faculty of the department.

**Radio-analysis Laboratory**
Students use this laboratory to learn the quantification of trace elements to levels as low as parts per billion. The lab comprises an X-ray fluorescence analyzer (XRF) and an atomic absorption spectrometer (AAS) for this purpose. Undergraduate students practice such techniques through NE330 and NE360 courses.

**Diagnostic Radiography Laboratory**
This laboratory has diagnostic x-ray unit, Am-241 source and two tissue equivalent body phantoms. Experiments on imaging, direct and scattered X-ray measurements and shielding are performed. Students in NE 351, 451, 450 and 455 use the lab.

As far as the non-NE courses are concerned, the following laboratories in the department of civil and thermal engineering are used:

a. Strength of Materials lab.
b. Fluid Mechanics lab.
c. Heat Transfer lab.

Electronics and Maintenance Laboratory
This workshop covers the practical part of the Nuclear Electronics course NE440. Electronics experiments are performed in this lab in addition to some electronics experiments oriented for the Nuclear Engineering field.

**Calibration Laboratory**
The laboratory contains standard $^{137}$Cs and $^{241}$Am sources for calibration of survey meters and personnel dosimeters

## Library
The Department of Nuclear Engineering has a dedicated library that serves the needs of the students and the faculty for textbooks, references and scientific journals. Textbooks are updated for new editions from time to time and new collections of reference books added periodically. Major scientific journals related to Nuclear Engineering as well as Radiological Sciences are made available in the library. In addition, large number of books is available in the central and faculty libraries.

# PROGRAM REQUIREMENTS AND CURRICULUM

## Key to Course Numbers and Department Code

Each course is referred to by an alphabetical code and a three digits number as follows:

13. Nuclear Engineering Department is referred to by the code "NE"
14. The hundredth digit refers to the school year
15. The tenth digit refers to specialty within the department as indicated in the table.
16. The ones digit refers to course serial within the same specialty

Key of tenth digit in the codes of AE courses

| Tens Digit | Specialty |
|---|---|
| 0 | Basic nuclear sciences |
| 1 | Nuclear reactors physics |
| 2, 3 | Interdisciplinary Nuclear reactors engineering sciences |
| 4 | Radiation measurements engineering |
| 5 | Radiation protection engineering |
| 6 | Radioisotopes applications and engineering |
| 7, 8 | Engineering medical physics |
| 9 | Special topics and applications |

## Units Required for the B.Sc. Degree

Units required for the B.Sc. degree in the Department of Aeronautical Engineering.

### Conventional Program

| **Requirements** | **Cr. Hrs** |
|---|---|
| University Requirements (including the prep year) | 41 |
| Faculty Requirements | 37 |
| NE Departmental Requirements | 29 |
| Sub Major Requirements | 46 |
| Summer Training | 2 |
| **Total** | **155** |

### Cooperative Program

| **Requirements** | **Cr. Hrs** |
|---|---|
| University Requirements (including the prep year) | 41 |
| Faculty Requirements | 37 |
| NE Departmental Requirements | 29 |
| Sub Major Requirements | 40 |
| Coop Program | 8 |
| **Total** | **155** |

## Department Compulsory Courses

All departmental students are required to take 31 credits (10 courses) as indicated in the table.

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| IE 331 | Probability and Engineering Statistics | 3 | MATH 202, STAT 110 |
| EE 202 | Object-Oriented Computer Programming | ٣ | EE 201 |
| EE 332 | Numerical Methods in Engineering | 3 | EE 201, MATH 204 |
| NE 301 | Atomic and Nuclear Principles for Engineers | 2 | PHYS 202 |
| NE 302 | Nuclear Engineering Fundamentals | 3 | NE 301 |
| NE 340 | Nuclear Radiation Measurements | 4 | NE 302, EE 251 |
| NE 351 | Radiation protection I | 3 | NE 302 |
| NE 390 | Summer Training | 2 | NE 340, NE 451 |
| NE 451 | Radiation protection II | 4 | NE 351 |
| NE 499 | Senior Project | 4 | NE 340, NE 451 |
| Total | | 31 | |

NE 390 – the summer training, 400 hours of on-job training distributed over 10 weeks that is included in the counting of training units.

Compulsory Courses for Nuclear Power Engineering Track (37 credit hours)

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| ChE 210 | Material Science | 4 | CHEM 281 |
| MEP 261 | Thermodynamics I | 3 | MATH 202, PHYS 281 |
| MEP 290 | Fluid Mechanics | 3 | MATH 202, PHYS 281 |
| NE 303 | Energy and the environment | 2 | PHYS 281 |
| NE 304 | Introduction to Nuclear Engineering | 3 | NE 302 |
| NE 311 | Nuclear Reactor Analysis | 3 | NE 302 |
| NE 321 | Nuclear Heat Transport | 4 | NE 311, MEP261 |
| NE 330 | Nuclear Materials | 3 | NE 311, ChE 210 |
| NE 360 | Radioisotope Applications I | 3 | NE 340 |
| NE 402 | Computational Methods in Nuclear Engineering | 3 | EE 332, NE 321 |
| NE 411 | Thermal Reactor Dynamics and Kinetics | 3 | NE 311 |
| NE 450 | Radiation Shielding Design | 3 | NE 451, EE 332 |
| Total | | 37 | |

Compulsory Courses for Engineering Medical Physics Track (34 credit hours)

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| EE 300 | Analytical Methods in Engineering | ٣ | MATH 203 |
| NE 341 | Nuclear Electronics I | ٤ | EE 251 |
| NE 370 | Introduction to Medical Physics | ٣ | NE 302 |
| NE 371 | Medical Terminology | ٢ | BIO 110 |
| NE 372 | Radiobiology | ٣ | CHEM 281, BIO 110 |
| NE 470 | Radiotherapy I | ٤ | NE 370, NE 371 |
| NE 471 | Medical Imaging I | ٣ | NE 341, NE 370, NE 371 |
| NE 472 | Nuclear Medicine | ٣ | NE 370, NE 451 |

| | | | |
|---|---|---|---|
| NE 473 | Dosimetry | ٣ | NE 451, NE 470 |
| NE 474 | Medical Imaging II | ٤ | NE 471, EE 332 |
| NE 489 | Practical Training | ٢ | NE 451, NE 470, NE 471 |
| Total | | 34 | |

Compulsory Courses for Radiation Protection Engineering Track (31 credit hours)

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| NE 307 | Experimental Data Analysis | ٢ | IE 331 |
| NE 341 | Nuclear Electronics I | ٤ | EE 251 |
| NE 360 | Radioisotope Applications I | ٣ | NE 340 |
| NE 370 | Introduction to Medical Physics | ٣ | NE 302 |
| NE 372 | Radiobiology | ٣ | CHEM 281, BIO 110 |
| NE 441 | Advanced Nuclear Radiation Measurements | ٤ | NE 340, NE 341or EE 311 |
| NE 450 | Radiation Shielding Design | ٣ | NE 451, EE 332 |
| NE 453 | Rules and Regulations of Nuclear Radiation | ٣ | NE 451 |
| NE 454 | Environmental Radioactivity | ٣ | NE 351, NE 340 |
| NE 456 | Operational Radiation Protection | ٣ | NE 451 |
| NE 489 | Practical Training | ٢ | NE 451, NE 470, NE 471 |
| Total | | 31 | |

## Department Elective Courses

1) **Nuclear Power Engineering Track:** 9 Credit Units of which at least 6 Credit Units from nuclear engineering courses.
2) **Engineering Medical Physics Track (Regular):** 12 Credit Units of which at least 9 Credit Units from nuclear engineering courses.
3) **Engineering Medical Physics Track (Cooperative):** 6 Credit Units, all of which from nuclear engineering courses.
4) **Radiation Protection Engineering Track:** 15 Credit Units of which at least 12 Credit Units from nuclear engineering courses.

Note: Student can choose, as elective, from the required courses list of other tracks.

| Prerequisites | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|
| MATH 204, MATH 205 | 3 | Fundamentals of Nuclear Engineering Calculations | NE 300 |
| NE 302 | 3 | Non-Ionizing Radiations | NE 350 |
| ChE 210 | 3 | Introduction to Non Destructive Testing and Visual Inspection | NE 361 |
| NE 340, NE 351 | 3 | Technology of Radiation Equipments | NE 452 |
| NE 451 | 3 | Low Level Radioactive Waste Management | NE 457 |
| NE 360 | 3 | Radioisotope Applications II | NE 460 |
| NE 361 | 3 | Eddy Current Testing and Magnetic Particle Testing | NE 461 |
| NE 361 | 3 | Ultrasonic Testing and Liquid Penetrant Testing | NE 462 |
| NE 361 | 3 | Industrial Radiography | NE 463 |
| NE 340 | 3 | Radioanalytical Techniques | NE 464 |
| NE 351, NE 340 | 3 | Radiochemistry | NE 467 |
| NE 470 | 3 | Radiotherapy II | NE 475 |
| NE 340, NE 451, NE 370 | 3 | Quality Assurance of Medical Equipments | NE 478 |
| Consent | 3 | Special Topics in Radiation Protection Engineering (I) | NE 492 |
| Consent | 3 | Special Topics in Radiation Protection Engineering (II) | NE 493 |
| Consent | 3 | Special Topics in Engineering Medical Physics (I) | NE 494 |
| Consent | 3 | Special Topics in Engineering Medical Physics (II) | NE 495 |
| Consent | 3 | Special Topics in Nuclear Power Engineering (I) | NE 496 |
| Consent | 3 | Special Topics in Nuclear Power Engineering (II) | NE 497 |
| Consent | 2,3 or 4 | Any course from the required courses of other tracks | NE --- |

- Each one theoretical hour calculated as one credit unit
- Each two or three practical hour calculated as one credit unit
- There is no circumstance for training hour (not counted in credit calculations)

# A TYPICAL PROGRAM FOR NUCLEAR ENGINEERING
## *Nuclear Power Engineering Track*

### 3rd Year

**5th Semester** | **6th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 3 | Series & Vector Calculus | MATH 205 | 3 | Differential Equations I | MATH 204 |
| 3 | Computational Methods in Engineering | EE 332 | 2 | Atomic and Nuclear Principles for Engineers | NE 301 |
| 3 | Nuclear Engineering Fundamentals | NE 302 | 3 | Arabic Language (2) | ARAB 201 |
| 3 | Probabilities and Engineering Statistics | IE 331 | 2 | Introduction to Engineering Design II | IE 202 |
| 2 | Islamic Culture (2) | ISLS 201 | 4 | Basic Electrical Engineering | EE 251 |
| 2 | Energy and the environment | NE 303 | 3 | Object-Oriented Computer Programming | EE 202 |
| 16 | Total | | ١٧ | Total | |

### 4th Year

**7th Semester** | **8th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 4 | Material Science | ChE 210 | 3 | Thermodynamics | MEP 261 |
| 4 | Nuclear Heat Transport | NE 321 | 3 | Fluid Mechanics | MEP 290 |
| 3 | Nuclear Materials | NE 330 | 3 | Introduction to Nuclear Engineering | NE 304 |
| 3 | Radiation protection I | NE 351 | 3 | Nuclear Reactor Analysis | NE 311 |
| 3 | Radioisotope Applications I | NE 360 | 4 | Nuclear Radiation Measurements | NE 340 |
| | | | ٢ | Islamic Culture III | ISLS 301 |
| 17 | Total | | ١٨ | Total | |

### 4th Year Summer – Training

| | | |
|---|---|---|
| 2 Cr. Hr. | Summer Training | NE 390 |

## 5th Year

**9th Semester** **10th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 3 | Computational Methods in Nuclear Engineering | NE 402 | 2 | Islamic Culture (4) | ISLS 401 |
| 4 | Senior Project | NE 499 | 3 | Thermal Reactor Dynamics and Kinetics | NE 411 |
| 3 | Elective Course 3 | NE xxx | 3 | Radiation Shielding Design | NE 450 |
| 3 | Elective Course 4 | NE xxx | 4 | Radiation protection II | NE 451 |
| | | | 3 | Elective Course 1 | NE xxx |
| 13 | Total | | ١٥ | Total | |

## *Engineering Medical Physics Track (Regular Program)*

### 3rd Year (Regular)

**5th Semester** | **6th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 3 | Series & Vector Calculus | MATH 205 | 3 | Differential Equations I | MATH 204 |
| 3 | Computational Methods in Engineering | EE 332 | 2 | Atomic and Nuclear Principles for Engineers | NE 301 |
| 3 | Nuclear Engineering Fundamentals | NE 302 | 3 | Arabic Language (2) | ARAB 201 |
| 3 | Probabilities and Engineering Statistics | IE 331 | 2 | Introduction to Engineering Design II | IE 202 |
| 2 | Islamic Culture (2) | ISLS 201 | 4 | Basic Electrical Engineering | EE 251 |
| | | | 3 | Object-Oriented Computer Programming | EE 202 |
| 14 | Total | | ١٧ | Total | |

### 4th Year (Regular)

**7th Semester** | **8th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 3 | Introduction to Medical Physics | NE 370 | 3 | Radiation protection I | NE 351 |
| 4 | Nuclear Electronics I | NE 341 | 3 | Analytical Methods in Engineering | EE 300 |
| 3 | Radiobiology | NE 372 | 2 | Medical Terminology | NE 371 |
| 4 | Radiation protection II | NE 451 | 4 | Nuclear Radiation Measurements | NE 340 |
| 3 | Elective Course 1 | NE xxx | 2 | Islamic Culture (3) | ISLS 301 |
| 17 | Total | | ١٤ | Total | |

### 4th Year Summer – Training (Regular)

| | | |
|---|---|---|
| 2 Cr. Hr. | Summer Training | NE 390 |

## $5^{th}$ Year (Regular)

**$9^{th}$ Semester** **$10^{th}$ Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 2 | Practical Training | NE 489 | 4 | Radiotherapy I | NE 470 |
| 3 | Dosimetry | NE 473 | 3 | Medical Imaging I | NE 471 |
| 4 | Medical Imaging II | NE 474 | 3 | Nuclear Medicine | NE 472 |
| ٢ | Islamic Culture 4 | ISLS 401 | 4 | Senior Project | NE 499 |
| 3 | Elective Course 3 | NE xxx | 3 | Elective Course 2 | NE xxx |
| 3 | Elective Course 4 | NE xxx | | | |
| 17 | Total | | ١٧ | Total | |

## *Engineering Medical Physics Track (Cooperative Program)*

### 3rd Year (Cooperative)

**5th Semester** / **6th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 3 | Series & Vector Calculus | MATH 205 | 3 | Differential Equations I | MATH 204 |
| 3 | Computational Methods in Engineering | EE 332 | 2 | Atomic and Nuclear Principles for Engineers | NE 301 |
| 3 | Nuclear Engineering Fundamentals | NE 302 | 3 | Arabic Language (2) | ARAB 201 |
| 3 | Probabilities and Engineering Statistics | IE 331 | 2 | Introduction to Engineering Design II | IE 202 |
| 2 | Islamic Culture (2) | ISLS 201 | 4 | Basic Electrical Engineering | EE 251 |
| 3 | Analytical Methods in Engineering | EE 300 | 3 | Object-Oriented Computer Programming | EE 202 |
| | | | 2 | Medical Terminology | NE 371 |
| 17 | Total | | ١٩ | Total | |

### 4th Year (Cooperative)

**7th Semester** / **8th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 4 | Radiotherapy I | NE 470 | 3 | Radiation protection I | NE 351 |
| 3 | Medical Imaging I | NE 471 | 3 | Radiobiology | NE 372 |
| 4 | Radiation protection II | NE 451 | 4 | Nuclear Radiation Measurements | NE 340 |
| 3 | Elective Course 1 | NE xxx | 2 | Islamic Culture (3) | ISLS 301 |
| 2 | Islamic Culture (4) | ISLS 401 | 3 | Introduction to Medical Physics | NE 370 |
| 3 | Elective Course 2 | NE xxx | 4 | Nuclear Electronics I | NE 341 |
| 19 | Total | | ١٩ | Total | |

# 5th Year (Cooperative)

**9th Semester** **10th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 8 | Coop Work Program | NE 490 | 4 | Medical Imaging II | NE 474 |
| | | | 3 | Nuclear Medicine | NE 472 |
| | | | 4 | Senior Project | NE 499 |
| | | | 3 | Dosimetry | NE 473 |
| | | | ٢ | Practical Training | NE 489 |
| ٨ | Total | | ١٦ | Total | |

## *Radiation Protection Engineering Track*

### 3rd Year

**5th Semester** / **6th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 3 | Series & Vector Calculus | MATH 205 | 3 | Differential Equations I | MATH 204 |
| 3 | Computational Methods in Engineering | EE 332 | 2 | Atomic and Nuclear Principles for Engineers | NE 301 |
| 3 | Nuclear Engineering Fundamentals | NE 302 | 2 | Islamic Culture (2) | ISLS 201 |
| 3 | Probabilities and Engineering Statistics | IE 331 | 2 | Introduction to Engineering Design II | IE 202 |
| 3 | Arabic Language (2) | ARAB 201 | 4 | Basic Electrical Engineering | EE 251 |
| 2 | Energy and the environment | NE 303 | 3 | Object-Oriented Computer Programming | EE 202 |
| 17 | Total | | ١٦ | Total | |

### 4th Year

**7th Semester** / **8th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 3 | Radioisotope Applications I | NE 360 | 3 | Radiation protection I | NE 351 |
| 4 | Nuclear Electronics I | NE 341 | 2 | Experimental Data Analysis | NE 307 |
| 3 | Radiobiology | NE 372 | 3 | Introduction to Medical Physics | NE 370 |
| 4 | Radiation protection II | NE 451 | 4 | Nuclear Radiation Measurements | NE 340 |
| 3 | Elective Course 1 | NE xxx | 2 | Islamic Culture (4) | ISLS 401 |
| 17 | Total | | ١٤ | Total | |

### 4th Year Summer – Training

| | | |
|---|---|---|
| 2 Cr. Hr. | Summer Training | NE 390 |

## 5th Year

**9th Semester** **10th Semester**

| Cr. Hr. | Course Title | Course No. | Cr. Hr. | Course Title | Course No. |
|---|---|---|---|---|---|
| 3 | Environmental Radioactivity | NE 454 | 3 | Radiation Shielding Design | NE 450 |
| 3 | Operational Radiation Protection | NE 456 | 3 | Rules and Regulation of Nuclear Radiation | NE 453 |
| 3 | Elective Course 4 | NE xxx | 4 | Advanced Nuclear Radiation Measurements | NE 441 |
| 3 | Elective Course 5 | NE xxx | 3 | Elective Course 2 | NE xxx |
| 4 | Senior Project | NE 499 | 3 | Elective Course 3 | NE xxx |
| 16 | Total | | ١٦ | Total | |

## COURSE DESCRIPTION

**(2:2,1) Atomic and Nuclear Principles for Engineers NE 301**

Special theory of relativity. Wave properties of matter. Quantum theory of light. Wave function and its physical significance. Origin of quantum hypothesis. De Broglie's hypothesis of matter wave & its experimental verification. Uncertainty principle. Atomic structure. Bohr atom and atomic spectra. X-rays. Periodic table. Free Electron model of solids: conductors, insulators and semiconductors. Intrinsic and extrinsic semiconductors. p-n junctions. Sizes of nuclei. Atomic masses. Binding energy. Excited states of nuclei. α-,β- and γ-decay. Internal conversion. Electron capture. Conservation laws for radioactive decay.

**PHYS 202 Prerequisite:**

**(3:3,0) Nuclear Engineering Fundamentals NE 302**

The strong interaction between nucleons. Liquid drop and shell models. Interaction of ionizing radiation with matter: Slowing down of electrons. Positive ions and fission fragments in matter. Collision losses: the Bethe-Bloch stopping power formula. Interactions of X- and γ-ray photons with matter: photo-electric effect, Compton scattering, pair production, photo-nuclear reactions. The interaction of neutrons with matter: Slowing down and absorption of neutrons. Nuclear fission. The neutron cycle of thermal reactors. Nuclear fusion as an energy source. Cosmic rays.

**NE 301 Prerequisite:**

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| **Credit** | **Tr.** | **Pr.** | **Th.** | | | |
| **2** | **-** | **-** | **2** | **هـ ن ٣٠٣** | **NE 303** | **Energy and the Environment** |
| PHYS 281 | | | | | **Prerequisites** | |
| Renewable and non-renewable energy resources including oil, coal, nuclear, hydro, solar, wind, and geothermal. Utilization, reserves, production, consumption and geographical distribution of energy sources. Environmental and economic implications of energy production and utilization. Energy conservation and policies. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** A. Maheshwari and G. Parmar, A Textbook of Energy, Ecology, Environment and Society. Anmol Publications Pvt Ltd; (2004).

***Reference:*** R. Wolfson, Energy Environment and Climate. W. W. Norton & Company; 1st edition

(2008).

***<u>Course Learning Objectives: By completion of the course, the students should be able to</u>:***

1. Define energy efficiency.
2. Describe Nuclear energy.
3. Describe nuclear energy economy, environmental impact and limitations.
4. Describe oil and gas energy and world resources
5. Oil and gas energy economy, environmental impact and limitations.
6. Describe world resources of coal, its economy, environmental impact and limitations.
7. Describe solar- thermal energy system, their economy and limitations
8. Describe solar voltaic cells economy and limitations
9. Describe wind energy economy and limitations
10. Describe biomass, tidal and other sources of energies economy and limitations

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **2** | Nuclear energy | 1 |
| **2** | Oil and gas | 2 |
| **2** | Coal energy | 3 |
| **1** | Solar thermal | 4 |
| **1** | Solar voltaic | 5 |
| **2** | Wind energy | 6 |
| **2** | Other sources of energy | 7 |
| **1** | Energy reports | 8 |
| **1** | Review | 9 |

***<u>Class Schedule</u>:***
- **Lecture**: Two 1.0 hour sessions per week
- **Tutorials**: One 1.0 hours sessions per week

***<u>Course Contribution to professional Component</u>:***
- Engineering Science: 100 %
- Engineering Design: 0 %

***<u>Course Relationship to Program Outcomes:</u>***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **f** | **i** | **ABET Program Outcomes** |
| **1** | **-** | **2** | **1** | **-** | **1** | **3** | **3** | **1** | **-** | **-** | **1** | **1** | **2** | **Highest Attainable Level of Learning** |

| **Hours** | | | | **Arabic Code/No.** | **English Code /No** | **Course Title** |
|---|---|---|---|---|---|---|
| **Credit** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **-** | **-** | **٣** | **هـ ن ٣٠٤** | **NE 304** | **Introduction to Nuclear** |

| | | | | | | Engineering |
|---|---|---|---|---|---|---|
| NE 302 | | | | | Prerequisites | |
| Application of radioactive decay equations, energy from fission and fuel burnup, radiation shielding, selection of nuclear materials for reactor cooling, moderation, and cladding, multiplication factor (k), neutron diffusion, criticality equation, rate of heat production and types of reactors. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** J.R. Lamarsh and A.J. Baratta, Introduction to Nuclear Engineering. Prentice Hall; 3rd edition (2001).

***Reference:*** J. K. Shultis and R. E. Faw, Fundamentals of Nuclear Science and Engineering. CRC Press 2nd edition (2007).

B001HON5DW

***Course Learning Objectives: By completion of the course, the students should be able to:***

21. Use the radioactive decay equations for compound decay, $^{14}C$ dating, $^{238}U$ dating, $^{40}K$ dating and neutron activation.
22. Apply the knowledge of nuclear reactions to calculate the energy released from nuclear fission and nuclear fuels.
23. Apply the knowledge of cross-sections for neutron reactions and reaction rates to calculate fuel consumption rate in a nuclear reactor for the production of electrical power.
24. Discuss different components of a nuclear reactor.
25. Discuss the material frequently used for different components of a reactor and the major steps in selecting the material.
26. Define and discuss infinite multiplication factor and effective multiplication factor.
27. Classify nuclear reactors according to their applications.
28. Use the knowledge of neutron flux and cross section to estimate the thermal power in a nuclear reactor.
29. Discuss neutron migration and hence deduce diffusion equation.
30. Discuss reactor radiation sources and methods of shielding.

| ***NO*** | ***Topic Covered During Class:*** | ***Duration in Weeks*** |
|---|---|---|
| **1** | Decay Law, $T_{1/2}$, $T_{av.}$, $T_E$, Activity, units, Compound decay | **1** |

| | | |
|---|---|---|
| **2** | Radioactive Equilibrium, $^{14}C$ dating, $^{238}U$ & $^{40}K$ dating, Neutron Activation, Problems | **1** |
| **3** | Nuclear Reactions, Nuclear Fissions, Energy Calculations. | **1** |
| **4** | Cross-section for nuclear reactions, reaction rates. | **1** |
| **5** | Nuclear fuel performance, problems. | **1** |
| **6** | Nuclear Reactors, Components of Nuclear reactors, Cladding. | **1** |
| **7** | Reactor Materials, Multiplication factor. | **1** |
| **8** | Criticality calculation. | **1** |
| **9** | Heat sources in Reactor system, Reactor power. | **1** |
| **10** | Diffusion of neutrons, diffusion equation. | **1** |
| **11** | Neutron migration (slowing down), Problems. | **1** |
| **12** | Reactor radiation sources, Reactor shielding. | **1** |
| **13** | Shielding calculations. | **1** |

***Class Schedule:***

- **Lecture**: two 1:30 hour sessions per week
- **Tutorial**: one three hours session per week

***Course Contribution to professional Component:***

- Engineering science: 100%
- Engineering design: 0%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **2** | **1** | **-** | **-** | **-** | **-** | **2** | **-** | **2** | **1** | **-** | **2** | **-** | **-** | **Highest Attainable Level of Learning** |

| **Hours** | | | | **Arabic Code/No.** | **English Code /No** | **Course Title** |
|---|---|---|---|---|---|---|
| **Credit** | **Tr.** | **Pr.** | **Th.** | | | |
| **2** | **-** | **-** | **2** | **هـ ن ٣٠٧** | **NE 307** | **Experimental Data Analysis** |
| **IE 331** | | | | | **Prerequisites** | |

Binomial distribution, Poisson distribution, normal distribution, linear and non-linear fitting, error distribution, Chi square test, F test, Statistical data processing. Application to radiation Protection and Medical Physics.

Faculties and departments requiring this course (if any): None

***Textbook:*** J. Antony, Design of Experiments for Engineers and Scientists. Butterworth Heinemann; 1st edition (2003).

***Reference:*** D. C. Montgomery, Design and Analysis of Experiments. Wiley; 7th edition (2008).

***Course Learning Objectives: By completion of the course, the students should be able to:***

**26.** Define data and range.
**27.** State the procedure for finding the range of a set of numbers.
**28.** Compute the range of a set of numbers.
**29.** Apply range procedures to solve problems.
**30.** Describe the characteristics and differences between simple random sampling stratified random sampling,
**31.** Measure minimum detection limits and then estimate means and variances for censored data
**32.** Apply appropriate methods for detecting and estimating trends and seasonality in datasets
**33.** Recognize the importance (and limitations) of statistics in scientific research.
**34.** Describe the characteristics and limitations of research data.
**35.** Calculate and interpret 1 and 2-sample tests of mean and variance.
**36.** Construct, analyze, and interpret simple and multiple linear regression models.
**37.** Apply time series for analysis and forecasting
**38.** Identify distributions of variables using goodness of fits tests and other statistics
**39.** Apply appropriate transformations for normalizing data
**40.** Apply linear regression to develop predictive models for health indices and environmental data
**41.** Apply statistical tests to detect autocorrelation in regression models and use appropriate methods to handle autocorrelation in regression.
**42.** Apply conditional logistic regression to develop predictive models for health indices and environmental data.
**43.** Apply Poisson regression to develop predictive models for health indices and environmental data

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **1** | Random Variables | 1 |
| **2** | Probability Theory | 2 |
| **1** | Data characterization | 3 |
| **1** | Probability Distributions | 4 |
| **2** | Statistical model; Binomial distribution, Poisson distribution, and normal distribution | 5 |
| **3** | Application of statistical models | 6 |
| **2** | Error propagation | 7 |
| **1** | Optimization of counting experiments | 8 |
| **1** | Limits of detestability | 9 |

***Class Schedule:***

- Lecture: Two 1 hour sessions per week
- Tutorials: One 2 hours session per week

***Course Contribution to Professional Component:***

- Engineering science: 100%
- Engineering design: 0 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | i | f | ABET Program Outcomes |
| 2 | 2 | - | - | - | 1 | - | 1 | 2 | 3 | 3 | 2 | - | 1 | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | - | 3 | هـ ن ٣١١ | NE 311 | Nuclear Reactor Analysis |
| NE 302 | | | | | Prerequisites | |
| The fission chain reaction. Nuclear fuels. Nuclear reactors and their components. Neutron flux. Diffusion equation. Neutron moderation. One group diffusion equation and criticality calculations. Reflected reactors. Multi-group calculations and heterogeneous reactors. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook*** J.R. Lamarsh and A.J. Baratta, Introduction to Nuclear Engineering. Prentice Hall; 3rd edition (2001).

***Reference*** W. M. Stacey, Nuclear Reactor Physics. Wiley-VCH; 2nd edition (2007).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Analyze simple nuclear reactor core performance
2. Derive and determine solution to neutron diffusion equation using one group diffusion
3. equation
4. Develop multi-group diffusion equations
5. Solve problems the one-group diffusion theory for multi-region reactors
6. Derive and solve the point reactor dynamic equation for a point reactor
7. Compute dynamics and safety characteristics using point kinetics models with reactivity
8. feedback
9. Compute reactivity effects due to depletion and fission product buildup
10. Design heterogeneous reactors with specified characteristics

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **1** | Fission chain reaction | 1 |
| **2** | Nuclear reactors and their components | 2 |
| **2** | Neutron flux | 3 |
| **2** | Diffusion equations | 4 |
| **2** | Neutron moderation | 5 |
| **2** | One group diffusion equation and criticality calculations | 6 |
| **1** | Reflected reactors | 7 |
| **2** | Multi-group calculations and heterogeneous reactors | 8 |

***Class Schedule:***

- Lecture: Three 1 hour sessions per week
- Lab: one 3 hours session per week

***Course Contribution to Professional Component:***

- Engineering Science: 100 %
- Design : 0 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | i | f | ABET Program Outcomes |
| 3 | 3 | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | - | - | Highest Attainable Level of Learning |

<table>
<tr><th colspan="4">Hours</th><th rowspan="2">Arabic Code/No.</th><th rowspan="2">English Code /No</th><th rowspan="2">Course Title</th></tr>
<tr><th>Credit</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>4</td><td>-</td><td>-</td><td>٤</td><td>هـ ن ٣٢١</td><td>NE 321</td><td>Nuclear Heat Transport</td></tr>
<tr><td colspan="5">NE 311, MEP 261</td><td colspan="2">Prerequisites</td></tr>
<tr><td colspan="7">Heat generation in homogeneous and heterogeneous reactors, reactor shutdown heat generation, temperature distributions in fuel, cladding and coolant, core heat transfer coefficients. Two-phase flow, critical heat flux and burnout, boiling channel hydraulics. Boiling water reactors and pressurized water reactors.</td></tr>
</table>

Faculties and departments requiring this course (if any): none

***Textbook:*** N. E. Todreas and M. Kazimi, Nuclear Systems Volume I: Thermal Hydraulic
Fundamentals. Taylor & Francis; 2nd edition (1989).

***Reference:*** Y. Cengel and M. Boles, Thermodynamics: An Engineering Approach. McGraw-Hill
Science; 6th edition (2006).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Explain the process of heat generation inside a nuclear reactor.
2. Calculate the volumetric heat generation at any location inside a reactor and look for the data required for calculation.
3. Calculate heat generated in the radiation shield inside nuclear reactor core.
4. Explain the process of heat generation after reactor shutdown and its variation with operation time and time after shutdown.
5. Apply his knowledge with homogeneous reactors to calculate heat generation in heterogeneous nuclear reactors.
6. Calculate temperature distribution in nuclear fuel in all dimensions.
7. Describe the function and behavior of major nuclear reactor core components during reactor operation and heat generation.
8. Use critical heat flux and hot spot factors as limiting operating and design parameters.
9. Apply his information and computer skills to reactor thermal design.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **1** | Review, Atomic and nuclear structure and reactions | 1 |
| **1** | Review, Neutron flux distribution in cores | 2 |
| **2** | Reactor heat generation | 3 |
| **3** | Heat conduction in reactor elements; General and | 4 |

| | | |
|---|---|---|
| | 1D SS | |
| **2** | Heat conduction in reactor elements; Some special 1D SS | 5 |
| **1** | Heat conduction in reactor elements; 2D steady state cases | 6 |
| **2** | Heat transfer with change in phase | 7 |
| **1** | Two phase flow | 8 |
| **1** | The boiling core | 9 |

***Class Schedule:***

- Lecture: Two 1.5 Hour sessions per week
- Tutorials: Two 2.0 Hours sessions per week

***Course Contribution to professional Component***

- Engineering Science: 100 %
- Engineering Design: 0 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **2** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **2** | **-** | **2** | **-** | **-** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | - | 3 | هـ ن ٣٣٠ | NE 330 | Nuclear Materials |
| NE 311, ChE 210 | | | | | Prerequisites | |
| The role of materials in reactors. Components of a nuclear reactor: fuel, reflector, coolant, structure, shielding, moderator, cladding and control rod materials. Fuel materials including uranium, plutonium and thorium. Radiation effects theory. Radiation effects on different reactor materials including structural metals, ceramics and organics. | | | | | | |

Faculties and departments requiring this course (if any): none

***Textbook:*** Selected Nuclear Materials and Engineering Systems, Materials Science International
Team MSIT, Springer; 1st edition (2007).

***Reference:*** W. M. Bowen, C. A. Bennett, Statistical methods for nuclear material management,
Nuclear Regulatory Commission. Washington, DC, USA (1988).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Review those aspects of fundamental concepts of nuclear reactors that are pertinent to understand the working condition of nuclear reactors.
2. Review those aspects related to crystal structure fundamentals.
3. Study the factors that affect on material selection in the nuclear reactors.
4. Describe the role of materials in reactors.
5. Review those aspects of fundamental of theory of radiation damage in materials.
6. Show how radiation affects the mechanical properties of fuel, cladding, and structural materials in nuclear reactors.
7. Apply the concepts of selecting a material to uranium as a nuclear fuel.
8. Identify radiation damage picture of uranium in reactors.
9. Explain the behavior of metallic, ceramic, and cermet fuel how they are formed, and how they affect properties of the fuel and other major reactor components.
10. Compare between metallic, ceramic, cermet materials from radiation, thermal, and mechanical points of view.
11. Present crystal structure outlines, and radiation damage to some nuclear structural materials.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **1** | Introduction: types of reactor and their materials. | 1 |
| **1** | Crystal structure of solids; point defect types and structures. | 2 |
| **1** | Radiation deformation in solids: point, line, and | 3 |

| | | |
|---|---|---|
| | volume defects. | |
| **1** | Mechanical properties of metals. | 4 |
| **2** | Fission product behavior in nuclear fuel; fission products, swelling and release. | 5 |
| **1** | Polycrystalline solids; recrystallization and grain growth. | 6 |
| **1** | The role of materials in reactors. | 7 |
| **1** | Radiation damage in metals. | 8 |
| **2** | Uranium; structure, mechanical properties, thermal properties, manufacturing, and radiation damage. | 9 |
| **1** | Structural metals; Aluminum, Zirconium, and stainless steel. | 10 |
| **1** | Ceramics and cermets; structure, mechanical properties, thermal properties, manufacturing, and radiation damage. | 11 |
| **1** | Nuclear fuel elements. | 12 |

***Course Schedule:***

- Lecture: Three 1.0 hour sessions per week
- Tutorials: one 2.0 hours session per week

***Course Contribution to professional Component:***

- Engineering science: 100%
- Engineering design: 0%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **3** | **-** | **3** | **1** | **-** | **-** | **1** | **2** | **3** | **-** | **-** | **3** | **1** | **-** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| ٤ | - | ٢ | ٣ | هـ ن ٣٤٠ | NE 340 | Nuclear Radiation Measurements |
| NE 302, EE 251 | | | | | Prerequisites | |
| Counting statistics. Properties of ionization chambers. Proportional counters. Geiger-Muller counter. Scintillation detectors. Solid-state and other types of detectors. Radiation monitoring equipment. Quantitative and qualitative analysis of radiation. Experiments on alpha, beta, gamma, and neutrons measurements. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** G. F. Knoll, Radiation Detection and measurements. John Wiley; 3rd edition (2000).

***Reference:*** N. Tsoulfanidis, Measurements and Detection of Radiation. Taylor & Francis; 3rd edition (2010).

***Course Learning Objectives: By completion of the course, the students should be able to:***

1. Define detection overall and intrinsic efficiencies
2. Describe pulse formation in pulse detector
3. Measure gamma ray intensity and analyses spectrum
4. Measure beta ray intensity and analyze spectrum
5. Measure alpha ray intensity and analyze spectrum
6. Measure radiation exposure
7. Describe how gas filled detector functions & the counter functions
8. Describe how scintillation detector functions
9. Describe how solid state semi-conductor detector functions
10. Design an application specific detection system

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **1** | Interaction of radiation with matter | 1 |
| **1** | Simplified detector model, modes of operation of detectors | 2 |
| **1** | energy resolution, detection efficiency, dead time | 3 |
| **1** | Alpha and beta spectra | 4 |
| **1** | Gamma spectra | 5 |
| **1** | General properties of gas filled detectors | 6 |
| **1** | Ionization chambers, proportional counters | 7 |
| **1** | Proportional counters, G-M counters | 8 |
| **1** | General properties of scintillation detectors | 9 |
| **1** | Solid scintillation detectors and applications | 10 |

| | | |
|---|---|---|
| **1** | Liquid scintillation detectors and applications | 11 |
| **1** | General properties of semiconductor detectors | 12 |
| **1** | Spectra and application of semiconductor detectors | 13 |
| **1** | Review of project work | 14 |

***Class Schedule:***

- **Lecture**: Three 1.0 hour sessions per week
- **Tutorials**: Two 2.0 hours sessions per week

***Course Contribution to professional Component:***

- Engineering Science: 80 %
- Engineering Design: 20 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **3** | **3** | **2** | **2** | **3** | **2** | **2** | **2** | **2** | **3** | **3** | **3** | **2** | **2** | **Highest Attainable Level of Learning** |

| **Hours** | | | | **Arabic Code/No.** | **English Code /No** | **Course Title** |
|---|---|---|---|---|---|---|
| **Credit** | **Tr.** | **Pr.** | **Th.** | | | |
| ٤ | - | ٢ | 3 | هـ ن ٣٤١ | **NE 341** | **Nuclear Electronics I** |
| **EE 251** | | | | | **Prerequisites** | |

DC and AC circuits, introduction to semiconductors, diode applications, special-purpose diodes, Bipolar Junction transistors - BJT, transistor Bias Circuits. Some advance topics in electronics such as power amplifiers, operation amplifiers, and oscillators & timers.

Faculties and departments requiring this course (if any): None

***Textbook:*** T. L. Floyd, Electronic Devices. Prentice Hall International; 5th edition (1999).

***Reference:*** A. P. Mavino Electronic Principles. McGraw-Hill Science/Engineering/Math; 6th Edition (1998).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Review and identify the DC & AC circuits
2. Explain the semiconductor theory
3. Describe the general purpose diodes
4. Describe the special purpose diodes
5. Describe general & special purpose diodes applications
6. Explain the bipolar junction transistors (BJTs)
7. Explain the field effect transistors
8. Describe the power amplifiers
9. Describe the theory of operational amplifiers
10. Use advanced electronic devices such as op-am, oscillators, & timers.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Review Fundamentals in Electronics<br>• Direct Current Circuits - DC<br>• Alternating Current Circuits - AC | 1 |
| 1 | Introduction to Semiconductors<br>• Semiconductors, conductors, & insulators<br>• N-Type & P-Type Semiconductors<br>• The PN Junction & The Diode | 2 |
| 2 | Diode Applications<br>• Half & Full Wave Rectifiers<br>• Power Supply filters | 3 |
| 1 | Special-Purpose Diodes<br>• Zener & Optical Diodes & their applications<br>• Finalize Power Supply Components | 4 |
| 3 | Bipolar Junction Transistors - BJT<br>• Transistor Construction & Basic Transistor Operation<br>• Transistor as an Amplifier & as a Switch | 5 |
| 1 | Transistor Bias Circuits<br>• DC Operating Point, Base, Emitter, & Collector Bias | 6 |

| | | |
|---|---|---|
| | • Voltage-Dividing Bias<br>• Small Signal Amplifiers | |
| 1 | Advance Topics in Electronics<br>• Power Amplifiers<br>• Operation Amplifiers<br>• Oscillators & Timers | 7 |

***Class Schedule***:

- **Lecture:** Three 1.0 hour sessions per week
- **Tutorial**: Two 2.0 hours sessions per week

***Course Contribution to professional Component:***

- Engineering science: 100%
- Engineering design: 0%

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | i | f | ABET Program Outcomes |
| 3 | 3 | 2 | - | - | - | - | - | 2 | 1 | 2 | 3 | - | - | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| ٣ | - | - | 3 | هـ ن ٣٥١ | NE 351 | Radiation Protection I |
| NE 302 | | | | | Prerequisites | |

Radioactivity, half-life, average life, serial transformation, interaction of radiation with matter. Radiation dosimetry: exposure measurements, absorbed dose measurements, exposure-dose relationship, specific gamma ray emission, internal dose calculations, dose commitment. Biological effects of radiation, dose limits, relative biological effectiveness (RBE), quality factor (QF) and dose equivalent.

Faculties and departments requiring this course (if any): None

***Textbook:*** H. Cember and T. Johnson, Introduction to Health Physics. McGraw-Hill Medical; 4th edition (2008).

B001IQWATE

***Reference:*** M. G. Stabin, Radiation Protection and Dosimetry: An Introduction to Health Physics. Springer; 1st edition (2007).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Define "Radioactivity" and discuss the transformation mechanisms for α, β, and γ emission from nucleus.
2. Examine the basics of radioactive decay kinetics including determining half-life, activity, secular equilibrium and transient equilibrium. Apply this knowledge to solve problems related to activity, half-life, equilibrium, and specific activity.
3. Discuss how gamma photons interact with matter
4. Discuss how α and β particles interact with matter
5. Gain understanding of the concepts of dosimetry and exposure.
6. Explain different exposure measuring instruments
7. Use of the Gamma ray emission constant (Γ) to calculate dose and exposure
8. Calculate dose rate and total dose for internal radiation sources
9. Explain the basic biological effects of radiation on human cells. Explain acute, delayed and genetic effects of radiation. Explain the stochastic and non-stochastic effects of radiation
10. Give internet research based oral presentation on different aspects of the biological effects of radiation

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **1** | Radioactivity and Transformation Mechanism | 1 |
| **1** | Transformation Kinetics, half life, Activity, Specific Activity, Units. | 2 |
| **1** | Serial Transformation- Equilibrium of growth and decay. | 3 |
| **1** | Interaction of beta particles with matter, Mechanism of Energy loss | 4 |
| **1** | Interaction of alpha particles with matter, Mechanism of Energy loss | 5 |
| **2** | Gamma radiation-Exponential absorption, interaction mechanism, photoelectric, Compton effects and pair production. | 6 |
| **2** | Radiation dosimetry-Absorbed dose, Exposure, Exposure measurement,-Air well chamber, Free air chamber. | 7 |
| **1** | Exposure-dose relationship | 8 |
| **1** | Specific gamma ray emission. | 9 |
| **1** | Biological effects of radiation-Dose response | 10 |

| | | |
|---|---|---|
| | characteristic, direct and indirect actions. | |
| 1 | Radiation effects-Acute effects, Delayed effects, Genetic effects. | 11 |

***Class Schedule:***

- Lecture: Two 1.5 hour sessions per week
- Tutorials: Two 2.0 hours sessions per week

***Course Contribution to professional Component:***

- Engineering science: 100%
- Engineering design: 20%

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | i | f | ABET Program Outcomes |
| 2 | - | - | 2 | - | - | 2 | - | 1 | - | 1 | 2 | 2 | - | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | 1 | 3 | هـ ن ٣٦٠ | NE 360 | Radioisotope Applications I |
| NE 340 | | | | | Prerequisites | |
| Natural and artificial radioisotope production of radioisotopes, radiotracing. Selection of radioisotopes. Radiotracing applications. Radiography application with alpha and beta particles. Radiography applications with gamma rays. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook***: G. A. Johansen and P. Jackson, Radioisotope Gauges for Industrial Process Measurements. Wiley; 1st edition (2004).

***Reference:*** G. Foldiak, Industrial Application of Radioisotopes. Elsevier (1986).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Design a liquid level gauge based on gamma ray attenuation.
2. Design metal thickness gauge based on gamma ray attenuation.
3. Design a thickness gauge based on gamma backscattering.
4. Design a density gauge using radioactivity.
5. Calculate gamma ray attenuation in multi-layers.
6. Calculate gamma ray backscattering energy.
7. Calculate detector response to back scattered radiation.
8. Calibrate NaI(Tl) detector and counting system for gamma ray energy.
9. Calibrate Cd-Tl x-ray detector and counting system for characteristics x-ray.
10. Design an experiment by selecting appropriate radioactive source for radiographic imaging.
11. Design an experiment for identifying unknown metal or alloy.
12. Describe an experiment for using contrast media for better contrast in x-ray radiography.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **1** | Production of Radioisotopes | **1** |
| **1** | Radio-Tracing Principles and Techniques | **2** |
| **2** | Radio-Tracer Applications | **3** |
| **1** | Radio-gauging principles and techniques | **4** |
| **2** | Radio-gauging with charged particles | **5** |
| **2** | Radio-gauging with EM radiation | **6** |
| **2** | Radio-gauging with neutrons | **7** |
| **2** | Radiography | **8** |
| **2** | Miscellaneous Applications of radioisotopes | **9** |

***Class Schedule:***

- Lecture: Two 1.5 hour sessions per week
- Tutorials: Two 2.0 hours sessions per week

***Course Contribution to professional Component*:**

- Engineering science: 80%
- Engineering design: 20%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |

| 2 | 2 | 2 | 1 | 1 | - | - | - | 2 | 2 | 3 | 2 | 1 | - | **Highest Attainable Level of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| **Hours** | | | | **Arabic Code/No.** | **English Code /No** | **Course Title** |
|---|---|---|---|---|---|---|
| **Credit** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **-** | **-** | **٣** | **هـ ن ٣٧٠** | **NE 370** | **Introduction To Medical Physics** |
| **NE 302** | | | | | **Prerequisites** | |
| The course focuses on medical imaging and therapy. The content will cover the Radiation Imaging by ionizing radiation such as X-Ray, Nuclear Medicine and non-ionizing radiation like Ultrasound Imaging and Magnetic Resonance Imaging (MRI). Radiation Therapy. Planning, treatment by linear accelerator, treatment by sealed and unsealed sources. Radiation Protection. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook***: E.B. Podgorzak, Radiation Oncology Physics: A Handbook for Teachers and Students. IAEA Library Cataloguing in Publication Data (2005).

***References:*** J. E. Bushberg, J. A. Seibert, E. M. Leidholdt J. R, and J. M. Boone, The Essential Physics of Medical Imaging Published. Lippncott Williams & Wilkens; 2nd edition (2002).

Faiz M. Khan, The Physics of Radiation Therapy. Lippincott Williams and Wilkins. 3rd edition (2003).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Define the medical physics Field and responsibilities of a medical physicists
2. Define and describe the major medical physics subfields
3. Describe a radiation therapy system and break down into its main components, for each of the radiation therapy machines covered (Co-60, Linac, and Breakytherapy)
4. Describe an imaging system and break some of it down into its main components
5. Relates the interaction of charge particles & photons with matter in main therapeutic and diagnostic system machines
6. Describe scientific articles that relate to medical physics and be able to communicate their understanding in a professional manner
7. Learn to communicate the physical principles behind medical technology and relevant applications
8. Practice and apply elements of active learning, develop team norms and writing skills.
9. Describe how ideas from physics are integrated into medicine
10. See themselves as people who are more educated about medical physics than the average layperson
11. Able to inform and educate other intelligent citizen about the role of medical physics in personal and public life

12. Be excited about medical physics as a broad, complex, multifaceted field of study
13. Value the importance of precise language in the field of medical phyiscs work as part of professionalism
14. Be able how to read assigned materials responsibly.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 2 | Introduction to the Engineering of Medical Physics<br>Syllabus in details<br>Introduction to Medical Physics (Define field, subfield, responsibilities and roles) | **1** |
| 1 | Introduction to the Physics of Radiation Therapy<br>Basics Radiation Physics | **2** |
| 1 | Dosimetry Principles, Quantities and Units | **3** |
| 1.5 | Radiation Monitoring | **4** |
| 1.5 | Treatment Machines for External Beam Radiotherapy | **5** |
| 1 | External Photon Beams: Physics Aspects | **6** |
| 1 | Clinical Treatment Planning In External Photon Beam Radiotherapy | **7** |
| 1 | Electron Beams: Physical and Clinical Aspects | **8** |
| 1.5 | Introduction to the Physics of Medical Imaging<br>Physics of the Eyes and Vision | **9** |
| 1.5 | Introduction to Medical Imaging<br>Introduction to Radiation with Matter in Dx | **10** |
| 1 | Computers in Medical Imaging | **11** |

***Class Schedule:***

- Lecture: Two 1.5 hour sessions per week.
- Tutorials: None.

***Course Contribution to professional Component:***

- Engineering science: 100 %
- Engineering design: 0 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **1** | **1** | **1** | **1** | **2** | **2** | **2** | **2** | **-** | **-** | **-** | **1** | **1** | **2** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 2 | 1 | - | 2 | هـ ن ٣٧١ | NE 371 | Anatomy and Physiology for Medical Physicists |
| | | | | BIO 110 | Pre-requisites | |
| Introduction to human anatomy and physiology. Medical terminology of human organs and of human diseases. Understanding basic medical anatomy from 3D re-sliced medical images: Axial, Sagittal, Coronal, and oblique reformat and from 2D projections of medical data: anterior-posterior and posterior-anterior orientations. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** Heinz Feneis and Wolfgang Dauber, Atlas of Human Anatomy. Thieme Flexibook; 5th edition (2000).

***Reference:*** J. Race, Medical Terminology with Human Anatomy. Prentice Hall; 5th edition (2004).

***Course Learning Objectives: By completion of the course, the students should be able to:***

1. Define the nomenclature of the different organs, bone, muscles, of the human body.
2. Describe the physiology of the different human body organs.
3. Describe the anatomy of human body.
4. Explain information about the metabolic pathways of the human body.
5. Communicate well with the physicians, nurses and technologists in the hospital during the practical work.

6. Identify the biological relation between muscles and the skeletal bones.
7. Differentiate between normal organs and abnormal ones.
8. Adapt the scientific concepts and engineering technologies with the human body.
9. Handle, set-up and have a good response with patients during medical or diagnostic investigations.

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **2** | Human skeletal bones | 1 |
| **2** | Human Muscle | 2 |
| **2** | Human Digestive System | 3 |
| **2** | Human myocardium System | 4 |
| **2** | Hyman Lymphatic System | 5 |
| **2** | Human Secretion System | 6 |
| **1** | Human CNS | 7 |
| **1** | Human Respiratory system | 8 |
| **1** | Human Brain | 9 |

***Course Schedule***

- Lecture: Two 1.0 hour sessions per week
- Tutorial: One 1.0 hour session per week

***Course Contribution to professional Component:***

- Engineering Science: 100 %
- Engineering Design: 0 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **2** | **3** | **-** | **1** | **-** | **-** | **1** | **-** | **3** | **1** | **1** | **2** | **1** | **-** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic | English Code | Course Title |
| --- | --- | --- | --- | --- | --- | --- |
| Credit | Tr. | Pr. | Th. | Code/No. | /No | |
| ٣ | 0 | ٠ | ٣ | هـ ن ٣٧٢ | NE 372 | Radiobiology |
| BIO 110, CHEM 281 | | | | | Prerequisites | |
| Physico-chemical aspects of interaction of ionizing radiation with the cell, radiation effects on macromolecules, cellular radiation biology, radiobiology of tissues and organs, cell survival curves, radiation biology as applied to radiation therapy, effects of radiation on the environment and man. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** E. J. Hall and A. J. Giacci, Radiobiology for the Radiologist.
Lippincott Williams & Wilkins edition; 6th edition (2005).

***Reference:*** K. N. Prasad, Handbook of Radiobiology. CRC Press; 2nd edition (1992).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

**32.** Describe the various types of ionizing radiation
**33.** Define the main radiation quantities (units) used in the measurement of radiation levels
**34.** Describe the physical and chemical events that follow an ionizing event, including their spatial distribution, and the time scale
**35.** Define and give examples of direct and indirect effects of radiation
**36.** Describe the induced damage to the DNA and macromolecules
**37.** Describe the effect of radiosensitizers and radioprotectors
**38.** Construct a dose survival curve
**39.** Explain the practical aspects of dose fractionation in radiotherapy
**40.** Explain the radiation syndromes including: bone-marrow, gastrointestinal, central nervous system and hematopoietic syndromes
**41.** Discuss genetic effects of radiation and effects of radiation on embryogenesis
**42.** Describe the process leading to cancer
**43.** Explain the long term effects of radiation exposure, specifically as it relates to leukemia and other cancers, cataracts, Life shortening

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| 1 | Interaction of radiation with matter: | 1 |
| 1 | Absorption of energy | 2 |
| 1 | Radiation chemistry | 3 |
| 1 | Basic cell biology | 4 |
| 2 | Cellular radiation damage | 5 |
| 1 | Modification of cellular radiation damage | 6 |
| 1 | Molecular radiation biology | 7 |
| 1.5 | Repair of radiation damage | 8 |
| 1.5 | Radiation syndromes | 9 |
| 2 | Radiation carcinogenesis | 10 |
| 1 | Radiation induced genetic damage | 11 |

***Class Schedule***:

- Lecture:  Two 1.5 hour sessions per week
- Tutorial: None

***Course Contribution to professional Component:***

- Engineering science:   100%
- Engineering design:     0%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **-** | **-** | **2** | **-** | **2** | **1** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **1** | **Highest Attainable Level of Learning** |

<table>
<tr><th colspan="4">Hours</th><th rowspan="2">Arabic<br>Code/No.</th><th rowspan="2">English Code<br>/No</th><th rowspan="2">Course Title</th></tr>
<tr><th>Credit</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>٢</td><td>٤</td><td>-</td><td>-</td><td>هـ ن ٣٩٠</td><td>NE 390</td><td>Summer Training</td></tr>
<tr><td colspan="5">NE 340, NE 451</td><td colspan="2">Prerequisites</td></tr>
<tr><td colspan="7">Training is usually arranged at an industrial establishment under the supervision of a faculty member. Students have to submit a report regarding their achievements in addition to any other requirements as assigned by the department.</td></tr>
</table>

Faculties and departments requiring this course (if any): None

***Textbook:*** Donald Dinero, Training Within Industry: with CDROM. Productivity Press; (2005).

***Reference:*** Health and Safety at Work: A Guide for Trainees (Engineering Training Guide).
Training Publications Ltd; 2nd edition (1990).

***Course Learning Objectives: By completion of the course, the students should be able to:***

25. Formulate an objective or mission statement that identify the real problem and describe the expected outcomes of the training activity.
26. Break-down a work environment into its units and work functions, and describe how these units are assembled into a whole entity.
27. Describe a professional organizational structure, its size and how it is related to its main products and to market issues.
28. Exhibit integrity, punctuality, and ethical behavior in engineering practice and relationships.
29. Demonstrate enthusiasm and business focusing.
30. Establish successful relationships with team members, advisors, and clients to understand their needs and to achieve or exceed agreed-upon quality standards.
31. Maintain focus to complete important tasks on time and with high quality, amidst multiple demands
32. Relate practical work to previous knowledge from basic sciences, engineering fundamentals, and discipline related courses.
33. Collect and review related data such as technical information, regulations, standards, and operational experiences from credible literature resources
34. Utilize prior knowledge, independent research, published information, and original ideas in addressing problems and generating solutions
35. Monitor achievement, identify causes of problems, and revise processes to enhance satisfaction
36. Communicate, clearly and concisely, training details and gained experience, both orally and in writing, using necessary supporting material, to achieve desired understanding and impact.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **2** | Acquainting the trainee by the company, its work environment, organizational structure, products, costumers, engineering units, and quality system. | 1 |
| **2** | Familiarizing the trainee of one production or design unit with deep understanding of the work environment, regulations, standards, etc. | 2 |
| **6** | Allocating the trainee to a project team and allowing him to study and collect necessary data about the project using internal and external data sources. | 3 |

***Class Schedule:***

Oral Presentation after submitting a written training report; both evaluated by at least 2 faculty members.

***Course Contribution to professional Component***:

- Engineering science: None
- Engineering design: None
- Others 100%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **2** | **1** | **ABET Program Outcomes** |
| **-** | **3** | **3** | **-** | **3** | **3** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **3** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| **2** | **4** | **-** | **-** | **هـن ٤٩٠** | **NE 490** | **Coop Work Program in Medical Physics** |
| **NE 340, NE 451, NE 470, NE 371** | | | | | **Prerequisites** | |
| Students of the Engineering Medical Physics Track are assigned coop clinical rotational training in different radiological departments at hospitals to familiarize the students with actual procedures and practices in the field of medical physics. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** AAPM Presidential Ad Hoc Committee on the Clinical Training of Radiological Physicists, Essentials and guidelines for hospital based medical physics residency training programs. (AAPM report); (1992)

***Reference:*** Douglas P. Beall, Radiology Sourcebook: A Practical Guide for Reference and Training. Humana Press; 1st edition (2010).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Identify the role of medical physicist in realistic profession environment.
2. Apply theoretical medical physics concepts
3. Use different equipment and technologies used in the field of medical physics.
4. Practice the professional and ethical behavior toward patients, physicians, and co-workers in the profession of medical physics.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **6** | Radiology clinical rotation | 1 |
| **6** | Nuclear Medicine clinical rotation | 2 |
| **6** | Radiotherapy clinical rotation | 3 |
| **7** | Quality control, quality assurance | 4 |

***Class Schedule:***

- Oral Presentation after submitting a written training report; both evaluated by at least 2 faculty members.

***Course Contribution to professional Component*:**

- Engineering science: None
- Engineering design: None
- Others 100%

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | i | f | ABET Program Outcomes |
| - | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | - | 2 | - | 2 | 3 | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | 1 | 3 | هـن ٤٠٢ | NE 402 | Computational Methods in |

| | | | | | | Nuclear Engineering |
|---|---|---|---|---|---|---|
| **EE 332, NE 321** | | | | | | **Prerequisites** |
| Introduction to numerical methods commonly encountered in nuclear engineering calculations, finite differencing, explicit and implicit techniques, convergence and stability criteria. Application of the above techniques to one group diffusion equation, multigroup diffusion equation, coupled diffusion equation with delayed neutrons, heat conduction and convection, criticality search method. Generation of heterogeneous cross-sections. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** S. Nakamura, Computational Methods in Engineering and Science. J. Wiley & Sons;
(1996).

***Reference:*** W.F. Miller, Computational Method of Books: Neutron Transport.
John Wiley & Sons; (1984).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

30. Compare between deterministic and probabilistic numerical methods
31. Describe the computer methods for eigen values problem solving
32. Discuss different types of numerical solution techniques
33. Compare between numerical methods that used to solve neutron transport problems
34. Describe variance reduction techniques
35. Describe MCNP method and its sampling methods
36. Analyze of different methods that used in solving 1D neutron transport
37. Analyze and compare between error reduction techniques

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **2** | Fundamentals of numerical analysis<br>• Deterministic and Probabilistic Methods<br>• Numerical solution of neutron transport/diffusion equation<br>• Discretization in time, energy, angle and space | 1 |
| **2** | Computer solutions for 1D eigen value problems<br>• Iterative computational methods for solving partial differential equations<br>• Finite element methods,<br>• Finite difference method,<br>• Coarse-mesh rebalancing method | 2 |
| **2** | Neutron Transport Equation in 1D:<br>• Numerical Solution of integro-Differential Equation<br>• Spatial discretization in slab geometry | 3 |
| **2** | Collision probability and Monte Carlo methods<br>• Continuous and discrete probability distribution<br>• Probability density function | 4 |

| | | |
|---|---|---|
| | • Cumulative probability distribution function Random numbers<br>• Categories of random sampling<br>• Importance sampling<br>• Variance reduction methods | |
| **3** | Monte Carlo simulation of neutron transport<br>• Sampling of the position, direction, distance to collision<br>• type of collision | 5 |
| **2** | Sampling of energy and angle in Compton scattering<br>• Definitions of true and sample mean, variance, standard deviation<br>• Central limit theorem. Collision and track length estimators for flux calculation. | 6 |

***Course Schedule:***

- Lecture: Three 1.0 hour sessions per week
- Tutorials: Two 1.0 hour sessions per week

***Course Contribution to professional Component:***

- Engineering science: 100 %
- Engineering design: 0 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **3** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **3** | **-** | **1** | **3** | **-** | **-** | **Highest Attainable Level of Learning** |

| **Hours** | | | | **Arabic Code/No.** | **English Code /No** | **Course Title** |
|---|---|---|---|---|---|---|
| **Credit** | **Tr.** | **Pr.** | **Th.** | | | |
| **٣** | **-** | **-** | **٣** | **هـ ن ٤١١** | **NE 411** | **Thermal Reactor Dynamics and Kinetics** |
| **NE 311** | | | | | | **Prerequisites** |

| |
|---|
| Reactor kinetics, effect of delayed neutrons, reactor control by control rods and chemical shim methods, temperature effects on reactivity and fission products poisoning. |

Faculties and departments requiring this course (if any): None

***Textbook:*** W. M. Stacey, Nuclear Reactor Physics. Wiley-Interscience; 1st edition (2001).

***Reference:*** D. L. Hetrick, Dynamics of Nuclear Reactors. American Nuclear Society; (1993)

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Analyze simple nuclear reactor core performance
2. Derive and determine solution to neutron diffusion equation using one group diffusion equation
3. Develop multi-group diffusion equations
4. Solve problems the one-group diffusion theory for multi-region reactors
5. Derive and solve the point reactor dynamic equation for a point reactor
6. Compute dynamics and safety characteristics using point kinetics models with reactivity feedback
7. Compute reactivity effects due to depletion and fission product buildup
8. Design heterogeneous reactors with specified characteristics

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **1** | Classification of time problems | 1 |
| **1** | Prompt neutron lifetime | 2 |
| **1** | Reactor with no delayed neutrons | 3 |
| **1** | Reactor with delayed neutrons | 4 |
| **1** | The prompt critical state | 5 |
| **1** | The prompt jump or drop | 6 |
| **1** | Small Reactivity | 7 |
| **1** | Control rods and chemical shim and their reactivity worth | 8 |
| **1** | Reactivity coefficients, Temperature coefficient | 9 |
| **1** | Moderator coefficient | 10 |
| **1** | Void coefficient | 11 |
| **1** | Fission product poisoning | 12 |
| **1** | Equilibrium Xenon | 13 |
| **1** | Xenon after shutdown and reactor dead time | 14 |

***Class Schedule:***

- Lectures: Tow lectures of 1.5 hours sessions per week.
- Tutorials: Two 1.0 hours sessions per week.

***Course Contribution to professional Component***:

- Engineering science: 100%
- Engineering design: 0 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | i | f | ABET Program Outcomes |
| 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 3 | 1 | 1 | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 4 | - | 2 | ٣ | هـ ن ٤٤١ | NE 441 | Advanced Nuclear Radiation Measurements |
| NE 340, NE 341 | | | | | Prerequisites | |

| |
|---|
| Advanced radiation measuring equipment that includes: scintillation detectors, solid state detectors, neutron detectors and other types of detectors used for x-ray, gamma ray, neutron detection and spectrometry. Design of experiments; measurements of XRF, gamma rays and neutrons. |

Faculties and departments requiring this course (if any): None

***Textbook:*** G. F. Knoll, Radiation Detection and Measurements. John Wiley; 3rd edition (2000).

***Reference:*** N. Tsoulfanidis, Measurements and Detection of Radiation. Taylor & Francis; 3rd edition (2010).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Describe properties of advanced x-ray and gamma detectors.
2. Describe methods of advanced x-ray and gamma detectors.
3. Describe properties of fast and slow neutron detectors.
4. Describe methods for fast and neutron measurements.
5. Describe properties of XRF detectors.
6. Measure different types of gamma rays.
7. Measure slow neutrons.
8. Measure fast neutrons.
9. Calibrate equipment for energy and efficiency.
10. Design new experiments for gamma, x-ray and neutron measurements.

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **2** | Properties of advanced scintillation detectors | 1 |
| **2** | Gamma and x-ray detection and spectrometry by scintillation detectors | 2 |
| **2** | Properties of advanced solid state detectors | 3 |
| **2** | X-ray and gamma ray measurements and spectrometry by solid state detectors | 4 |
| **1** | Slow neutron interactions | 5 |
| **2** | Detectors and methods of slow neutron measurements | 6 |
| **1** | Fast neutron interactions | 7 |
| **1** | Detection and spectrometry of fast neutrons | 8 |
| **1** | New experiment | 9 |

***Class Schedule:***

- Lectures: Three 1.0 hour sessions per week.
- Labs.: Two 2.0 hours sessions per week or one 4.0 hours session per week

***Course Contribution to professional Component*:**

- Engineering science: 80%

• Engineering design: 20 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | i | f | ABET Program Outcomes |
| 2 | 2 | 3 | - | 3 | 1 | - | 1 | 2 | 1 | 3 | 2 | - | 1 | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| ٣ | - | - | ٣ | ٤٥٠ هـ ن | NE 450 | Radiation Shielding Design |
| NE 451, EE 332 | | | | | | Prerequisites |
| Principles of radiation shielding design, attenuation of nuclear radiation, shield layout analysis and design, gamma ray, x-ray and neutron shielding, principles of reactor shielding and use of computers to solve shielding problems. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** J. K. Shultis and R. E. Faw, Radiation Shielding. American Nuclear Society; (2000).

***Reference:*** G. F. Knoll, Radiation Detection and measurements. John Wiley; 3rd edition (2000).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Calculate shield thickness around a point gamma source that reduces exposure to desired level.
2. Calculate shield thickness over contaminated land that reduces exposure to desired level.
3. Design a shield for a gamma source used in a level gauge.
4. Calculate exposure at the surface of a person injected by radioactive materials.
5. Design a shield around a wire irradiated inside a nuclear reactor.
6. Calculate exposure rate outside two layer shield of a gamma beam.
7. Defline: exposure, effective dose, entrance surface dose. Neutron removal cross section.
8. Design a shield for a neutron generator inside a room.
9. Describe equipment for measuring exposure.
10. Describe equipment for measuring neutron dose.
11. Calculate shield thickness for primary x-ray machine.
12. Calculate fast neutron dose due to a fission source at certain depth in water.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **1** | Review of gamma and neutron radiation interaction | 1 |
| **1** | Introduction to gamma ray shielding, meanings of exposure & dose, direct & scattered radiation | 2 |
| **1** | Good geometry attenuation, broad beam attenuation, build-up factor. | 3 |
| **1** | Gamma point source shielding | |
| **1** | Gamma ray line source shielding | |
| **1** | Gamma ray planar source shielding | |
| **1** | Internal source shielding | |
| **1** | Gamma ray multi-layer shielding | |
| **1** | Removal cross-section, Neutron removal in water and by flat attenuator | |
| **1** | Neutron shielding | |
| **1** | Nuclear reactor shielding | |
| **1** | Neutron generator shielding, X-ray shielding | |
| **1** | Shielding X-rays -Primary shielding | |
| **1** | X-ray secondary radiation shielding | |

***Class Schedule:***

- Lectures: Three 1.0 hour sessions per week.
- Tutorials: Two 1.0 hour sessions per week.

***Course Contribution to professional Component***:

- Engineering science: 80%
- Engineering design: 20 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | i | f | ABET Program Outcomes |
| 2 | 2 | - | - | - | 1 | - | 1 | 2 | 3 | 3 | 2 | - | 1 | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| ٤ | - | ٢ | ٣ | هـ ن ٤٥١ | NE 451 | Radiation Protection II |
| NE 351 | | | | | | Prerequisites |
| Radiation protection guides such as ICRP, NCRP etc. Radiation safety criteria, Allowable Limit on Intake (ALI), Derived Air Concentration (DAC), Maximum Permissible Concentration (MPC). Health Physics instruments, diagnostic and therapeutic x-ray shielding, basic principles for external and internal radiation protection and radioactive waste management. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** H. Cember and T. Johnson, Introduction to Health Physics. McGraw-Hill Medical; 4th edition (2008).

***Reference:*** G. F. Knoll, Radiation Detection and Measurements. John Wiley; 3rd edition (2000).

***<u>Course Learning Objectives: By completion of the course, the students should be able to</u>*:**

1. Understand the role of organization that set Radiation Safety Guides
2. Application of basic recommendations of radiation protection such as Justification, Optimization, and dose limitation.
3. Estimate the population risk based on collective dose.
4. Differentiate between stochastic and non- stochastic effects.
5. Calculate the derived limits ( ie. ALI, DAC,MPC…) from basic limits.
6. Determine which survey meters, or dose marinating instruments should be used in the field.
7. Understand the three basic principles of external radiation protection Time, Distance , Shielding
8. Test the existing shielding in any X – ray facility and give recommendation.
9. Explain different exposure and dose measuring instruments
10. Apply specific Gamma ray emission constant ( Γ́ ) to estimate exposure.
11. Explain acute, delayed and genetic effects of radiation.
12. Explain RBE and QF and hence calculate dose equivalent

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **1** | Radiation protection guides such as ICRP, NCRP etc. | 1 |
| **1** | Radiation safety criteria, Annual Limit of Intake (ALI), Derived Air | 2 |
| **2** | Concentration (DAC) and Maximum Permissible concentration (MPC) | 3 |
| **2** | Health Physics instruments | 4 |
| **2** | Diagnostic and therapeutic x-ray shielding | 5 |
| **2** | Basic principles for external radiation protection | 6 |
| **2** | Basic principles for internal radiation protection | 7 |
| **2** | Radioactive waste management | 8 |

***<u>Class Schedule:</u>***

- Lectures: Two 1.5 hour sessions per week.
- Labs.: One 2.0 hour sessions per week.

***<u>Course Contribution to professional Component</u>***:

- Engineering science: 75%
- Engineering design: 25 %

***<u>Course Relationship to Program Outcomes:</u>***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **3** | **2** | **2** | **1** | **1** | **1** | **2** | **2** | **2** | **3** | **3** | **3** | **1** | **1** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| ٣ | - | - | ٣ | هـ ن ٤٥٣ | NE 453 | **Rules and Regulation of Nuclear Radiation** |
| NE 451 | | | | | **Prerequisites** | |
| In this course the student will know rules and regulations of Nuclear radiation (local & international), recommendations of International Atomic Energy Agency (IAEA), International Commission of Radiation Protection (ICRP), and other international recommendations. He will also learn how to compare between those recommendations and their application in medical, industrial and environmental fields. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** International Atomic Energy Agency Publications, www.iaea.org.

***Reference:*** International Atomic Energy Agency Publications, www.iaea.org.

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Explain and discuss the general concept of the nuclear law
2. Define and describe the general concept of the regulatory body

3. Identify and describe the regional and international treaties, conventions, and agreements
4. Recognize and identify local rules and regulations of nuclear radiation
5. Recognize and identify recommendations of IAEA, ICRP, and other international bodies
6. Apply nuclear regulations in medical, industrial and environmental fields

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Concepts of nuclear law (Risks and benefits and National legal hierarchy) | 1 |
| 1 | Definition of nuclear law | 2 |
| 1 | Objective of nuclear law | 3 |
| 1 | Principles of nuclear law | 4 |
| 3 | Legislative process for nuclear law | 5 |
| 1 | Security culture and safety culture in nuclear law | 6 |
| 2 | The Regulatory Body | 7 |
| 1 | Advisory bodies and external support | 8 |
| 1 | International Agreements Joined or Ratified by KSA | 9 |
| 2 | The State System of Accounting for and Control of Nuclear Materials (SSAC) | 10 |
| 1 | Local rules and regulations of nuclear radiation | 11 |
| 1 | Recommendations of IAEA, ICRP, and other international recommendations | 12 |
| 1 | Examples and Exemptions | 13 |
| 1 | Administrative requirements for radiation protection and safety of radiation sources | 14 |

***Class Schedule:***

- Lectures: Three 1.0 hour sessions per week.
- Tutorials: One 2.0 hours session per week.

***Course Contribution to professional Component***:

- Engineering science: 0 %
- Engineering design: 0 %
- Other 100%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **1** | **-** | **3** | **2** | **1** | **3** | **3** | **2** | **-** | **-** | **-** | **1** | **2** | **3** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| ٣ | - | - | ٣ | هـ ن ٤٥٤ | NE 454 | Environmental Radioactivity |
| NE 340, NE 351 | | | | | | Prerequisites |
| Natural radioactivity: radionuclides in the earth, cosmogeonic radioactivity, cosmic radiation, external and internal doses from natural radioactivity, sources of man-made radioactivity contamination covering fallout, radiation accidents, and radioactive waste. Pathways of radionuclides from environment to man. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** R. Tykva and J. Sabol, Low Level Environmental Radioactivity. Technomic Publication (1995).

***Reference:*** M. Eisenbud and T. Gesell, Environmental Radioactivity from Natural, Industrial & Military Sources. Academic Press; 4th edition (1997).

***Course Learning Objectives: By completion of the course, the students should be able to:***

1. Describe Terrestrial Radioactivity and list the three radioactive series that exist
2. Describe cosmogenic radionuclides and identify some of them
3. Explain cosmic radiation and its two components
4. Explain external and internal doses from natural radioactivity and means of determining the same
5. Describe radiation fall-out

6. Identify some of the nuclear accidents and assess the damages caused and their long- term effects
7. Explain radioactive waste and describe how to classify them. Explain different pathways of radionuclides reaching man
8. Identify different radionuclides that are transported through air, water and soil

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **1** | Environmental Radioactivity – Introduction | 1 |
| **1** | Terrestrial and Cosmic Radiation | 2 |
| **1** | Contamination from Natural radioactivity (External) | 3 |
| **1** | Contamination from Natural radioactivity (Internal) | 4 |
| **1** | Sources of Man-made radioactivity | 5 |
| **1** | Radiation fall-out | 6 |
| **1** | Nuclear Accidents | 7 |
| **1** | Radioactive waste: Identification, classification | 8 |
| **2** | Radioactive waste disposal | 9 |
| **1** | Transport of radioactivity through air | 10 |
| **1** | Transport of radioactivity through water | 11 |
| **1** | Transport of radioactivity through Soil | 12 |
| **1** | Transport of radioactivity through Soil | 13 |

***Class Schedule:***

- Lectures: Three 1.0 hour sessions per week.
- Tutorials: Two 2.0 hours session per week.

***Course Contribution to professional Component***:

- Engineering science: 100 %
- Engineering design: 0 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **2** | **-** | **-** | **-** | **-** | **2** | **-** | **2** | **1** | **-** | **-** | **2** | **-** | **2** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| **3** | **-** | **-** | **٣** | **هـ ن ٤٥٦** | **NE 456** | **Operational Radiation Protection** |
| **NE 451** | | | | | | **Prerequisites** |
| Laboratory operation and good work practice, use of radiation survey meters, calibration, frequency of calibration. Radiation dose limits, limits of radionuclides in water in unrestricted areas, limits in sewerage, leakage and surface contamination limits, accessibility control, labeling, use of protection equipments, emergency procedures, low and intermediate waste management. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** H. Cember and T. Johnson, Introduction to Health Physics. McGraw-Hill Medical; 4th edition (2008).

***Reference:*** Merril Eisenbud and Thomas Gesell, Environmental Radioactivity. Academic Press; 4th edition (1997).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Describe how measuring device operates (principally in terms of its energy and count rate response).
2. Recognize the diverse aspects of good work practice in labs (source storage, source containment, identification of radiation hazard, spillage, waste disposal).
3. Calibrate a measuring instrument.
4. Specify the radiation dose limits set by ICRP.
5. Apply the regulations related to release of radioactivity and waste disposal.
6. Describe different procedures to handle radiation incidents.

| Duration in Weeks | Topic Covered During Class: | NO |
|---|---|---|
| **2** | Laboratory operation and good work practice | 1 |
| **2** | Use of radiation survey meters | 2 |
| **1** | Calibration and frequency of calibration | 3 |
| **1** | Radiation dose limits | 4 |
| **2** | limits of radionuclides in water in unrestricted areas, limits in sewage | 5 |
| **2** | leakage and surface contamination limits | 6 |
| **2** | Accessibility control, labeling, use of protection equipments | 7 |
| **1** | Emergency procedures | 8 |
| **1** | Low and intermediate and high waste managements | 9 |

***Class Schedule:***

- Lectures: Three 1.0 hour sessions per week.
- Tutorials: Two 2.0 hours session per week.

***Course Contribution to professional Component*:**

- Engineering science: 100 %
- Engineering design: 0 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | i | f | ABET Program Outcomes |
| - | - | 2 | - | - | 1 | - | - | 1 | - | 2 | - | - | 1 | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 4 | - | 2 | ٣ | هـ ن ٤٧٠ | NE 470 | Radiotherapy I |
| NE 370, NE 371, NE 372 | | | | | Prerequisites | |
| Dose and exposure calculations, patient dose calculation, treatment plans and use of computer in radiotherapy, treatment by linear accelerator and sealed and open sources. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** F. M. Khan, The Physics of Radiation Therapy, Williams & Wilkins (2009).

***Reference:*** G. Bentel, Radiation Therapy Planning. McGraw-Hill Professional; 2nd edition (1995).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Define precise technical information about radiotherapy machine.
2. Define the physical characteristics of photon & electron therapy beams.
3. Calculate the absorbed dose to cancer lesions.
4. Use calibration protocol for megavoltage beams
5. Lear the dose distribution in phantoms and human body.
6. Identify the dose calculation parameters
7. Differentiate between the dose delivered to regular & irregular fields.
8. Use the TPS for measurement and planning isodose curves.
9. Describe physical approach of the different types of radiation modulators.
10. Define precisely the radiotherapy terminology.
11. Explain combination of therapy fields with the patients.
12. Describe the ideal setup of the patient during radiation treatment.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Specification and technology of linac | 1 |
| 1 | Specification and technology of radionuclide therapy | 2 |
| 2 | Treatment planning technology | 3 |

| | | |
|---|---|---|
| 2 | Calculation of absorbed dose in phantoms and patients | 4 |
| 2 | Absorbed dose calibration protocols for megavoltage beams | 5 |
| 3 | Dose distribution and scatter analysis<br>1- PDD<br>2- TAR<br>3- SAR | 6 |
| 2 | System of dosimetric calculations | 7 |
| 1 | Corrections for the absorbed dose to the patients | 8 |
| 1 | Radiation field combination | 9 |

***Class Schedule:***

- Lectures: Three 1.0 hour sessions per week.
- Labs: Two 2.0 hours session per week.

***Course Contribution to professional Component*:**

- Engineering science: 100 %
- Engineering design: 0 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **3** | **1** | **-** | **2** | **1** | **-** | **-** | **-** | **2** | **1** | **2** | **3** | **2** | **-** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| ٣ | - | - | ٣ | هـ ن ٤٧١ | NE 471 | Medical Imaging I |
| NE 341, NE 370, NE 371 | | | | | | Prerequisites |
| Introduction to medical image processing and medical image quality. Medical imaging modalities based on ionizing radiation. Physical principles and components of X-ray Radiography. X-ray spectrum and factors that affect its shape. Physical principles and components of X-ray Computed Tomography. Mathematical algorithms used to reconstruct CT and Nuclear Medicine images: Center Slice Theorem, Radon Transform, Filter Back-projection and iterative reconstruction techniques. Introduction to medical imaging modalities based on non ionizing radiation; such as MRI and US Imaging. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** J.E. Bushberg, J.A. Seibert, E.M. Leidholdt JR, and J.M. Boone, The Essential Physics of Medical Imaging. Lippncott Williams & Wilkens Editions; 2nd Edition (2002).

***Reference:*** P. Suetens, Fundamentals of Medical Imaging. Cambridge University Press; (2002).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Define the key factors that affect image quality
2. List, define, and explain an ionizing imaging system and break it down into its components and physical principles, for each of the imaging modalities covered (X-ray Radiography and
3. X-ray computed tomography)
4. Describe published scientific articles that relate to medical imaging and be able to communicate their understanding in a professional manner
5. Learn to communicate the physical principles behind medical technology and relevant applications
6. Describe basic components of the nuclear medicine imaging equipments such Gamma Camera, SPECT, and PET in addition to the image reconstruction techniques.

7. Describe basic components of the non-ionizing medical imaging equipments such MRI and US
8. Remember the terms associated with Medical Imaging
9. Remember the image quality parameters
10. Practice and apply elements of active learning, develop team norms and writing skills.
11. Able to critically evaluate bodies of literature in the medical imaging application
12. Integrate ideas from physics into medicine
13. See themselves as people who are more educated about medical imaging
14. Able to inform and educate other intelligent citizen about the role of medical imaging in personal and public life
15. Be excited about medical imaging as a broad, complex, multifaceted field of study
16. Value the importance of precise language in the field of medical imaging work as part of professionalism
17. Be able how to read assigned materials responsibly.

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **1** | **Introduction to Digital Image Processing**<br>· Anatomy of the eye, Property of Light, Color Models, & Visual Illusions<br>· Definition of digital images; dynamic range, quantization, histogram<br>· Evaluation of image quality; resolution, contrast, noise, & artifacts | 1 |
| **1** | · Basic Image operations; gray level transformations, multi-image operations, geometric operations and linear and non-linear filters | 2 |
| **1** | · Introduction to Linear System Theory<br>· Introduction to Medical Imaging and Computers in Medical Imaging | 3 |
| **1.5** | **Diagnostic Radiographic Imaging**<br>· X-ray Machine, X-ray Tubes, Filters, Collimators, Grid, & Generators | 4 |
| **1.5** | · Image Receptors, Screen – Film Radiography, Image Intensifiers, Computed Radiography, Direct Radiography Detectors | 5 |
| **1.5** | · X-ray Production, Radiographic Charts, Factors Affecting X-ray Emission Spectra, Scatter Radiation, Image Quality, & Biological Effect & Safety. | 6 |
| **1.5** | **X-ray Computed Tomography Imaging – CT**<br>· Generations of X-ray CT: Machine Components, CT Image, CT Number | 7 |
| **1.5** | · Tomography, projection, Radon Transform, Sampling, Center Slice Theorem & Filter Back projection Reconstruction | 8 |
| **1.5** | · Types of CT, Spiral, Multi-slice CT, Pitch, Image Quality & Radiation Dose | 9 |
| **1** | **Nuclear Medicine Imaging – NM**<br>· NM imaging; Components, Choices of | 10 |

| | | |
|---|---|---|
| | Radionuclide, Types of Image Reconstructions for Single Photon Emission Tomography (SPECT) & Positron Emission Tomography (PET).<br>Planner & Tomographic NM imaging & Clinical Applications in NM | |
| **1** | **Non Ionizing Radiation Imaging Modalities**<br>· Introduction Magnetic Resonance Imaging – MRI<br>· Introduction to Ultrasonic Imaging – US | 11 |

***Class Schedule:***

- Lectures: Two 1.5 hour sessions per week.
- Tutorials: None.

***Course Contribution to professional Component***:

- Engineering science: 100 %
- Engineering design: 0 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **2** | **-** | **2** | **2** | **1** | **2** | **1** | **1** | **1** | **-** | **-** | **2** | **2** | **2** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| ٣ | - | - | ٣ | هـ ن ٤٧٢ | NE 472 | Nuclear Medicine |
| NE 370, NE 451 | | | | | | Prerequisites |
| Production of radionuclide, radiopharmaceuticals, nuclear medicine instrumentations (NaI(Tl)) detector, well counter, Thyroid probe, dose calibrator, gamma camera, SPECT, and PET), quality control, clinical applications, internal radiation dosimetry, safe handling of radionuclides, and statistics of radiation counting. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** M. A. Wilson, Textbook of Nuclear Medicine. Lippincott Williams & Wilkins Editions (1998).

***Reference:*** F. Mettler and M. Guiberteau, Essentials of Nuclear Medicine Imaging. Saunders; 5$^{th}$ edition (2005).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Define and explain difference between radionuclides and radiopharmaceuticals
2. Explain different methods for production of radiopharmaceuticals
3. Apply mathematical formulas to calculate radionuclides in the pharmaceuticals
4. Solve problems associated with the production methods of radiopharmaceuticals
5. Explain the physics of NaI (Tl) detector and gamma camera
6. Define and explain SPECT and its application in nuclear medicine imaging
7. Define and explain PET and its application in nuclear medicine imaging
8. Explain the purpose of well counter in the field of nuclear medicine
9. Explain the use of dose calibration in nuclear medicine
10. Discuss the use of thyroid probe in nuclear medicine

11. Define quality control in nuclear medicine, explain instrumentation quality control, and radiopharmaceutical quality control
12. Calculate thyroid uptake of radioisotopes
13. Discuss diagnosis and treatment of thyroid disease
14. Discuss radionuclide renal evaluation
15. Employ isotope dilution technique for the measurement of plasma volume
16. Compute dose and dose rate for internally deposited radioisotopes
17. Explain the principles of radiation protection and discuss the effect of time, distance, and shielding
18. Discuss different steps to avoid internal contamination
19. Discuss DOs and DON'Ts in radiation protection practice
20. Employ the idea of radiation counting statistics and propagation of errors to compute percentage uncertainty in nuclear medicine clinical applications

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Radiopharmaceuticals and their production | 1 |
| 1 | NaI(Tl) detectors and gamma cameras | 2 |
| 1 | Well counter, thyroid probe, and dose calibrator | 3 |
| 1 | SPECT | 4 |
| 1 | PET | 5 |
| 1 | Quality control in nuclear medicine | 6 |
| 1.5 | Clinical applications | 7 |
| 1.5 | Internal radiation dosimetry | 8 |
| 1.5 | Safe handling of radionuclides | 9 |
| 1.5 | Statistics of radiation counting | 10 |

***Class Schedule:***

- Lectures: Two 1.5 hour sessions per week.
- Tutorials: One 2.0 hours session per week.

***Course Contribution to professional Component***:

- Engineering science: 100 %
- Engineering design: 0 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **3** | **2** | **1** | **2** | **-** | **-** | **1** | **-** | **2** | **-** | **2** | **3** | **2** | **-** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| ٣ | - | - | ٣ | هـ ن ٤٧٣ | NE 473 | Dosimetry |
| NE 451, NE 470 | | | | | | Prerequisites |
| Radiation exposure, radiation absorbed dose, dose units, kinetic energy absorbed in unit mass, dose equivalent, Bragg-Gray theory, measurement methods and detection by ionization chambers, proportional detectors and solid state detectors, Geiger tubes, TLD, calorimetric method, and scintillation detectors. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** M. G. Stabin, Radiation Protection and Dosimetry: An Introduction to Health Physics. Springer; 1st edition (2010).

***Reference:*** K. Arshak and O. Korostynska, Advanced Materials and Techniques for Radiation Dosimetry. Artech House Publishers; 1st edition (2006)

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Define and explain radiation exposure and its units
2. Define and explain radiation absorbed dose and its units
3. Derive the relationship between exposure rate and absorbed dose
4. Solve problems to compute exposure rate and absorbed dose rate for different types of radiation field
5. Explain the difference between Kerma and absorbed dose
6. Discuss different methods used for the measurement of exposure such as free ionization chamber and the air wall chamber (Thimle chamber)

7. Solve problems to compute exposure rate using the theory outlined in the measurement methods
8. Discuss different methods used for the measurement of absorbed dose such as calorimetric dosimeter and film badges
9. Define and explain Bragg-Gray principle for absorbed dose measurement
10. Solve problems using Bragg-Gray principle
11. Solve problems to compute dose and dose rate for external radiation sources
12. Solve problems to compute dose and dose rate for internally deposited radioisotopes
13. Explain and discuss gas filled detectors such as ionization chamber, proportional counter, and Geiger detectors
14. Explain and discuss scintillation detectors
15. Explain and discuss solid state detectors
16. Explain and discuss thermo-luminescent dosimeter (TLD) for dose measurement
17. Solve problems using the theory outlined in the above detectors/dosimeters

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Exposure for x-rays and gamma rays | 1 |
| 1 | Absorbed radiation dose | 2 |
| 1 | Different dose units | 3 |
| 1 | Kerma and absorbed dose | 4 |
| 1 | Exposure-Dose relationship | 5 |
| 1 | Simple dosimeter model in terms of cavity theory | 6 |
| 1 | Exposure measurement-Free air | 7 |
| 1 | Exposure measurement-Thimble Chamber | 8 |
| 1 | Absorbed dose measurement- Calorimetric dosimeter | 9 |
| 1.5 | Absorbed dose measurement-Calorimetric dosimeter, Film Badges | 10 |
| 1 | Bragg-Gray theory for absorbed dose calculations | 11 |
| 1.5 | Computation of dose from external radiation sources | 12 |
| 1.5 | Computation of dose from internal radiation sources | 13 |
| 1.5 | Gas filled detectors-Ionization chamber, proportional counter, and Geiger counter | 14 |
| 1 | Scintillation detectors | 15 |
| 1 | Solid state detectors | 16 |
| 1.5 | TLD and film badges | 17 |

***Class Schedule:***

- Lectures: Three 1.0 hour sessions per week.
- Tutorials: One 3.0 hours session per week.

***Course Contribution to professional Component***:

- Engineering science: 100 %
- Engineering design: 0 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | 2 | 1 | ABET Program Outcomes |
| 3 | 2 | 1 | 2 | - | - | 1 | - | 2 | - | 2 | 3 | - | 3 | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 4 | - | 2 | ٣ | هـ ن ٤٧٤ | NE 474 | Medical Imaging II |
| EE 332, NE 471 | | | | | | Prerequisites |
| Evaluation techniques of medical images using ROC analysis, Contrast Detail curve, Rose Model, MTF, NPS, and DQE. Medical imaging modalities based on non ionizing radiation. Physical principles and components of Magnetic Resonance Imaging. Intrinsic and Extrinsic parameters that affect the NMR and the MRI signal. Fundamental MRI pulse sequences. MRI gradient and image formation. Factors that affect MR image quality. Mathematical formulation, physical principles and components of Ultrasound Imaging. Advance applications of X-ray Radiography; such as Mammography, Fluoroscopy, and DSA. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** J.E. Bushberg, J.A. Seibert, E.M. Leidholdt JR, and J.M. Boone, The Essential Physics of Medical Imaging. Lippncott Williams & Wilkens editions; 2nd edition (2002).

***Reference:*** P. Suetens, Fundamentals of Medical Imaging. Cambridge University Press; (2002).

***Course Learning Objectives: By completion of the course, the students should be able to:***

1. Define the terms associated with Medical Imaging
2. Define the image quality parameters
3. Define and explain the key factors that affect image quality and address these factors for the different imaging modalities taught in class
4. List, define, explain and apply medical image evaluation techniques to assess the quality of medical images
5. Describe how the physical principles of the magnetic resonance imaging, Mammography, and Fluoroscopy imaging modalities
6. Describe the non ionizing imaging system and break it down into its components, for each of the imaging modalities covered (MRI, US);
7. Describe the physical principals occurring in MR pulse sequences such as spin echo, inversion recovery, gradient recall echo pulse sequences
8. Describe the difference between NMR and MRI
9. List and describe how the image quality parameters are affected in the non-ionizing imaging modalities
10. Describe some of the ionizing imaging system and break it down into its components, for each of the imaging modalities covered (Mammography & Fluoroscopy)
11. List and describe how the image quality parameters are affected in the ionizing imaging modalities
12. Communicate information published in scientific articles related to medical imaging
13. Communicate the physical principles behind medical technology and relevant applications
14. Practice and apply elements of active learning, develop team norms and writing skills.
15. Able to critically evaluate bodies of literature in the medical imaging application
16. Integrate ideas from physics into medicine
17. Educate others the role of medical imaging in personal and public life
18. Recognize and appreciate medical imaging as a broad, complex, multifaceted field of study
19. Practice precise language in the field of medical imaging as part of professionalism
20. Read assigned materials responsibly.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 1 | Description & Evaluation of Medical Images (Resolution, Noise, Contrast) | 1 |
| 1 | SNR, Weiner Spectra, & Modulation Transfer Function, Contrast Detail, Rose Model, & ROC Analysis | 2 |
| 1.5 | Non-ionization Radiation Imaging Modality – Magnetic Resonance Imaging (Magnetism and the Magnetic Property of Matter, Principles of Nuclear MR) | 3 |
| 1.5 | **NMR:** Tissue MR parameters - Spin, T1 and T2 , T2* relaxations, FID | 4 |
| 1 | **MRI:** Pulse Sequences-Spin echo, Inversion Recovery, GRE, Perfusion, & Diffusion. | 5 |
| 1 | **MRI:** MRI & Gradients: Slice, Frequency & Phase encoding, K-space & Image Quality | 6 |
| 2 | Clinical Applications of Diagnostic Radiographic Imaging (Mammography, Dedicated Equipments, Specialized X-ray Tubes, Optimized Image Receptor Systems, X-ray Tube, Target, Tube Port & Filtration, & Beam Quality, HVL, Collimation & Field Alignment, X-ray Generator, AEC, Compression, Scatter | 7 |

| | | |
|---|---|---|
| | Radiation, MTF, Stereotactic Breast Biopsy, Radiation Dosimetry, Full Field Digital Mammography, SFM vs FFDM, Computer Aided Diagnoses, Quality Assurance and Quality Control) | |
| 2 | Fluoroscopy (Image Intensifier Components & Characteristics Brightness Gain, Conversion Factor, DQE, Contrast Ratio, FOV, Artifacts of II, Video Camera & Resolution, Peripherals, Modes of Operations, ABC, Image Quality, Radiation Dose, & Fluoroscopy Suites) | 8 |
| 1.5 | Ultrasound Imaging: Physical Principles of Diagnostic Ultrasound, Instrumentation, and Operation | 9 |
| 1.5 | Ultrasound Imaging: acoustic waves, wave propagation in tissue, wave propagation, imaging and Doppler imaging, and scanning mode | 10 |

***Class Schedule:***

- Lectures: Two 1.5 hour sessions per week.
- Tutorials: None.

***Course Contribution to professional Component*:**

- Engineering science: 100 %
- Engineering design: 0 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **2** | **-** | **2** | **2** | **1** | **1** | **1** | **-** | **2** | **-** | **1** | **2** | **2** | **1** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 2 | 4 | - | - | هـن ٤٨٩ | NE 489 | Practical Training |
| NE 340, NE 451, NE 470, NE 371 | | | | | Prerequisites | |
| Students of the Engineering Medical Physics Track are assigned practical clinical rotational training in different radiological departments at hospitals to familiarize the students with actual procedures and practices in the field of medical physics. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** AAPM Presidential Ad Hoc Committee on the Clinical Training of Radiological Physicists, Essentials and guidelines for hospital based medical physics residency training programs. (AAPM report); (1992)

***Reference:*** Douglas P. Beall, Radiology Sourcebook: A Practical Guide for Reference and Training. Humana Press; 1st edition (2010).

***Course Learning Objectives: By completion of the course, the students should be able to:***

5. Identify the role of medical physicist in realistic profession environment.
6. Apply theoretical medical physics concepts
7. Use different equipment and technologies used in the field of medical physics.
8. Practice the professional and ethical behavior toward patients, physicians, and co-workers in the profession of medical physics.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **4** | Radiology clinical rotation | 1 |
| **4** | Nuclear Medicine clinical rotation | 2 |
| **4** | Radiotherapy clinical rotation | 3 |

***Class Schedule:***

- Oral Presentation after submitting a written training report; both evaluated by at least 2 faculty members.

***Course Contribution to professional Component:***

- Engineering science: None
- Engineering design: None
- Others 100%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **-** | **2** | **3** | **2** | **3** | **3** | **2** | **2** | **2** | **-** | **2** | **-** | **2** | **3** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 4 | - | ٢ | 3 | هـ ن ٤٩٩ | NE 499 | Senior Project |

| NE 340, NE 451<br>Department's Consent | Prerequisites |
|---|---|
| Application of engineering principles to a significant nuclear or radiation design project including team-work, written and oral communications. The project should also consider realistic technical, economic and safety requirements. The design project progresses step-by-step from the stages of problem definition, analysis and synthesis to design and tests. Students will deliver a final report and an oral presentation. This design project will involve a multi-disciplinary approach to the problem. Consultation from a business/industrial counterpart is highly recommended. | |

Faculties and departments requiring this course (if any): None

***Textbook:*** Bahattin Karagözoğlu, A Guide to Engineering Design Methodologies and Technical Presentation, Department of Electrical and Computer Engineering, Faculty of Engineering, KAU (2007).

***Reference:*** Assessment Rubrics for BS Projects, available from the BS Project Committee.
Nuclear Engineering Department, Faculty of Engineering, KAU (2007).

***Course Learning Objectives: By completion of the course, the students should be able to:***

13. Analyze a project statement, brief, or proposal to identify the real problem and the most relevant needs and operational constraints.
14. Identify potential costumers, their needs, and their operational constraints.
15. Collect and review related data such as technical information, regulations, standards, and operational experiences from credible literature resources.
16. Integrate previous knowledge from mathematics, basic sciences, engineering fundamentals and discipline related courses to address the problem.
17. Discuss all applicable realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
18. Define design objectives, measures of design viability, and the evaluation criteria of the final project, and reformulate the problem based on collected data.
19. Generate possible solutions; compare alternatives, and select one alternative based on evaluation criteria and feasibility analysis.
20. Plan an effective design strategy and a project work plan, using standard project planning techniques, to ensure project completion on time and within budget.
21. Implement a planned design strategy for an Experimental Design Project, if applicable:
    - 21.1 Identify experimental variables and parameter with ranges and desired accuracies.
    - 21.2 Select appropriate experimental tools such as sensors, instruments, and software.
    - 21.3 Explain a reliable experimental setup and experimental procedure that solves the problem.
    - 21.4 Explain efficient measures to deal responsibly with safety issues and environmental hazards.
    - 21.5 Use appropriate measurement techniques to ethically collect and record data.
    - 21.6 Analyze experimental data using appropriate tools such as data reduction and statistical analysis.
    - 21.7 Perform uncertainty analysis.
    - 21.8 Judge, verify, and validate the experimental result by comparing them with theory and/or previous experimental works.
22. Implement a planned design strategy for a Product-Based Design Project, if applicable:
    - 22.1 Identify design parameters as well as assumptions.

22.2 Carry out initial design calculations using modern engineering tools.
22.3 Use modern engineering tools to estimate the performance parameters of the initial design.
22.4 Use constraint analysis and trade-off studies of the design parameters to refine the initial design and obtain a final optimized design.
22.5 Evaluate the project related environmental, social, health and safety issues, as well as hazards anticipated by the project.
22.6 Evaluate project success in satisfying customer's needs, design criteria, and operational constraints.

23. Communicate design details and express thoughts clearly and concisely, both orally and in writing, using necessary supporting material, to achieve desired understanding and impact.
24. Demonstrate ability to achieve project objectives using independent, well organized, and regularly reported multidisciplinary team management techniques that integrate, evaluate, and improve different skills of team members

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| 1 | Project selection and team formation | 1 |
| **2** | Problem Definition | 2 |
| **3** | Literature review and data collection | 3 |
| **3** | Problem formulation:<br>• Knowledge integration<br>• Operational and realistic constraints<br>• Design objectives<br>• Evaluation criteria | 4 |
| **2** | Design options and initial layout | 5 |
| **1** | Work plan and budgeting | 6 |
| **1** | Progress report and oral presentation | 7 |
| **7** | Implementation phase | 8 |
| **3** | Design refinement | 9 |
| **3** | Final report and oral presentation | 10 |

***Course Schedule:***
2 general audience oral presentations of 30 minutes each

***Course Contribution to professional Component:***
- Engineering science: 30%
- Engineering design: 70%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **-** | **3** | **3** | **3** | **Highest Attainable Level of Learning** |

## Description of Departmental Elective Courses

| **Hours** | | | | **Arabic Code/No.** | **English Code /No** | **Course Title** |
|---|---|---|---|---|---|---|
| **Credit** | **Tr.** | **Pr.** | **Th.** | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **3** | **-** | **-** | **3** | **هـ ن ٣٠٠** | **NE 300** | **Fundamentals of Nuclear Engineering Calculations** |
| **MATH 204, MATH 205** | | | | | **Prerequisites** | |
| Ordinary differential equations of the first and second order applicable to nuclear engineering calculations. Power series solutions of differential equations. Laplace transformations. Use of Laplace transformations to solve ordinary differential equations. Fourier series and integrals. Partial differential equations and divergence theorem of Gauss. Legendre polynomials and Bessel functions. | | | | | | |

Faculties and departments requiring this course ( if any) : None

***<u>Textbook</u>***: E. Kreyszig, Advanced Engineering Mathematics. John Wiley & Sons; (2006).

***<u>References:</u>*** S. L. Ross, Differential Equations. John Wiley & Sons; (2003).

C. R. Wylie and L. C. Barratt, Advanced Engineering Mathematics. McGraw Hill; 6th edition (1995).

**<u>Course Learning Objectives : By completion of this course, the students should be able to</u>** :

1. Solve ordinary differential equations of first and second order
2. Generate first and second order differential equations from nuclear engineering problems
3. Apply his knowledge to solve these differential equations
4. Solve differential equations by power series method and Laplace transform
5. Apply his knowledge with power series method to solve Legendre differential equation and hence to deduce Legendre polynomials
6. Apply method of Forbenius to solve Bessel differential equation and hence to derive Bessel's function
7. Understand periodic function, Fourier series and Fourier coefficients
8. Apply his information and skills to obtain Fourier series of a function f(x) for different Intervals
9. Convert surface integral to volume integral and vice-versa
10. Use the method of separation of variables to find solution of a partial differential equation relating to nuclear engineering problem

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| 1 | Special Functions | 1 |
| 1 | Solutions of first order differential equations | 1 |
| 1 | Applications of first order differential equations | 1 |
| 1 | Solutions of second order & higher order differential equations | 2 |
| 1 | Applications of second order differential equations | 1 |
| 1 | Power series solution of differential equations | 1 |
| 1 | Solution of Bessel differential equation and Bessel function | 2 |
| 1 | Solution of Legendre equation and Legendre polynomials | 1 |
| 1 | Solution of differential eqs. Using Laplace transform | 1 |
| 1 | Fourier Series | 1 |
| 1 | Applications of Partial differential equations | 1 |
| 1 | Gauss's Divergence Theorem | 1 |

***Class Schedule:***

Lectures: Three 50 min. sessions per week.

***Course Contribution to professional Component***:

- Engineering science: 100 %
- Engineering design: 0 %
- Other 0%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **e** | **f** | **j** | **h** | **k** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **3** | **-** | **2** | **-** | **2** | **-** | | **-** | **2** | **-** | **-** | **3** | **-** | **-** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| ٣ | - | - | 3 | هـن ٣٥٠ | NE 350 | Non-ionizing Radiations |
| NE 302 | | | | | Prerequisites | |
| Physics of wave motion, Health effects of sound and ultrasound, Response spectra for physical agents, Electric current and electrocution, Static and low frequency electric and magnetic fields, Radiofrequency and microwave fields, Radiometric and photometric units for optical measurements, Ocular Effects of Visible Light, Lasers and laser safety, Health effects of ultraviolet radiation. | | | | | | |

***Textbook:*** R. T. Hitchcock, R. M. Patterson, Radiofrequency and ELF Electromagnetic Energies: A Handbook for Health Professionals. Van Nostrand Reinhold; (1995).

***References:*** H. Cember and T. Johnson, Introduction to Health Physics. Mc Graw Hill; 4th edition (2009)

P. Polk and E. Postow, eds. Handbook of Biological Effects of Electromagnetic Fields. CRC; 2nd edition (1996).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Show knowledge of the different physical agents: noise, ultrasound, electric current, low frequency electric and magnetic fields, radiofrequency/microwave fields, visible light, lasers and ultraviolet radiation.
2. Analyze the factors determining absorption rates of electromagnetic radiation by the human body
3. Describe the biological effects of the non ionizing radiation on human beings
4. Evaluate physical and biological hazards of non ionizing radiation on humans
5. Determine the applicable standards for UV light, lasers, radio frequency radiation and static magnetic and electric fields
6. Apply wherever possible, common physical and biological concepts to the treatment of the various physical agents.
7. Recommend basic hazard controls including safe work practices, training

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 3 | Show knowledge of the different physical agents: noise, ultrasound, electric current, low frequency electric and magnetic fields, radiofrequency/microwave fields, | 1 |

| | | |
|---|---|---|
| | visible light, lasers and ultraviolet radiation. | |
| 2 | Analyze the factors determining absorption rates of electromagnetic radiation by the human body | 2 |
| 2 | Describe the biological effects of the non ionizing radiation on human beings | 3 |
| 2 | Evaluate physical and biological hazards of non ionizing radiation on humans | 4 |
| 2 | Determine the applicable standards for UV light, lasers, radio frequency radiation and static magnetic fields | 5 |
| 2 | Apply wherever possible, common physical and biological concepts to the treatment of the various physical agents. | 6 |
| 2 | Recommend basic hazard controls including safe work practices, training | 7 |

***Class Schedule:***

- Lectures: Two 1.0 hour sessions per week.
- Tutorials: One 1.0 hour session per week.

***Course Contribution to professional Component*:**

- Engineering science: 30 %
- Engineering design: 0 %
- Other 70 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **1** | **-** | **1** | **-** | **1** | **-** | **2** | **-** | **-** | **-** | **-** | **1** | **-** | **1** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | 1 | 3 | هـن٣٦١ | NE 361 | Introduction to Non Destructive Testing and Visual Inspection |
| ChE 210 | | | | | Prerequisites | |

**NON DESTRUCTIVE TESTING:** Importance of NDT, Non-destructive testing: applications and tendencies, Defects detection principles, Various techniques of NDT: Liquid penetrant, Magnetic leakage, Eddy Currents, Radiography, Ultrasounds, Case studies for various industrial applications
**VISUAL INSPECTION:** Visual inspection principles, Visual inspection of welded components, Testing techniques, Inspection characteristics, Case studies (welding, casting, ..), Standards.

Faculties and departments requiring this course (if any): none

***Textbook:*** X. E. Gros, Applications of NDT Data Fusion. Springer; 1st edition (2001).

***Reference:*** P. E. Mix von John, Introduction to Non destructive Testing: A Training Guide.
Wiley & Sons; (2005).

***Course Learning Objectives:*** By completion of the course, the students should be able to:

1. understand the application of nondestructive techniques in general
2. know the advantages and the limits non destructive techniques
3. Importance of standards, technical specifications, and test procedures
4. test some important industrial components such as welded and cast samples by visual inspection
5. record the test results
6. take a decision: acceptance or rejection by evaluating the test results according to the related standards (ASME, EN, etc.)

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **1** | Importance of NDT, Non-destructive testing: applications and tendencies, | 1 |
| **1** | Defects detection principles, Various techniques of NDT, Optical processes, processes use, | **2** |
| **1** | Liquid penetrant, Magnetic leak flow processes, | **3** |
| **1** | Eddy Currents, Ultrasounds | **4** |
| **1** | Radiography, | **5** |

| | | |
|---|---|---|
| **1** | **VISUAL INSPECTION:** Visual inspection principles, Welding processes, Welded assemblies' quality | 6 |
| **1** | The testing techniques, Inspection characteristics, The welding main processes, Standards application. | 7 |

***Course Schedule:***

- Lecture: Three 1.0 hour sessions per week
- lab: one 3.0 hours session per week

***Course Contribution to professional Component:***

- Engineering science: 100%
- Engineering design: 0%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **1** | **1** | **2** | **1** | **-** | **2** | **1** | **2** | **1** | **1** | **2** | **1** | **1** | **2** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| ٣ | - | - | ٣ | هـ ن ٤٥٢ | NE 452 | Technology of Radiation Equipments |
| NE 340, NE 351 | | | | | | Prerequisites |
| Production and characteristics of x-rays, diagnostic radiology, quality of an image, special radiographic techniques in diagnostic radiography. High energy machines in medical applications: linear accelerators, cyclotrons, neutron generators and betatrons. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** W. Huda, Review of Radiologic Physics. Lippincott Williams & Wilkins; 1st edition (1995).

***Reference:*** J. T. Bushberg, J. Seibert, E. Leidholdt and J. Boone, The Essential Physics of Medical Imaging. Lippincott Williams & Wilkins; 2nd edition (2001).

***Course Learning Objectives: By completion of the course, the students should be able to:***

1. Describe the production of X-rays
2. Identify the function of each component in X-ray machine.
3. Explain the characteristics of X-rays.
4. Explain the interactions of X-rays with matter
5. Demonstrate the formation of image on the photographic plate.
6. Define the quality of image.
7. Acquire the knowledge of CT imaging system.
8. Explain the image reconstruction in CT system.
9. Acquire the knowledge of MRI system.
10. Define the principle of Cyclotron Betatron.
11. Describe the principle of Linacs and Co-60 teletherapy machine
12. Acquire the knowledge of applications of these machines for radiation therapy

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|

| | | |
|---|---|---|
| **1** | Production of X-rays | 1 |
| **1** | X-rays machine | 2 |
| **1** | Characteristics of X-ray | 3 |
| **1** | Production of Laser and ultrasound | 4 |
| **1** | Interaction of X-rays with matter/tissue | 5 |
| **1** | Image formation on photographic plate | 6 |
| **1** | Image quality | 7 |
| **1** | CT imaging system | 8 |
| **1** | Image reconstruction in CT system | 9 |
| **1** | Image formation in MRI system | 10 |
| **1** | Principle of cyclotron and Betatron for particle acceleration | 11 |
| **1** | Principle of Medical Linacs | 12 |
| **1** | Co-60 teletherapy machines | 13 |
| **1** | Radiation therapy using these machines | 14 |

***<u>Class Schedule:</u>***

- Lectures: Three 1.0 hour sessions per week.
- Tutorials: One 3.0 hours session per week.

***<u>Course Contribution to professional Component</u>***:

- Engineering science: 100%
- Engineering design: 0 %

***<u>Course Relationship to Program Outcomes:</u>***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **1** | **1** | **3** | **2** | **1** | **2** | **1** | **-** | **2** | **-** | **1** | **1** | **2** | **2** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | - | ٣ | هـ ن ٤٥٧ | NE 457 | Low Level Radioactive Waste Management |
| NE 451 | | | | | Prerequisites | |
| Radioactive waste classification, Radiation toxicity of Radiation sources, Medical radioactive waste, industrial Radioactive waste. Sorting. Storage and transportation of radioactive waste. Radiation protection in treatment of radioactive waste. | | | | | | |

***Textbook:*** J. H. Saling and A. W. Fentiman, Radioactive Waste Management. Taylor and Francis Editions; 2nd edition (2001).

***Reference:*** A. Rahman, Decommissioning and Radioactive Waste Management. Whittles Publishing; 1st edition (2008).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Define roles and responsibilities of individuals as they pertain to the low level waste certification program
2. Show an understanding of the radioprotection associated with radioactive waste and decommissioning
3. Describe the proper disposal of protective clothing used in hospitals
4. Show ways to reduce the amount of low radioactive waste level
5. Recognize approved radioactive waste containers
6. Show an understanding of the various rules governing waste management.
7. Present methods to use to ensure radiation exposure is maintained As Low As Reasonably Achievable or ALARA.
8. Identify the requirements that must be met before a waste container can be picked up.
9. Identify situations/circumstances requiring emergency response.

| *Duration in Weeks* | *Topic Covered During Class:* | NO |
|---|---|---|
| 2 | Define roles and responsibilities of individuals as they pertain to the low level waste certification program | 1 |
| 2 | Show an understanding of the radioprotection associated with radioactive waste and decommissioning | 2 |
| 2 | Describe the proper disposal of protective clothing used in hospitals | 3 |
| 2 | Show ways to reduce the amount of low radioactive waste level | 4 |
| 1 | Recognize approved radioactive waste containers | 5 |
| 2 | Show an understanding of the various rules governing waste management | 6 |
| 2 | Present methods to use to ensure radiation exposure is maintained As Low As Reasonably Achievable or ALARA | 7 |
| 1 | Identify the requirements that must be met before a waste container can be picked up | 8 |
| 2 | Identify situations/circumstances requiring emergency response | 9 |

***Class Schedule:***

- Lectures: Two 1.0 hour sessions per week.
- Tutorials: One 1.0 hour session per week.

***Course Contribution to professional Component***:

- Engineering science: 30 %
- Engineering design: 0 %
- Other 70 %

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **-** | **-** | **1** | **-** | **1** | **2** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **1** | **Highest Attainable Level of Learning** |

<table>
<tr><th colspan="4">Hours</th><th rowspan="2">Arabic Code/No</th><th rowspan="2">English Code /No</th><th rowspan="2">Course Title</th></tr>
<tr><th>Credit</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>٣</td><td>-</td><td>-</td><td>٣</td><td>هـ ن ٤٦٠</td><td>NE 460</td><td>Radioisotopes Applications II</td></tr>
<tr><td colspan="6">NE 360</td><td>Prerequisites</td></tr>
<tr><td colspan="7">Advanced applications of radioisotopes in medicine, agriculture and industry. Irradiation technology, radiography with neutrons, x-ray fluorescence. Sterilization of medical equipment, food irradiation, irradiation of polymers to improve their characteristics.</td></tr>
</table>

Faculties and departments requiring this course (if any): None

***Textbook:*** J. R. Woods and A. K. Pikaev, Applied Radiation Chemistry: Radiation Processing. John Wiley & Sons; (1994).

***References:*** R. L. Murry, Nuclear Energy. Butterworth-Heinemann; (2001).

G. Foldiak, Industrial Applications of Radioisotopes. Elsevier; (1996).

***Course Learning Objectives: By completion of the course, the students should be able to:***

1. Understand different characteristics of radiation sources used in this course
2. Define polymerization, curing and grafting
3. Understand polymer modification by radiation
4. Discuss the use of different radiation sources for the production of beneficial changes in materials and the use of modified products in different fields
5. Discuss the treatment of foodstuffs by ionizing radiation
6. Discuss the radiation sterilization of medical products
7. Discuss the radiation treatment of different types of industrial and municipal wastes
8. Discuss the beneficial changes in agriculture products through mutation caused by radiation
9. Discuss “SIT” for control of insect and mosquito
10. Discuss X-ray fluorescence spectrometry and its use for measuring trace amounts of some materials
11. Differentiate between x-ray and neutron radiography

12. Discuss the use of different types of radionuclides for medical diagnosis and therapy

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 50 min. x3 | Irradiation technology, Radiography with neutrons, X-ray fluorescence | 1&2 |
| 50 min. x3 | Irradiation of polymers to improve their characteristics | 3&4 |
| 50 min. x 3 | Food irradiation | 5&6 |
| 50 min. x 3 | Sterilization of medical products | 7&8 |
| 50 min. x3 | Applications in agriculture | 9 |
| 50 min. x3 | Medical applications | 10 |
| 50 min. x3 | Applications of radioisotopes in hydrology | 11 |
| 50 min. x 3 | Other applications | 12&13 |

***Class Schedule:***

Lectures: Three 50 minutes sessions per week

***Course Contribution to professional Component***:

- Engineering science: 100 %
- Engineering design: 0 %
- Other 0%

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | i | f | ABET Program Outcomes |
| 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | - | - | - | 1 | 2 | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| **3** | **-** | **1** | **3** | هـن ٤٦١ | **NE 461** | **Eddy Current Testing and Magnetic Particle Testing** |
| **NE 361** | | | | | **Prerequisites** | |
| Importance of NDT, Manufacturing processes and typical defects, Electro-magnetic theory<br>**EDDY CURRENT TESTING**: Fundamental principles of Eddy current testing, Equipments and accessories, Applications and limitations, Minimum requirements for testing, Standards, Case studies<br>**MAGNETIC PARTICLE TESTING**: Fundamental principles of magnetic particle testing, Techniques, Equipments and accessories, Applications and limitations, Minimum requirements for testing, Standards, Case studies. | | | | | | |

Faculties and departments requiring this course (if any): none

***Textbook:*** X. E. Gros, Applications of NDT Data Fusion. Springer; 1st edition (2001).

***Reference:*** P. E. Mix von John, Introduction to Non destructive Testing: A Training Guide.

Wiley & Sons; (2005).

***Course Learning Objectives:*** By completion of the course, the students should be able to:

1. understand the electricity theory
2. test some industrial components by Eddy current method (pipe industry, aeronautic industry, etc)
3. know the advantages and the limits of eddy current technique
4. record the test results
5. take a decision: acceptance or rejection of the tested components by evaluating the results according to the related standards (ASME, EN, etc.)
6. understand the theory of magnetism
7. test some industrial components by magnetic particle method (welded, cast, heat treated, and forged samples)
8. know the advantages and the limits of this technique

9. record the test results
10. take a decision: acceptance or rejection of the tested components by evaluating the results according to the related standards (ASME, EN, etc.)

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **2** | EDDY CURRENTS: Importance of NDT, Sciences of material, | 1 |
| **1** | manufacturing processes and defects | 2 |
| **2** | Fundamental principles, Eddy currents theory, | 3 |
| **1** | Equipments and testing procedures by Eddy currents, | 4 |
| **1** | The E.C testing applications, Limits of testing by Eddy currents, Minimum equipment recommended for practical. | 5 |
| **1** | Magnetic Particules: Materials, manufacturing and defects, | 6 |
| **1** | Physical principle, Method and technique of testing, | 7 |
| **1** | Equipments and accessories, Applications, Limit of the method, | 8 |
| **1** | Materials and equipment recommended for the practice. | 9 |

***Course Schedule:***

- Lecture: Three 1.0 hour sessions per week
- lab: one 3.0 hours session per week

***Course Contribution to professional Component:***

- Engineering science: 100%
- Engineering design: 0%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **2** | **2** | **2** | **1** | **-** | **2** | **1** | **2** | **2** | **1** | **2** | **2** | **1** | **2** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | 1 | 3 | هـ ن ٤٦٢ | NE 462 | Ultrasonic Testing And Liquid Penetrant Testing |
| NE 361 | | | | | Prerequisites | |

**ULTRASONIC TESTING**: Importance of NDT, Fundamental principles, Theory of ultrasounds (physical principles), Ultrasonic field characteristics, Sound velocity, Attenuation of ultrasounds, Testing techniques, Equipments, Composition and functioning of an ultrasonic instrument, Equipments characteristics, Signal visualization, Calibration and operating methods, Controlling the properties of the transducers, Distance Amplitude Correction (DAC) method, Determining the location of defects, Defects sizing methods, Typical defects in the industrial components, Limits of using UT, Minimum equipment recommended, Standards and test instructions, Case studies (welding, casting, rolling).
**LIQUID PENETRANT TESTING**: Physical principles, Testing procedure, Accessories and testing equipments, Application fields and limits of the method, Practical and typical class of accessories, Calibration blocks, Case studies (welding, casting, forging).

Faculties and departments requiring this course (if any): none

***Textbook:*** X. E. Gros, Applications of NDT Data Fusion. Springer; 1st edition (2001).

***Reference:*** P. E. Mix von John, Introduction to Non destructive Testing: A Training Guide.
Wiley & Sons; (2005).

***Course Learning Objectives:*** By completion of the course, the students should be able to:

Ultrasonic part of the course:

1. understand the interaction between the acoustical waves and the matter
2. calibrate the ultrasonic equipment, and then, to test some important industrial components such as welded, cast, forged, or rolled samples

3. know the advantages and the limits of ultrasonic technique
4. record the test results
5. take a decision: acceptance or rejection by evaluating the test results according to the related standards (ASME, EN, etc.)

Liquid penetrant part of the course:

6. test industrial components such as welded, cast, forged, or rolled samples by liquid penetrant method
7. know the advantages and the limits of liquid penetrant technique
8. record the test results
9. take a decision: acceptance or rejection of the tested components by evaluating the results according to the related standards (ASME, EN, etc.)

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **1** | Importance of NDT, Fundamental principles | 1 |
| **2** | Theory of ultrasounds (physical principles), Ultrasonic field characteristics, | 2 |
| **1** | Attenuation of ultrasounds, Testing Techniques methods, | 3 |
| **1** | Equipments, calibration and operating methods, Composition and functioning of an ultrasonic instrument, Equipments characteristics, | 4 |
| **2** | Signal visualization, Equipments calibration, Transducers check, | 5 |
| **1** | Distance Amplitude Correction (DAC), | 6 |
| **1** | Defects location, Defects sizing methods, | 7 |
| **1** | Testing applications by UT, Limits of using UT, | 8 |
| **2** | Defects types, | 9 |
| **1** | Minimum equipment recommended, | 10 |
| **1** | Instructions and procedures | 11 |
| **1** | **LIQUID PENETRANTS** : Physical principles, Testing procedure, Testing procedure, Accessories and testing equipments | 12 |
| **1** | The application fields, Limits of the method, Practical and typical class of accessories, Calibration blocks. | 13 |

***<u>Course Schedule:</u>***

- Lecture: Three 1.0 hour sessions per week
- lab: one 3.0 hours session per week

***<u>Course Contribution to professional Component:</u>***

- Engineering science: 100%
- Engineering design: 0%

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | i | f | ABET Program Outcomes |
| 2 | 2 | 2 | 1 | - | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | | 1 | 3 | هـن٤٦٣ | NE 463 | Industrial Radiography |
| NE 361 | | | | | Prerequisites: | |
| Importance of NDT, Physical principles of radiation and radiography (X-rays, Gamma rays), Equipments, Films, Film development: manual, automatic , Film parameters , Filters and screens: principle and their influences, Image quality , Other accessories (markers, densitometer, illuminator), Exposure techniques: geometrical configurations, Exposure time, Interpretation and test report , Applications and limitations, Safety and radiation protection, Case studies from different industrial applications. | | | | | | |

Faculties and departments requiring this course (if any): none

***Textbook:*** X. E. Gros, Applications of NDT Data Fusion. Springer; 1st edition (2001).

***Reference:*** P. E. Mix von John, Introduction to Non destructive Testing: A Training Guide.
Wiley & Sons; (2005).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. understand the interaction between the electromagnetic waves and the matter
2. to test some important industrial components (welded and cast samples) by X and Gamma rays
3. know the advantages and the limits of this technique
4. record the test results

5. take a decision: acceptance or rejection by evaluating the radiographic films according to the related standards (ASME, ASTM, EN, etc.)

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **2** | Importance of NDT, Physical principles of radiation and radiography (X-rays, Gamma rays), | 1 |
| **1** | Equipments (X-ray, Isotopes such as Ir192, Se75, Co60) | 2 |
| **1** | Films, Film development: manual, automatic , | 3 |
| **1** | Film parameters, Filters and screens: principle and their influences, Images quality, Other accessories (Markers, Densitometer, Illuminator), | 4 |
| **1** | Exposure techniques: geometrical configurations, | 5 |
| **1** | Exposure time, | 6 |
| **1** | Interpretation and testing report, | 7 |
| **1** | Applications, Limitations, | 8 |
| **1** | Safety and radiation protection (protection against radiation), | 9 |

***Course Schedule:***

- Lecture: Three 1.0 hour sessions per week
- lab: one 3.0 hours session per week

***Course Contribution to professional Component:***

- Engineering science: 100%
- Engineering design: 0%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **2** | **2** | **2** | **1** | **-** | **2** | **1** | **2** | **2** | **1** | **2** | **2** | **1** | **2** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| ٣ | - | - | ٣ | هـ ن ٤٦٤ | NE 464 | Radioanalytical Techniques |
| NE 340 | | | | | Prerequisites | |
| Theory of Atomic Absorption Spectrometry (AAS) and its instrumentation. Principles of atomization and background correction, calibration procedures and their applications. Theory of X-ray Fluorescence (XRF) as an analytical tool. Qualitative and quantitative analyses, computer applications in quantitative spectral analysis and their applications. General principles of Neutron Activation Analysis (NAA). Treatment of experimental data, use of some available computer software. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** E. Berman, Toxic Metals and their Analysis. Heyden & Sons; (2006).

***References:*** S. J. Haswell, Atomic Absorption Spectrometry. Elsevier; (2001).

B. L. Carson and J. L. McCann, Toxicology and Biological Monitoring Of Metals in Humans. Lewis Publishers Inc.; (1999).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Explain the theory of Atomic Absorption Spectrometry ( AAS)
2. Define and describe atomization, background correction and calibration of AAS

3. Discuss the applications of AAS for the measurement of trace elements in foodstuffs, biological samples
4. Discuss the theory of X-ray fluorescence ( XRF)
5. Apply the idea of XRF for the determination of trace elements
6. Explain the principle of Neutron Activation Analysis (NAA)
7. Apply the idea of NAA for the estimation of elemental concentrations in foodstuffs, biological samples etc.
8. Apply your idea of error calculation for the treatment of experimental data
9. Apply your computer skills for use of some available computer software.

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| 1 | Theory of Atomic Absorption Spectrometry( AAS) | 1 |
| 1 | Applications of AAS | 2 |
| 1 | Theory of X-ray Fluorescence ( XRF ) | 3 |
| 1 | Applications of XRF | 4 |
| 1 | Theory of Neutron Activation Analysis ( NAA) | 5 |
| 1 | Applications of NAA | 6 |
| 1 | Error calculations & analysis of experimental data | 7 |
| 1 | Applications of some available computer software | 8 |

***Class Schedule:***

Lectures: Three 45 min. sessions per week.

***Course Contribution to professional Component***:

- Engineering science: 100 %
- Engineering design: 0 %
- Other 0%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **1** | **-** | **1** | **2** | **1** | **-** | **1** | | **-** | **-** | **2** | **1** | **2** | **-** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | - | ٣ | هـ ن ٤٦٧ | NE 467 | Radiochemistry |
| NE 340, NE 351 | | | | | Prerequisites | |
| Theory and kinetics of radioactive decay, Chemical phenomenon in reactions and reactors, Chemical properties of radioactive elements, Chemical separation methods, Chemical aspect of nuclear energy, Isotope exchanges and radioactive tracer techniques in chemical applications, Preparation and use of some radiopharmaceuticals. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** G. Choppin, J. Rydberg and J-O Liljenzin. Radiochemistry and Nuclear Chemistry. Butterworth-Heinemann; 3rd edition (2001).

***Reference:*** W. D. Ehmann and D. E. Vance, Radiochemistry and Nuclear Methods of Analysis (Chemical Analysis: A Series of Monographs on Analytical Chemistry and its Applications). Wiley-Interscience; (1993).

***Course Learning Objectives: By completion of the course, the students should be able to:***

1. Show an understanding of the theory and kinetics of radioactive decay
2. Show an understanding of the theory and phenomena of nuclear reactions
3. Show an understanding of the nature and energetics of radioactivity,
4. Show an understanding of the chemical properties of radioactive elements

5. Show an understanding of the use of radioactive elements in the study of some biological and physical phenomena
6. Show an understanding of the radioactive tracer techniques in chemical applications
7. Know how Radiopharmaceuticals are used in routine use B001HPMWTE

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 2 | Theory and kinetics of radioactive decay | 1 |
| 2 | Chemical phenomenon in reactions and reactors | 2 |
| 2 | Chemical properties of radioactive elements | 3 |
| 2 | Chemical separation methods | 4 |
| 2 | Isotope exchanges | 5 |
| 2 | radioactive tracer techniques in chemical applications | 6 |
| 2 | Preparation and use of some radiopharmaceuticals | 7 |

***<u>Class Schedule:</u>***

- Lectures: Two 1.0 hour sessions per week.
- Tutorials: One 1.0 hour session per week.

***<u>Course Contribution to professional Component</u>***:

- Engineering science: 20 %
- Engineering design: 0 %
- Other 80 %

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **2** | **-** | **1** | **-** | **1** | **-** | **1** | **-** | **-** | **-** | **1** | **2** | **-** | **1** | **Highest Attainable Level of Learning** |

<table>
<tr><th colspan="4">Hours</th><th rowspan="2">Arabic Code/No.</th><th rowspan="2">English Code /No</th><th rowspan="2">Course Title</th></tr>
<tr><th>Credit</th><th>Tr.</th><th>Pr.</th><th>Th.</th></tr>
<tr><td>3</td><td>3</td><td>0</td><td>3</td><td>هـن٤٧٤</td><td>NE 475</td><td>Radiotherapy II</td></tr>
<tr><td colspan="5">NE 470</td><td colspan="2">Prerequisites</td></tr>
<tr><td colspan="7">Tumor treatment with high energy X-ray and with high energy electron beam from linear accelerators, and with neutron therapy through neutron capture, ionizing radiation treatment of tumor by means of directed beam, treatment by radioactive sealed and unsealed sources, measurement of dose, treatment planning.</td></tr>
</table>

Faculties and departments requiring this course (if any): None

***Textbook***: F. M. Khan, The Physics of Radiotherapy. Lippncott Williams & Wilkens. 3rd edition; (2003)

***References:*** W. R. Hendee, G. S. Ibbott, and I. G. Hendee, Radiation Therapy Physics. Wiley-Liss; 3rd edition (2004).

E.B. Podgorzak, Radiation Oncology Physics A Handbook for Teachers and Students. IAEA; (2005).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Describe a external beam radiation therapy system and break down into its main components, for each of the radiation therapy machines covered (Co-60, Linac, and Linac)
2. Describe a interall beam radiation therapy system and break down into its main components, for each of the radiation therapy machines covered (Breakytherapy)
3. Understand and Describe Radiation Treatment Plannning
4. Remember the terms associated with Radiotherapy
5. Remember the dose calculation parameters
6. Define and explain the key factors that affect radiotherapy treatment
7. Understand published scientific articles that relate to radiotherapy and be able to communicate their understanding in a professional manner.
8. Learn to communicate the physical principles behind radiotherapy technology and relevant applications
9. Practice and apply elements of active learning, develop team norms and writing skills.
10. Able to critically evaluate bodies of literature in radiotherapy applications
11. Integrate ideas from physics and engineering into medicine
12. See themselves as students who are much more educated about the physics of radiotherapy
13. Able to inform and educate others about the role of radiotherapy in personal and public life
14. Be excited about the physics of radiotherapy as a broad, complex, multifaceted field of study
15. Value the importance of precise language used in the field of radiotherapy as part of professionalism
16. Be able how to read assigned materials responsibly.

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **1** | **Classical radiation therapy**<br>• Dose Distribution and scatter analysis | 1 |
| **1** | • A system of dosimetric calculations<br>• Treatment Planning I: Isodose distributions | 2 |
| **2** | • Treatment Planning II: Patient Data corrections and setup<br>• Treatment Planning III: Field shaping , skin dose, and field separation | 3 |
| **1** | • Electron Beam Therapy | 4 |
| **1** | • Brachytherapy | 5 |
| **1** | • Radiation Projection<br>• Quality Assurance<br>• Total Body Irradiation | 6 |
| **1** | **Modern Radiation Therapy**<br>Three-dimentional conformal radiation therapy | 7 |
| **1** | • Intensity-modulated radiation therapy | 8 |

| | | |
|---|---|---|
| **1** | • Stereotactic Radiosurgery | 9 |
| **1** | • High dose Rate Brachytherapy | 10 |
| **1** | • Protstate Implants | 11 |
| **1** | • Intravascular Brachytherapy | 12 |
| **1** | • Intravascular Brachytherapy | 13 |

***Class Schedule:***

- Lecture: three one hour session per week
- Tutorials: three hours session per week

***Course Contribution to professional Component:***

- Engineering science: 100%
- Engineering design: 0%

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills And Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **i** | **f** | **ABET Program Outcomes** |
| **3** | **-** | **2** | **2** | **3** | **2** | **2** | **-** | **1** | **-** | **1** | **3** | **2** | **2** | **Highest Attainable Level of Learning** |

| **Hours** | | | | **Arabic Code/No.** | **English Code /No** | **Course Title** |
|---|---|---|---|---|---|---|
| **Credit** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **-** | **-** | **٣** | **هـ ن ٤٧٨** | **NE 478** | **Quality Assurance Of Medical Equipments** |
| **NE 340, NE370, NE 451** | | | | | **Prerequisites** | |
| Quality assurance of radiation protection in medical centers. Quality control and testing techniques for all types of diagnostic x-ray machine and nuclear medicine imaging equipment. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** C. J. Martin and D. G. Sutton, Practical Radiation Protection in Healthcare.
Oxford University Press; (2002).

***Reference:*** S. C. Bushong, Radiation Science for Technologists. Elsevier-Mosby; (2008).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Describe general and mobile x-ray machines and parameters.
2. Describe Mammography and Fluoroscopy machines and parameters.
3. Describe CT Machines and parameters.
4. Define resolution, contrast, surface dose, HVL. Focal spot size.
5. Define accuracy, consistency, reproducibility in QC measurements
6. Describe equipment used for QC of diagnosis x ray equipments
7. Measure accuracy, consistency, reproducibility in QC of x-ray machines
8. Measure Entrance Surface Dose and Dose-Area Products
9. Calculate errors in QC measurements.
10. Measure leakage radiation, scattered radiation and primary radiation
11. Describe radiation safety aspects in medical centers

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **2** | General properties of x-ray machines | 1 |
| **1** | Mammography and Fluoroscopy machines and parameters | 2 |
| **1** | CT Machines and parameters | 3 |
| **3** | Quality control parameters in diagnostic x-ray machines | 4 |
| **1** | x-ray machine radiation measurements | 5 |
| **2** | Workers and patient safety aspects in diagnostic x-ray machines rooms | 6 |
| **1** | Patient dose measurements | 7 |
| **1** | Equipment check | 8 |
| **2** | Nuclear medicine QC | 9 |

***Class Schedule*:**

- **Lecture**: Two 1.0 hour sessions per week
- **Tutorials**: Three 2.0 hours sessions per week

***Course Contribution to professional Component*:**

- Engineering Science: 90 %
- Engineering Design: 10 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **f** | **i** | **ABET Program Outcomes** |
| **2** | **3** | **1** | **1** | **2** | **3** | **-** | **1** | **1** | **1** | **3** | **2** | **3** | **1** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | - | ٣ | هـ ن ٤٢٢ | NE 422 | **Nuclear Power Planning & Project Implementation** |
| NE 311 | | | | | Prerequisites | |
| Methods of long-range forecasting of power demand, calculations of cost of generation of electricity from nuclear and conventional power plants, selection of an optimum system expansion program, preparation of feasibility studies, bid documents and evaluation of bids, type of contracts, project management and use of available nuclear power planning computer codes. | | | | | | |

Faculties and departments requiring this course (if any): none

***Textbook:*** Consideration to Lunch a Nuclear Power Program. IAEA; (2007).

***Reference:*** Harry Henderson, Nuclear Power: A Reference Handbook. ABC-CLIO edition; (2000).

***Course Learning Objectives: By completion of the course, the students should be able to:***

1. Discuss management organization
2. Review feasibility studies
3. Discuss sitting of power plants
4. Discuss human resources development,
5. Discuss societal problems associated with the choice of nuclear power energy over other sources of energy
6. Describe emergency plans

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **2** | Methods of long-range forecasting of power demand | 1 |
| **2** | Calculations of cost of generation of electricity from nuclear and conventional power plants | 2 |
| **2** | Selection of an optimum system expansion program | 3 |
| **2** | type of contracts | 4 |
| **3** | Preparation of feasibility studies, bid documents and evaluation of bids | 5 |
| **2** | Project management and use of available nuclear power planning computer codes. | 6 |

***Class Schedule:***

- **Lecture**: Two 1.0 hour sessions per week
- **Tutorials**: One 1.0 hours sessions per week

***Course Contribution to professional Component:***

- Engineering Science: 80 %
- Engineering Design: 20 %

***Course Relationship to Program Outcomes:***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **f** | **i** | **ABET Program Outcomes** |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 3 | - | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 1 | 3 | - | **Highest Attainable Level of Learning** |

| **Hours** | | | | **Arabic Code/No.** | **English Code /No** | **Course Title** |
|---|---|---|---|---|---|---|
| **Credit** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **-** | **-** | **٣** | **هـ ن ٤٧٧** | **NE 477** | **Advanced Medical Imaging** |
| **NE 474** | | | | | **Prerequisites** | |
| Image processing, image enhancement, linear and nonlinear filters, segmentation techniques, rigid and affine registration techniques, 3D visualization techniques: surface and volume rendering, morphometric quantitative measurements from medical image data; surface area, volume, and shape index. image processing algorithms, programs in Matlab that implement signal processing methods and estimators used in medical imaging. | | | | | | |

Faculties and departments requiring this course (if any): None

***Textbook:*** J.E. Bushberg, J.A. Seibert, E.M. Leidholdt JR, and J.M. Boone, The Essential Physics of Medical Imaging. Lippncott Williams & Wilkens Editions; 2nd edition (2002).

***Reference:*** P. Suetens, Fundamentals of Medical Imaging. Cambridge University Press; (2002).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Explain the signal processing involved in making a B-mode ultrasound image.
2. Explain signal processing methods for estimating blood velocity using ultrasound.
3. Explain back-projection algorithms used in CT, MR, and PET scanners.
4. Write programs in Matlab that implement signal processing methods and estimators used in medical imaging.
5. Give a quantitative evaluation of signal and image processing algorithms in terms of performance and accuracy.
6. Write a scientific report explaining a signal processing algorithm implementation made in Matlab and quantifying its performance.

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **2** | Image processing, image enhancement | 1 |
| **1** | linear and nonlinear filters | 2 |
| **1** | segmentation techniques | 3 |
| **1** | rigid and affine registration techniques | 4 |
| **1** | x-ray machine radiation measurements | 5 |
| **3** | 3D visualization techniques | 6 |
| **3** | Write programs in Matlab that implement signal processing methods and estimators used in medical imaging. | 7 |

***Class Schedule*:**

- **Lecture**: Two 1.0 hour sessions per week
- **Tutorials**: One 1.0 hours sessions per week

***Course Contribution to professional Component*:**

- Engineering Science: 70 %
- Engineering Design: 30 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | f | i | ABET Program Outcomes |
| 3 | 2 | 3 | - | 1 | - | 1 | - | 3 | - | 3 | 3 | - | - | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | - | ٣ | هـن ٤٢٤ | NE 424 | Thermo Nuclear Fusion Technology |
| NE 302, MEP 261 | | | | | Prerequisites | |

Fusion requirements, fundamentals of plasmas at thermonuclear burning. Plasma confinement and heating, materials, reactor control, plant construction and maintenance. Dynamics, stability, and control. Fusion fuel production. Applications in tokamaks. Fusion-fission hybrid reactor, radiation sources in fusion plants and safety of nuclear fusion.

Faculties and departments requiring this course (if any): none

***Textbook:*** V. A. Stefan, Laser Thermonuclear Fusion: Research Review. Stefan University Press; (2008).

***Reference:*** Ma. Davoudi, Mo. Davoudi and G. Dantona, Diagnosis of Electron Cyclotron Heating Power Deposition on Plasma: For Controlling Thermonuclear Fusion Power in Tokamaks, VDM Verlag; (2010).

***Course Learning Objectives: By completion of the course, the students should be able to:***

1. Describe and distinguish different mechanisms of wall erosion and fuel retention.
2. Explain and assess the impact of physical and chemical processes on erosion of wall material.
3. Critically assess and motivate material choice for respective plasma-facing components.
4. Compare and assess fuel inventory in different wall materials and assess its impact on the fuel cycle.
5. Evaluate power loads to the wall during normal operation, disruptions and edge localised modes.
6. Relate thermo-mechanical properties of materials (CFC, W, Be) to their response to power loads
7. Relate wall erosion to its impact on plasma operation.
8. Explain causes for dust formation and assess the risk of such process for the reactor operation.
9. Select methods for studies (analysis) and qualification of wall materials.
10. Apply knowledge to experiment planning and conceptual design of: diagnostic for erosion-deposition measurement and propose the use of diagnostic for specific experiments in a controlled fusion device; plasma-facing components for testing under reactor conditions.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **2** | Fusion requirements, fundamentals of plasmas at thermonuclear burning | 1 |
| **2** | Plasma confinement and heating, materials, reactor control, plant construction and maintenance | 2 |
| **2** | Dynamics, stability, and control | 3 |
| **2** | Fusion fuel production | 4 |

| | | |
|---|---|---|
| 2 | Applications in tokamaks | 5 |
| 2 | Fusion-fission hybrid reactor, | 6 |
| 3 | Radiation sources in fusion plants and safety of nuclear fusion. | 7 |

***Class Schedule:***

- **Lecture**: Two 1.0 hour sessions per week
- **Tutorials**: One 1.0 hours sessions per week

***Course Contribution to professional Component:***

- Engineering Science: 100 %
- Engineering Design: 0 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | f | i | ABET Program Outcomes |
| 2 | 2 | 3 | - | 2 | 1 | 2 | 2 | - | 1 | 1 | 2 | - | - | Highest Attainable Level of Learning |

| Hours | Arabic | English Code | Course Title |
|---|---|---|---|

| Credit | Tr. | Pr. | Th. | Code/No. | /No | |
|---|---|---|---|---|---|---|
| 3 | - | 1 | ٢ | هـ ن ٤٤٠ | NE 440 | **Nuclear Electronics** |
| **NE 340** | | | | | **Prerequisites** | |
| Conduction in solids. Semi-conductor devices, pulse amplifiers, pulse height discriminators, digital storage and counting circuits, timing circuits, multi-channel pulse height analysis. Data acquisition systems. | | | | | | |

Faculties and departments requiring this course (if any): none

***Textbook:*** V Polushkin, Nuclear Electronics: Superconducting Detectors and Processing Techniques. Wiley; 1st edition; (2004).

***Reference:*** S. Tavernier, Experimental Techniques in Nuclear and Particle Physics. Springer; 1st edition, (2010).

***Course Learning Objectives: By completion of the course, the students should be able to*:**

1. Demonstrate an understanding conduction in solids
2. Describe qualitatively and quantitatively the pulse amplifying process
3. Explain qualitatively and quantitatively the pulse height discriminators
4. Explain the characteristics and uses of nuclear detectors and calculate their properties (efficiency, energy resolution, time resolution, pulse-pair resolution, dead-time).
5. Be familiar with the multi-channel analyzer

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **2** | Conduction in solids | 1 |
| **1** | Semi-conductor devices | 2 |
| **2** | Pulse amplifiers, pulse height discriminators | 3 |
| **2** | Digital storage and counting circuits | 4 |
| **2** | Timing circuits | 5 |
| **2** | Multi-channel pulse height analysis | 6 |
| **3** | Data acquisition systems. | 7 |

***Class Schedule*:**

- **Lecture**: Two 1.0 hour sessions per week
- **Tutorials**: Two 1.0 hours sessions per week

***Course Contribution to professional Component*:**

- Engineering Science: 70 %
- Engineering Design: 30 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | f | i | ABET Program Outcomes |
| 2 | 2 | 3 | - | 1 | - | - | - | - | 1 | 3 | 2 | - | - | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | 2 | ٢ | هـ ن ٤٥٨ | NE 458 | Radiation Emergency Planning |
| NE 451 | | | | | Prerequisites | |
| Plans and simulations of a real emergency case, spilling of open sources, losing radioactive sources, safety of sources during fire, spreading of radioactive sources, use and calibration of radiation protection related equipment. Visits to radiation facilities and reviewing their radiation protection rules and regulations and emergency plans. Calculation and assessment of doses following an accident, dealing with workers and public in emergency, reasonability of the workers in emergency, treating highly exposed people, emergency records. | | | | | | |

Faculties and departments requiring this course (if any): none

***Textbook:*** A. Ansari, Radiation Threats and Your Safety: A Guide to Preparation and Response for Professionals and Community. Chapman and Hall/CRC; 1st edition, (2009).

***Reference:*** Kenneth L. Miller Handbook of Management of Radiation Protection Programs. CRC Science; 2nd edition, (1992).

***Course Learning Objectives: By completion of the course, the students should be able to:***

1. Recognize the types of emergencies and disasters that can impact nuclear facilities
2. Understand the phases of emergency management
3. Classify emergency levels (unusual event, alert, site area emergency, general emergency)
4. Review the purpose of the Incident Command System
5. Describe key tasks to any evacuation
6. Apply the protective actions to minimize the public, livestock and farm exposures
7. Use and calibrate radiation protection related equipment
8. Calculate and assess of doses following an accident.

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| 2 | Types of emergencies and disasters that can impact nuclear facilities | 1 |
| 1 | Phases of emergency management | 2 |
| 2 | Emergency levels | 3 |
| 1 | key tasks to any evacuation | 4 |

| | | |
|---|---|---|
| **2** | Protective actions to minimize the public, livestock and farm exposures | 5 |
| **3** | Calculation and assessment of doses following an accident | 6 |
| **2** | Use and calibration radiation protection related equipment | 7 |

***<u>Class Schedule</u>:***

- **Lecture**: Two 1.0 hour sessions per week
- **Tutorials**: Two 1.0 hours sessions per week

***<u>Course Contribution to professional Component</u>:***

- Engineering Science: 100 %
- Engineering Design: 0 %

***<u>Course Relationship to Program Outcomes:</u>***

| **Communication, IT, and Numerical Skills** | | | **Interpersonal Skills and Responsibility** | | | **Cognitive Skills** | | | | | | **Knowledge** | | **NCAAA Domains of Learning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **f** | **i** | **ABET Program Outcomes** |
| **-** | **-** | **3** | **-** | **1** | **-** | **1** | **1** | **-** | **3** | **-** | **2** | **3** | **-** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| **Credit** | **Tr.** | **Pr.** | **Th.** | | | |
| **3** | **-** | **-** | **٣** | **هـ ن ٤٢٣** | **NE 423** | **Nuclear Reactor Safety** |
| **NE 321, NE 411** | | | | | **Prerequisites** | |
| Safety philosophies and safety criteria, design criteria and regulations, deterministic and probabilistic models, risk assessment, reactor accidents, engineering safety features, release and dispersal of radioactive materials and radiological consequences, reactor licensing. | | | | | | |

Faculties and departments requiring this course (if any): none

***Textbook:*** D. G. Cacuci, Nuclear Reactor Safety Systems. Woodhead Publishing Ltd; (2011).

***Reference:*** G. Keßler, Sustainable and Safe Nuclear Fission Energy: Technology and Safety of Fast and Thermal Nuclear Reactors (Power Systems). Springer; 1$^{st}$ Edition, (2011).

***Course Learning Objectives: By completion of the course, the students should be able to:***

1. Perform safety calculations in support of the preparation of an abbreviated Safety Analysis Report for an advanced reactor.
2. Develop and quantify simplified fault and event trees for an advanced reactor.
3. Prepare a seismic analysis for a nuclear power reactor.
4. Prepare an abbreviated Safety Analysis Report for an advanced reactor.
5. Interpret the Nuclear Regulatory Commission’s requirements and policy statements for an advanced reactor system.
6. Make a formal presentation on the results of their analyses to a “mock” safety review board.
7. Demonstrate the strengths and weaknesses in an advanced reactor design.

| ***Duration in Weeks*** | ***Topic Covered During Class:*** | ***NO*** |
|---|---|---|
| **2** | Safety philosophies and safety criteria | 1 |
| **2** | Deterministic and probabilistic models, risk assessment | 2 |
| **2** | Reactor accidents | 3 |
| **2** | Engineering safety features | 4 |
| **2** | Release and dispersal of radioactive materials and | 5 |

| | | |
|---|---|---|
| | radiological consequences | |
| **3** | Calculation and assessment of doses following an accident | 6 |
| **2** | Reactor licensing | 7 |

***Class Schedule:***

- **Lecture**: Two 1.0 hour sessions per week
- **Tutorials**: Two 1.0 hours sessions per week

***Course Contribution to professional Component:***

- Engineering Science: 100 %
- Engineering Design: 0 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **k** | **g** | **i** | **d** | **f** | **j** | **h** | **e** | **c** | **b** | **a** | **f** | **i** | **ABET Program Outcomes** |
| **1** | **-** | **3** | **-** | **1** | **2** | **1** | **2** | **1** | **-** | **-** | **1** | **3** | **-** | **Highest Attainable Level of Learning** |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | - | ٣ | هـن٤٢٧ | NE 427 | **Nuclear Reactor Design** |
| **NE 411, NE 421** | | | | | **Prerequisites** | |
| Specifications of the principal parameters in reactor design (economic analysis to determine capital and operating costs, fuel management and fuel cycle optimization). Selection of fuel and cladding. Thermal Hydraulics design (convective and/or boiling heat transfer at fuel element surface, pressure drops, heat exchanger calculations, thermodynamic cycle efficiency, steam turbine reheat and regeneration, preheating and inlet sub-cooling). Use of computer codes to solve realistic design problems involving, criticality, fuel management, thermal hydraulics and shielding. Design and subsequent optimization of an entire system. | | | | | | |

Faculties and departments requiring this course (if any): none

***Textbook:*** D. G. Cacuci, Handbook of Nuclear Engineering: Vol. 2: Reactor Design.
Springer; 1st edition, (2010).

***Reference:*** A. Agung, Conceptual Design of a Fluidized Bed Nuclear Reactor: Statics,
Dynamics and Safety-related Aspects. IOS Press; (2007).

***Course Learning Objectives: By completion of the course, the students should be able to:***

1. Demonstrate competence in neutronic aspects of nuclear reactor design
2. Understand both qualitatively and quantitatively neutron transport in practical nuclear reactor systems
3. Solve the one-speed neutron diffusion equation for a variety of situations;
4. Analyze nuclear reactor fuel and core steady-state thermal performance;
5. Couple the reactor neutronics to the core thermal-hydraulics in a design environment.
6. Understand the nuclear power plant systems, licensing, design, operation & maintenance, safety, and security
7. Perform a general design and nuclear safety analysis for a simple reactor system

| Duration in Weeks | Topic Covered During Class: | NO |
|---|---|---|
| **2** | Atomic and Nuclear Physics | 1 |
| **3** | Reactor Heat Removal | 2 |
| **2** | Radiation Protection and Shielding | 3 |
| **2** | Nuclear Fuel Cycle | 4 |
| **2** | Neutron Diffusion and Moderation | 5 |
| **2** | Materials: selection of fuel and cladding, corrosion | 6 |
| **2** | Pressure Vessel: stress calculations, materials selection/thicknesses | 7 |
| **2** | Safety: temperature and void coefficients, emergency cooling, hazards considerations | 8 |
| **2** | Nuclear Power Plant Licensing | 9 |

***Class Schedule:***

- **Lecture**: Two 1.0 hour sessions per week
- **Tutorials**: Two 1.0 hours sessions per week

***Course Contribution to professional Component:***

- Engineering Science: 70 %
- Engineering Design: 30 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | f | i | ABET Program Outcomes |
| 2 | 1 | 3 | - | - | - | 1 | 1 | 2 | 2 | 3 | 2 | 3 | - | Highest Attainable Level of Learning |

| Hours | | | | Arabic Code/No. | English Code /No | Course Title |
|---|---|---|---|---|---|---|
| Credit | Tr. | Pr. | Th. | | | |
| 3 | - | 2 | ٢ | هـ ن ٤٧٩ | NE 479 | Brachytherapy |
| NE 470 | | | | | Prerequisites | |
| Physics and dose calculation, introduction to radiobiology, use of radiation sources in radiotherapy, preparation of sources and their applications, brachytherapy planning technique: reconstruction, points and axes, positioning, normalization, prescription, optimization techniques including geometric, volumetric and inverse, plan evaluation and outputs, principles of treatment: LDR, HDR, PDR cervix, UTM; prostate HDR, permanent seeds; breast; X- ray, CT, MRI imaging and target definition. | | | | | | |

Faculties and departments requiring this course (if any): none

***Textbook:*** F. M. Khan, The Physics of Radiation Therapy, Williams & Wilkins (2009).

***Reference:*** G. Bentel, Radiation Therapy Planning. McGraw-Hill Professional; 2nd edition (1995).

| *Duration in Weeks* | *Topic Covered During Class:* | *NO* |
|---|---|---|
| **2** | Physics and dose calculation | 1 |
| **3** | Introduction to radiobiology | 2 |
| **2** | Use of radiation sources in radiotherapy | 3 |
| **3** | Preparation of sources and their applications in brachytherapy techniques | 4 |
| **3** | Principles of treatment | 5 |
| **2** | Optimization techniques | 6 |

***Class Schedule:***

- **Lecture**: Two 1.0 hour sessions per week
- **Practicals**: Two 1.0 hours sessions per week

***Course Contribution to professional Component***:

- Engineering Science: 70 %
- Engineering Design: 30 %

***Course Relationship to Program Outcomes:***

| Communication, IT, and Numerical Skills | | | Interpersonal Skills and Responsibility | | | Cognitive Skills | | | | | | Knowledge | | NCAAA Domains of Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | k | g | i | d | f | j | h | e | c | b | a | f | i | ABET Program Outcomes |
| - | - | 3 | - | 2 | 1 | 1 | - | - | 1 | 1 | - | 3 | - | Highest Attainable Level of Learning |

# DEPARTMENT OF PRODUCTION ENGINEERING AND MECHANICAL SYSTEMS DESIGN

# INTRODUCTION

The Mechanical Engineering Department was established in the year (1395 H / 1975) to satisfy the needs of the development plans in the Kingdom .Production Engineering was a branch of specialization in the Department.
The university council in (1402 H / 1982), rearranged Department of Mechanical Engineering into three Departments; Production Engineering and Mechanical Systems Design, Thermal Engineering and Desalination and Aeronautical Engineering.

The specialization of the Department of Production Engineering and Mechanical Systems Design encompasses wide fields of Mechanical Engineering activities. These include design, manufacturing and control of mechanical systems, as well as their subsystems and components. In addition to teaching, the Department is naturally engaged in research and development works in these areas. The Department has three main scientific fields:

- Machine Design,
- Manufacturing Engineering, and
- Applied Mechanics.

The Mechanical Engineer who graduates from the Department is a potential candidate to become one of the pillars of any design, development or manufacturing activity in the industry and society.

The Department is involved in teaching engineering courses to both undergraduate and graduate students. It offers a variety of opportunities for the acquisition of mental and technical skills. These prepare the student for the exciting challenges of a mechanical engineering career. In addition to striving to keep high standards in analytic capabilities, the Department attaches ample importance to the hands-on training of students by undertaking experimental work in the various areas of study.

The Department also participates in research activities that are relevant to the requirements of the country and the region. Continuous efforts are being made to boost the cooperation with the local industry. This is accomplished by offering consultations and organizing seminars, courses, meetings and visits with the objective of knowledge transfer between university and industry.

# VISION AND MISSION STATEMENTS

## The Vision of the Department

Innovation and leadership in education of mechanical and production engineering, applied research, and community services.

## The Mission of the Department

To educate, train and produce highly qualified mechanical engineering personnel inspired with ethical and Islamic values and to conduct scientific research and studies which collectively allow for a sustainable development of the society.

# EDUCATIONAL OBJECTIVES

Production Engineering and Mechanical Systems Design Department is preparing its graduates to

- Practice mechanical and production engineering in the general areas of mechanical systems design, materials and manufacturing.
- Engage in successful careers and leadership positions in industry, government, and academia.
- Practice engineering in a responsible, professional and ethical manner in global and societal context.

## Programs Offered

The Department confers Bachelors as well as Master's Degrees in Mechanical Engineering (Production Engineering and Mechanical Systems Design). The specialization encompasses wide fields of mechanical engineering activities. These include design, manufacturing, control and applied mechanics of mechanical systems, as well as their subsystems.

The Department courses offer a variety of opportunities for the acquisition of mental and technical skills, high standards in analytical capabilities and practical experimental work. Also, the courses address economical, ethical and social aspects of the engineering profession.

The Department actively participates in research activities, consultations, seminars, short courses and meetings with the local industry with the objective of knowledge transfer between the department and the industry.

## Aspects of Development

The department of the Mechanical Engineering (Production Engineering and Mechanical Systems Design) has most of the necessary resources needed to implement the new plan, however, some improvements and extra resources are needed to increase the ability of the department to accommodate more students considering the increase in demand for Mechanical Engineers (Production Engineering and Mechanical Systems Design graduates) for the expanding industries in the Kingdom. Future plans should consider the followings:-

24. Modernization and upgrading of existing manufacturing Labs
25. Modernization and upgrading of existing CNC Lab
26. Modernization and upgrading of existing Mechanics of materials Lab
27. Modernization and upgrading of existing dynamics and control Lab
28. Establishment of a new nondestructive testing lab
29. Establishment of a new nonconventional machining lab
30. Establishment of a new computer aided manufacturing lab
31. Establishment of a new mechatronics lab
32. Recruiting high professionals to operate and maintain laboratory equipment.
33. Recruiting additional faculty members in department specializations

# ADMISSION AND GRADUATION REQUIREMENTS

## Students Admissions into the Department Program

The actual policy of the department is to accept, each semester, a fixed number of students; normally between 25 and 30 with GPA not less than 3.5; from those expressing their interest to join the department.

## Graduation Requirements

In order to qualify for a B.Sc. degree in Mechanical Engineering (Production Engineering and Mechanical Systems Design), students must successfully complete 155 credit units with an overall GPA of 2.75 out of 5 or better. The student has to complete 49 required courses and two elective courses with a grade of D or better including 10 weeks of Industrial Summer Training and a Capstone B.Sc. design project.

## CAREER OPPORTUNITIES

The Mechanical Engineering graduate (from Production Engineering and Mechanical Systems Design) represents a potential candidate to become one of the pillars of any design, development or manufacturing activity in the industry and the society.

Graduates of the Department find good opportunities in the industrial sector to work in the following:

- Analysis and design of machinery, equipments and material handling systems.
- Automatic control systems including hydraulic and pneumatic.
- Production, manufacturing techniques and automations.
- Testing, measurement, inspection and quality control of products.
- Maintenance, failure analysis and fault diagnosis of mechanical systems.

## PROGRAM REQUIREMENTS AND CURRICULUM

## Key to Course Numbers and Department Code

Each course is referred to by an alphabetical code and a three digits number as follows:

17. Production Engineering and Mechanical Systems Design Department is referred to by the code "MENG"
18. The hundredth digit refers to the school year
19. The tenth digit refers to specialty within the department as indicated in the table.
20. The ones digit refers to course serial within the same specialty

Key of tenth digit in the codes of MENG courses

| Tens Digit | Specialty |
|---|---|
| 0 | Fundamentals |
| 1 | Design |
| 2 | Design |
| 3 | Production and Manufacturing |
| 4 | Production and Manufacturing |
| 5 | Production and Manufacturing |
| 6 | Applied Mechanics |
| 7 | Applied Mechanics |
| 8 | Applied Mechanics |
| 9 | Training and Projects |

### Units Required for the B.Sc. Degree

Units required for the B.Sc. degree in the Production Engineering and Mechanical Systems Design Department

### Conventional Program

| Requirements | Cr. Hrs |
|---|---|
| University Requirements (including the prep year) | 41 |

| | |
|---|---|
| Faculty Requirements | 37 |
| Departmental Requirements (Compulsory) | 69 |
| Departmental Requirements (Electives) | 6 |
| Summer Training | 2 |
| **Total** | **155** |

## Cooperative Program

| **Requirements** | **Cr. Hrs** |
|---|---|
| University Requirements (including the prep year) | 41 |
| Faculty Requirements | 37 |
| Departmental Requirements (Compulsory) | 69 |
| Coop Program | 8 |
| **Total** | **155** |

## Department Compulsory Courses

Regular students are required to take 71 credits (2٤ courses) as indicated in the table.

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| MENG 130 | Basic Workshop | 2 | MENG 102 |
| CE 201 | Engg. Mechanics (Statics) | 3 | PHYS 281 |
| MENG 204 | Mechanical Engineering Drawings | 3 | MENG 130 |
| ChE 210 | Material Science | 4 | CHEM 281 |
| MEP 261 | Thermodynamics I | 3 | MATH 202,PHYS 281 |
| MENG 262 | Engg. Mechanics (Dynamics) | 3 | CE 201 |
| MENG 270 | Mechanics of Materials | 3 | CE 201 |
| MEP 290 | Fluid Mechanics | 3 | MATH 202, PHYS 281 |
| MENG 310 | Machine Elements Design | 3 | MENG 270 |
| MENG 332 | Manufacturing Technology | 3 | MENG 130, ChE 210 |
| MEP 360 | Heat Transfer | 3 | MEP 290, MEP 261, IE 202 |
| MEP 361 | Thermodynamics II | 3 | MEP 261, MEP 290 |
| MENG 364 | Machine Dynamics | 3 | MENG 262,MATH 205 |
| MENG 366 | System Dynamics and Control | 3 | MENG 262 |
| MENG 390 | Summer Training* | 2 | MENG 332 |
| MENG 410 | Mechanical Design | 3 | MENG 204,MENG 310 |
| MENG 412 | Computer Aided Design | 3 | MENG 410 |
| MENG 434 | Material Removal Processes | 3 | MENG 332 |
| MENG 436 | Metrology & Quality Control | 3 | MENG 434 |
| MEP 451 | Refrigeration & A/C I | 3 | MEP 360, MEP 361 |
| MENG 452 | Manufacture Planning & Shop Loading | 3 | MENG 434 |
| MENG 470 | Mechanical Vibrations | 3 | MATH 204,MENG 364 |
| MENG 472 | Fault Diagnosis of Mechanical Systems | 2 | MENG 470 |
| MENG 499 | Senior Project | 4 | MENG 410,MENG434 |
| Total | | 71 | |

MENG 390 – the summer training, 400 hours of on-job training distributed over 10 weeks that is included in the counting of training units.

Coop students are required to take all of the above mentioned 25 courses except MENG 390 which is replaced by the following course:

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| MENG 400 | Coop Work Program | 8 | MENG 332 |

## Department Elective Courses

Regular students select 2 courses (6 credit units) out of those in the table. For coop students no elective courses are required.

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| MENG 408 | Reverse Engineering | 3 | MENG 310 |
| MENG 416 | Material Selection in Design & Manufacturing | 3 | MENG 270, MENG 332 |
| MENG 418 | Machine Tool Design | 3 | MENG 410, MENG 434 |
| MENG 420 | Introduction to Finite Element Methods | 3 | MENG 204, MENG 270 |
| MENG 422 | Tribology | 3 | MENG 410 |
| MENG 424 | Design of Production Facilities | 3 | MENG 410, MENG 434 |
| MENG 428 | Special Topics in Mechanical Systems Design | 3 | MENG 310 |
| MENG 446 | Advanced Manufacturing Technology | 3 | MENG 434 |
| MENG 448 | Composite Materials | 3 | MENG 270, MENG 332 |
| MENG 450 | Computer Aided Manufacturing | 3 | MENG 204, MENG 434 |
| MENG 454 | Welding Technology | 3 | MENG 332 |
| MENG 458 | Special Topics in Production Engineering | 3 | MENG 332 |
| MENG 468 | Plasticity and Metal Forming | 3 | MENG 270, MENG 332 |
| MENG 476 | Mechanical System Modeling & Simulation | 3 | MENG 366 |
| MENG 478 | Mechanisms | 3 | MENG 364 |
| MENG 480 | Introduction to Robotics | 3 | MENG 364 |
| MENG 482 | Mechatronics | 3 | MENG 366 |
| MENG 488 | Special Topics in Applied Mechanics | 3 | MENG 364 |
| MENG 490 | Strategic Management and Leadership Skills | 3 | IE 201 |
| XXX 4xx | Elective Course from Faculty Depts. | 3 | Dept. Approval |

- Each one theoretical hour calculated as one credit unit
- Each two or three practical hour calculated as one credit unit
- There is no circumstance for training hour (not counted in credit calculations)

# A TYPICAL B.Sc. PROGRAM FOR MENG DEPARTMENT

## 3rd Year (Regular & Cooperative)

### 5th Semester / 6th Semester

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| MENG 130 | Basic Workshop | 2 | ISLS 201 | Islamic Culture (2) | 2 |
| CE 201 | Engg. Mechanics (Statics ) | 3 | MENG 204 | Mechanical Engineering Drawing | 3 |
| IE 202 | Introduction to Engineering Design II | 2 | EE 251 | Basic Electrical Engineering | 4 |
| MATH 205 | Series &Vector Calculus | 3 | MENG 262 | Engg. Mechanics, (Dynamics) | 3 |
| ChE 210 | Material Science | 4 | MENG 270 | Mechanics of Materials | 3 |
| MEP 261 | Thermodynamics I | 3 | MEP 290 | Fluid Mechanics | 3 |
| | Total | ١٧ | | Total | 18 |

## 4th Year (Regular and Cooperative)

### 7th Semester / 8th Semester

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| ARAB 201 | Arabic Language (2) | 3 | ISLS 301 | Islamic Culture (3) | 2 |
| MATH 204 | Differential Equations | 3 | MEP 360 | Heat Transfer | 3 |
| MENG 332 | Manufacturing Technology | 3 | MENG 366 | System Dynamics and Control | 3 |
| MENG 310 | Machine Elements Design | 3 | MENG 410 | Mechanical Design | 3 |
| MEP 361 | Thermodynamics II | 3 | MENG 434 | Material Removal Procedures | 3 |
| MENG 364 | Machine Dynamics | 3 | MENG 470 | Mechanical Vibrations | 3 |
| | Total | ١٨ | | Total | 17 |

The student must select Regular or Cooperative track immediately after the eights semester.

### 4th Year Summer – Training (Regular)

| | | |
|---|---|---|
| MENG 390 | Summer Training | 2 Cr. Hr. |

### 4th Year Summer – Training (Cooperative)

| | | |
|---|---|---|
| MENG 400 | Coop Work Program | 8 Cr. Hr. |

## 5th Year (Regular)

**9th Semester** | **10th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| MENG 412 | Computer Aided Design | 3 | ISLS 401 | Islamic Culture (4) | 2 |
| MEP 451 | Air Conditioning and Refrigeration I | 3 | MENG 436 | Metrology & Quality Control | 3 |
| MENG xxx | Elective Course (1) | 3 | MENG 452 | Manufacturing Planning & Shop Loading | 3 |
| MENG 499 | Senior Project | 4 | MENG 472 | Fault Diagnosis of Mechanical Systems | 2 |
| | | | MENG xxx | Elective Course (2) | 3 |
| | Total | ١٣ | | Total | 13 |

## 5th Year (Cooperative)

**9th Semester** | **10th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| MENG 499 | Senior Project | 4 | ISLS 401 | Islamic Culture (4) | 2 |
| | | | MENG 412 | Computer Aided Design | 3 |
| | | | MENG 436 | Metrology & Quality Control | 3 |
| | | | MEP 451 | Air Conditioning and Refrigeration I | 3 |
| | | | MENG 452 | Manufacturing Planning & Shop Loading | 3 |
| | | | MENG 472 | Fault Diagnosis of Mechanical Systems | 2 |
| | Total | 4 | | Total | 16 |

## COURSE DESCRIPTION

**MENG 102 Engineering Drawings (3:1,4)**

Introduction: Skills of freehand sketching. Methods of projection: orthographic, isometric. Dimensioning of views. Third view prediction. Primary and successive auxiliary views. Intersections of surfaces and bodies. Development of surfaces. Sectioning. Introduction to assembly drawings. Steel sections. Standards and conventions. Computer Aided Graphics using SOLIDWORK crafting package. Applications.

**Prerequisite: None**

**MENG 130 Basic Workshop (2:1,3)**

Introduction: Skills of freehand sketching. Methods of projection: orthographic, isometric. Dimensioning of views. Third view prediction. Primary and successive auxiliary views. Intersections of surfaces and bodies. Development of surfaces. Sectioning. Introduction to assembly drawings. Steel sections. Standards and conventions. Computer Aided Graphics using SOLIDWORK crafting package. Applications.

**Prerequisite: MENG 102**

**MENG 204 Mechanical Engineering Drawings (3:1,4)**

Introduction to CAD. Skills of using a drafting package. (AutoCAD).Types of assembly and detail drawings. Representation of mechanical elements (bolted, welded and riveted joints, shafts and keys, springs, gears). Geometrical and dimensional tolerances Applications on assembly and working drawings (valves, presses, bearings, vices etc.).

**Prerequisite: MENG 130**

**MENG 262 Engineering Mechanics (Dynamics) (3:2,3)**

Review of particle motion. Rotation and translation of a rigid body in the plane. General plane motion. Displacement, velocity, and acceleration of rigid bodies, including Coriolis motion. Equations of motion for a rigid body. Constrained plane motion. Work and energy. Impulse and momentum.

**Prerequisite: CE 201**

**MENG 270 Mechanics of Materials (3:2,3)**

Types of loads and stresses. Mechanical behavior of materials. Shearing forces and bending moment diagrams. Shearing stresses in beams. Stresses in compound bars. Bending stresses and deflection. Torsion of bars. Principal stresses, and Mohr's circle. 3-Dimensional stresses. Principal strains and Mohr's circles of strain. Stress-strain relations. Strain energy. Yield criteria. Thin and thick cylinders, fatigue analysis. Lab work.(tension, bending, hardness, fatigue, creep.)

**Prerequisite: CE 201**

**MENG 310 Machine Elements Design (3:2,3)**

Review of stress analysis (combined stress, bending). Buckling, failure theories, fatigue failure. Materials in mechanical design and safety factors. Design of fasteners: riveted, welded, bolted and fitted joints. Power screws, springs, ball bearing, sliding bearings, power transmission gears, shafts, couplings, clutches, brakes, belts, chains and ropes. Application on design projects.

**Prerequisite: MENG 270**

**MENG 332 Manufacturing Technology (3:2,3)**

Introduction, Casting processes (solidification and melting, furnaces, expendable and permanent mold casting). Bulk deformation processes (hot and cold forming processes, workability and limits of forming).Sheet metal processes (formability of sheets and sheet forming processes, processing of polymers). Metal powders and ceramics, welding processes. Heat treatment of metals, Principles of metal cutting (machining processes, types of chips, process sheet). Design of cutting tools such as single point tools, milling cutters and broaches.

**Prerequisite: MENG 130, ChE 210**

**MENG 364 Machine Dynamics (3:2,3)**

Design of ordinary gear trains and analysis of epicyclic gear trains. Computer aided design of disk cams. Grashof rules. Design of mechanisms in terms of transmission angle and time ratio. Kinematics and force analysis of linkages and machinery with the aid of computers. Flywheel design.

**Prerequisite: MATH 205, MENG 262**

**MENG 366 System Dynamics and Control (3:2,3)**

Introduction. Laplace transforms. Transfer function. Block diagrams. State space equations of control systems. Mathematical modeling of dynamic systems: Mechanical, electrical, electro-mechanical, liquid-level, thermal and pressure systems. Industrial automatic controllers: basic control actions. Pneumatic and hydraulic controllers. Transient response analysis: First and second order systems. Root locus analysis and design. Frequency response analysis and design. Computer program applications.

**Prerequisite: MENG 262, EE 251**

**MENG 390 Summer Training (3:2,3)**

10 weeks of supervised hands-on work experience at a recognized firm in a capacity which ensures that the student applies his engineering knowledge and acquires professional experience in his field of study at KAU. The student is required to communicate, clearly and concisely, training details and gained experience both orally and in writing. The student is evaluated based on his abilities to perform professionally, demonstrate technical competence, work efficiently, and to remain business focused, quality oriented, and committed to personal professional development.

**Prerequisite: MENG 332 and completing at least 125 credit units**

**MENG 400 Cooperative Work (8:0,0)**

Extensive 26 weeks of supervised hands-on work experience at a recognized firm in a capacity which ensures that the student applies his engineering knowledge and acquires professional experience in his field of study at KAU. The student is required to communicate, clearly and concisely, training details and gained experience both orally and in writing. The student is evaluated based on his abilities to perform professionally, demonstrate technical competence, work efficiently, and to remain business focused, quality oriented, and committed to personal professional development.

**Prerequisite: MENG 332 and completing at least 125 credit units**

**MENG 408 Reverse Engineering (3:2,3)**

Basic concepts, history, prescreening and preparation for the four stages process, stage 1: evaluation and verification, stage 2: technical data generation, stage 3: design verification and stage 4: project implementation.

**Prerequisite: MENG 310**

**MENG 410 Mechanical Design (3:2,3)**

Introduction, design methodology (concept, alternatives, considerations, skills of teamwork, reports, construction and detail drawings of machines). Comprehensive design projects include: fixed and moveable joints, shafts, sliding and rolling bearings, gears, couplings, clutches and brakes, belt drivers. Use of standards and technical manuals. Application of computer programs. Applications on design of production facilities.

**Prerequisite: MENG 204, MENG 310**

**MENG 412 Computer Aided Design (3:2,3)**

Introduction to computer aided engineering environment. Solid modeling. Introduction to Finite Element Method. CAD packages. Static linear analysis in one, two, and three dimensions. Thermal systems analysis and design, introduction to non linear analysis. Optimum design. Computer applications in mechanical design.

**Prerequisite: MENG 410**

**MENG 416 Materials Selection in Design & Manufacturing (3:2,3)**

Product life cycle. Performance of materials in service (failure of materials under mechanical loading, environmental degradation, selection of materials), effect of shape and manufacturing processes. Cost-per-unit-property method. Weighed properties method. Limits-on-properties method. Selection charts, computer-aided material and process selection (material databases). Case studies.

**Prerequisite: MENG 270, MENG 332**

**MENG 418 Machine Tool Design (3:2,3)**

Design and working principles of machine tool elements (Speed and feed of gear boxes. spindle and spindle bearings, rigidity and strengthening of structures- frames, beds and design of sideways against wear). Power sources and types of drives. Mechanisms design, motion control and transmission systems in machine tools. Safety devices. Static and dynamic acceptance tests for machine tools.
**Prerequisite: MENG 410, MENG 332**

**MENG 420 Introduction to Finite Element Methods (3:2,3)**

Virtual formulation. Finite element analysis: shape formation, equilibrium conditions, element classification, assembly of elements, modeling methodology. Structures and elements: trusses, beams, 2-D solids, 3-D solids, axisymmetric solids, thin-walled structures. Dynamic analysis. Heat transfer and thermal analysis.
**Prerequisite: MENG 204, MENG 270**

**MENG 422 Tribology (3:2,3)**

Nature of solid surfaces. Interaction of solid surfaces. Friction of metals and non-metals (mechanisms, theories, applications). Wear of metals and non-metals (types, mechanisms, theories, applications). Lubrication (methods, types, theories, applications). Lubricants (types, utilization) Selection of materials for tribological applications. Surface Engineering.
**Prerequisite: MENG 410**

**MENG 424 Design of Production Facilities (3:2,3)**

Hoisting machinery: crane chains, sprockets, pulleys, drums, ropes, sheaves and hooks. Gain in force and gain in speed systems. Wheels, rails, and drives. Jigs and fixtures: specifications of jigs and fixtures, conventions in fixture design. Degrees of freedom, location points, fixation point. Clamping devices, fool-proofing, Rigidity and wear considerations.

**Prerequisite: MENG 410, MENG 434**

**MENG 428 Special Topics in Mechanical Systems Design (3:2,3)**
Topics relevant to specialization of Mechanical Systems Design to strengthen student's knowledge in this field..

**Prerequisite: MENG 310**

**MENG 434 Material Removing Processes (3:2,3)**
Fundamentals of cutting. Mechanics of chip formation. Cutting forces and power. Effect of temperature on cutting. Tool life. Machinability: Metal removal rate, Cutting tool materials and fluids. Machining processes: turning, thread cutting, boring, drilling, reaming, milling, shaping and planning, broaching, gear cutting. Abrasives, grinding wheels, grinding

processes. Super finishing process: Lapping, honing. blasting and penning. Non-conventional machining. Numerical control of machine tools. Design and working principles of machine tool elements, (speed and feed of gear boxes, spindles and bearings).

**Prerequisite: MENG 332**

**MENG 436 Metrology and Quality Control (3:2,3)**

Quality. Standardization and standards. Accuracy and precision. Sensitivity and magnification systems. Errors, geometric tolerances. Surface texture. Interferometry and laser applications. Inspection and limit gauging. Quality control and sampling techniques, lot-acceptance, sampling plans, statistical control charts, quality assurance systems, total quality management.

**Prerequisite: MENG 332**

**MENG 446 Advanced Manufacturing Technology (3:2,3)**

Non-conventional machining: Principles, Ultrasonic machining, Electromechanical Machining, Electro-discharge Machining, Plasma Arc Machining, Laser Beam Machining, Electron Beam Machining. Numerical Control of Machine Tools: Automation of Manufacturing Processes, Numerical Control, Coordinate systems, Types and components of CNC systems, Programming for CNC, Adaptive control, Computer Integrated Manufacturing.

**Prerequisite: MENG 434**

**MENG 448 Composite Materials (3:2,3)**

Classification. Applications. Processing and fabrication of composites (metal-matrix, ceramic-matrix, reinforced plastics, honeycomb materials, forming structural shapes). Design Considerations. Laminate structures. Stress-strain characteristics of fiber-reinforced materials. Lamination theory. Failure theories of fiber-reinforced materials. Environmentally induced stresses in laminates.

**Prerequisite: MENG 270, MENG 332**

**MENG 450 Computer Aided Manufacturing (3:2,3)**

This course covers fundamentals of computer aided manufacturing with special emphasis on solid modeling, assembly and manufacturing using numerical control machining systems. Heavy emphasis will be on proper use of commercial CAM systems to generate optimized CNC tool path. Program generations will be reinforced with practical training in CNC Lab. This course is very much a course for the engineer of the future!.

**Prerequisite: MENG 204, MENG 434**

**MENG 452 Manufacturing Planning and Shop Loading (3:2,3)**

Productivity. Flow and handling of materials. Production methods and machine capacities. Planning of manufacturing processes. Factory location decisions and plant layout, plant layout problems. Scheduling, loading and project planning. Group technology (GT). Classification and coding. Computer Aided Production Planning (CAPP). Computer-integrated manufacturing systems.

**Prerequisite: MENG 434**

**MENG 454 Welding Technology (3:2,3)**
Fusion welding. Weld ability. Selection of welding electrodes. Hot cracking. Cold cracking. Welding metallurgy, heat affected zone. Welding of heat-treatable alloys. Welding of dissimilar alloys. Destructive and nondestructive testing of welds. Weld thermal cycles and residual stresses. Welding in manufacturing: pressure vessels, boilers and ship building industries; welding in automotive maintenance. Welding codes.

**Prerequisite: MENG 332**

**MENG 458 Special Topic in Production Engineering (3:2,3)**
Topics relevant to specialization of production engineering to strengthen student knowledge

**Prerequisite: MENG 332**

**MENG 468 Plasticity & Metal Forming (3:2,3)**
3- D State of Stress& Strain for Elastic Behavior, Yield criteria, Plastic stress- strain relation. Plane stress and plane strain problems. Determination the flow equation from experiments results. Theory of Plasticity. Applications: instability in thin vessels, thick vessels subjected to internal pressure, and beam under pure bending. Analysis of metal forming process and its techniques of analysis; energy method; slab method, upper bound method. Classification of metal forming processes. Bulk deformation processes. Forging, rolling, extrusion, and Rod and wire drawing

**Prerequisite: MENG 270, MENG 332**

**MENG 470 Mechanical Vibrations (3:2,3)**
Free and damped vibration of single degree of freedom systems. Viscous damping. Forced vibration. Resonance. Harmonic excitation. Rotating unbalance. Base motion. Vibration isolation. Fourier analysis. Vibration measuring. General excitation. Step and impulse response. Two degree of freedom systems. Frequencies and mode shapes. Modal analysis. Undamped vibration absorber. Multidegree of freedom systems. Introduction to Continuous systems, Applications with computer programs.

**Prerequisite: MATH 204, MENG 364**

**MENG 472 Fault Diagnosis of Mech. Systems (2:2,1)**
Review of vibration; Free vibration, Harmonically excited vibration, Fourier analysis. Instruments; Transducers, FFT analyzer, Sampling and aliasing. Machine vibration problems; Imbalance, Misalignment, Bearings, Gears, Fans, Belts. Vibration measuring techniques and maintenance management. Sound; Basic properties of waves, Intensity, Power level. Balancing; Static unbalance, Dynamic unbalance, Field balancing.

**Prerequisite: MENG 470**

**MENG 478 Mechanisms (3:2,3)**
Analytical and computer techniques for kinematics and dynamic analysis of planar linkages. Ordinary and planetary gear trains. Cam mechanisms. Inversion. Geared linkages. Mechanisms with actuators. System response to dynamic inputs.

**Prerequisite: MENG 364**

**MENG 480 Introduction to Robotics (3:2,3)**
Classifications. Forward kinematics: Orientation coordinate transformations, Configuration coordinate transformations, Denavit-Hartenberg coordinate transformations. Inverse kinematics for a planar robot, revolute robot and spherical robot. The 3-D case. Force and torque relations. Trajectory planning. Coordinated motion. Lagrange equations. Inverse dynamics.

**Prerequisite: MENG 364**

**MENG 482 Mechatronics (3:2,3)**
Introduction, modeling and simulations: simulation and block diagrams. Ana1ogies. Electrical and mechanical systems. Electro-mechanical coupling. Fluid systems. Sensors and transducers. Actuating devices. DC, stepper and servomotors. Fluid power actuation. Piezo electric actuators. Hardware components. Number systems. Binary logic systems and control. Real time interfacing. Data acquisition and control systems. The I/O process.

**Prerequisite: MENG 366**

**MENG 488 Special Topics in Applied Mechanics (3:2,3)**
Topics relevant to specialization of applied Mechanics to strengthen the student's knowledge in this field.

**Prerequisite: MENG 364**

**MENG 490 Strategic Management and Leadership Skills (3:2,3)**
Understanding good leadership behaviors ,differences between leadership and manager ship , preparation for strategic planning, setting strategic end point: developing /updating Vision, Mission Statement, Values, gaining insight into your patterns, beliefs and rules, strategic analysis, environmental scan(taking a wide look around), Looking at Organizations SWOT , strategies to achieve the goals and Gantt charts, Balanced Score Card (BSC), creative leadership skills using TRIZ, polishing Intrapersonal and Interpersonal communication skills , applications on i-plan 2.0 software.

**Prerequisite: IE 202**

**MENG 499 Senior Project (4:2,6)**

The student is required to function on multidisciplinary team to design a system, component, or process to meet desired needs within realistic constraints. A standard engineering design process is followed including the selection of a client defined problem, literature review, problem formulation (objectives, constraints, and evaluation criteria), generation of design alternatives, work plan, preliminary design of the selected alternative, design refinement, detailed design, design evaluation, and documentations. The student is required to communicate, clearly and concisely, the details of his design both orally and in writing in several stages during the design process including a final public presentation to a jury composed of several subject-related professionals.

**Prerequisite: MENG 410, MENG 434**

# DEPARTMENT OF THERMAL ENGINEERING AND DESALINATION TECHNOLOGY

# INTRODUCTION

The Department of Thermal Engineering and Desalination Technology is a discipline of the Mechanical Engineering Department at King Abdulaziz University. The program started on 23/3/1982 G (28/5/1402 H) to meet the Kingdom's growing needs for mechanical engineers with broad background in the fields of power generation, sea water desalination, air-conditioning, heat exchangers and other thermo-mechanical systems. These areas have been emphasized in appreciation to their importance for the fast growing development of the Kingdom and the neighboring Gulf States.

The department offers 5 years study program leading to Bachelor of Science degree (B.Sc.) in Mechanical Engineering with Thermal Sciences Major. The program provides graduates with strong basic engineering knowledge, professional skills, effective communication proficiency, ability to work in teams and appreciation of the ethical, societal and global issues required for engineers of the future.

# VISION AND MISSION STATEMENTS

## The Vision of the Department

To acquire and maintain a position of excellence in Mechanical Engineering Education.

## The Mission of the Department

To prepare distinctive quality students in mechanical engineering, able to apply the acquired knowledge successfully with engineering professional ethics based on Islamic values to serve the society, and pursue advanced studies.

# EDUCATIONAL OBJECTIVES

Our Educational Objectives list as published in the Faculty of Engineering, Undergraduate Bulletin 2007-2008 and posted on the Department web site (http://engg.kaau.edu.sa/mep/) is as follows: Students after graduation are able to

PEO_1: Engage in productive careers in Mechanical Engineering with emphasis on thermal and water desalination systems, or pursue postgraduate studies .

PEO_2: Advance in their careers through effective modeling, analysis, and design of mechanical-thermal systems, responding to continuous developments in the field and the needs of the society.

PEO_3: Practice professional engineering and contribute to the profession and to the society through team work, effective communication and appreciation of ethical, societal, environmental and economical issues.

## Aspects of Development

The department of the Thermal Engineering and Desalination Technology has most of the necessary resources needed to implement the new plan, however, some improvements and extra resources are needed to increase the ability of the department to accommodate more students considering the increase in demand for thermal engineers for the expanding industries in the Kingdom. Future plans should consider the followings:-

34. Modernization and upgrading of the existing thermo-fluid Labs.

35. Modernization and upgrading of the existing air-conditioning Lab.
36. Modernization and upgrading of the existing water desalination Labs.
37. Modernization and upgrading of the existing heat engine and power plant Labs.
38. Modernization and upgrading of the existing applied thermal engineering Labs.
39. Recruiting high professionals to operate and maintain the laboratory equipments.
40. Recruiting a qualified faculty member specialized in desalination to accommodate the increase in the number of students enrolling in the program.
41. Recruiting two qualified faculty members specialized in applied thermal hydraulics to accommodate the increase in the number of students enrolling in the program.
42. Recruiting two qualified faculty members specialized in thermal engineering to accommodate the increase in the number of students enrolling in the program.

It should be mentioned here that the new plan of the Thermal Engineering & Desalination Technology department has many strengths which can be summarized as follows:

1) A well designed set of core courses to provide the necessary scientific background and engineering design experience.
2) The specialized courses are fairly distributed among the three main areas of interest in the Department (Power, Air Conditioning and Desalination). The curriculum has the following compulsory courses to fulfill the local needs: one course in IC Engines, one course in Refrigeration and Air Conditioning, two courses in Desalination, one course in Turbo-Machines, one course in Heat Exchangers and one course in pumps and hydraulics.
3) Emphasis is given in a balanced manner to the scientific side as well as to the practical side of the field of interest
4) The curriculum includes a slot (5 credit hours) for selected topics that can cover any related subject of interest to the students.
5) The Program includes courses, projects and field trips in addition to a summer training period.
6) The students before their graduation must complete a 4-credit senior project. The student under the supervision of a faculty member prepares a report and defends it in the presence of two faculty members and a third member, who quite often is selected from the industry.
7) The curriculum also contains courses on economics and management to help the students in understanding the economical impact of their profession.

# ADMISSION AND GRADUATION REQUIREMENTS

## Students Admissions into the Department Program

The actual policy of the Thermal Engineering & Desalination Technology department is to accept, each semester, a fixed number of students (normally between 10 and 20) of the highest GPA from those expressing their interest to join the department.

## Graduation Requirements

In order to qualify for a BS degree in Thermal Engineering & Desalination Technology, students must successfully complete 155 semester credit hours with an overall GPA of 2.0 out of 5 or better. The student has to complete 49 required courses and two elective courses with a grade of D or better including 10 weeks of Industrial Summer Training and a Capstone B.Sc. design project as detailed in the MEP curriculum requirements.

## CAREER OPPORTUNITIES

Career opportunities for the Thermal Engineering and Desalination Technology graduates vary. Graduates work for both the government and private sectors. The graduates are generally employed by the following corporations and companies:

- ARAMCO (Arabian-American Company)
- SABIC
- Saudi Arabian Airlines
- Governmental Agencies, such as the Ministry of Petroleum and Minerals, Ministry of Agriculture, Ministry of Industry and Ministry of Electricity and Water, etc.
- Chemical and Petroleum Industry
- Automotive Industry
- Power and Electricity Company
- SWCC (Saline Water Conversion Corporation)
- Land and Sea Transport and Shipping Companies
- Foreign Companies in the Kingdom of Saudi Arabia (ABB, GE, Unilever)
- Other Industrial and Private Sectors

# PROGRAM REQUIREMENTS AND CURRICULUM

## Key to Course Numbers and Department Code

Each course is referred to by an alphabetical code and a three digits number as follows:

21. Thermal Engineering and Desalination Technology Department is referred to by the code "MEP"
22. The hundredth digit refers to the school year
23. The tenth digit refers to specialty within the department as indicated in the table.
24. The ones digit refers to course serial within the same specialty

Key of tenth digit in the codes of MEP courses

| Tens Digit | Specialty |
|---|---|
| 0 | N/A |
| 1 | General Mechanical Engineering |
| 2 | N/A |
| 3 | N/A |
| 4 | N/A |
| 5 | Measurements and electronic systems. |
| 6 | Basic Thermal and heat Systems. |
| 7 | Power Systems. |
| 8 | Desalination Systems. |
| 9 | Fluid Systems, training and research courses. |

## Units Required for the B.Sc. Degree

Units required for the B.Sc. degree in the Production Engineering and Mechanical Systems Design Department

### Conventional Program

| Requirements | Cr. Hrs |
|---|---|
| University Requirements (including the prep year) | 41 |
| Faculty Requirements | 37 |
| Departmental Requirements (Compulsory) | 69 |
| Departmental Requirements (Electives) | 6 |
| Summer Training | 2 |
| **Total** | **155** |

### Cooperative Program

| Requirements | Cr. Hrs |
|---|---|
| University Requirements (including the prep year) | 41 |

| | |
|---|---|
| Faculty Requirements | 37 |
| Departmental Requirements (Compulsory) | 69 |
| Coop Program | 8 |
| **Total** | **155** |

## Department Compulsory Courses

Regular students are required to take 71 credits (2٤ courses) as indicated in the table.

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| CE 201 | Engineering Mechanics (statics) | 3 | IE 200, PHYS 281 |
| ChE 210 | Materials Science | 4 | CHEM 281 |
| EE 332 | Computational Methods in Eng. | 3 | EE 201, MATH 204 |
| MATH 241 | Linear Algebra | 3 | MATH 202, MATH 203 |
| MENG 130 | Basic Workshop | 2 | MENG 102 |
| MENG 262 | Engineering Mechanics (Dynamics) | 3 | CE 201 |
| MENG 270 | Mechanics of Materials | 3 | CE 201 |
| MENG 310 | Mach. Elements Design | 3 | IE 202, MENG 270 |
| MENG 364 | Machine Dynamics | 3 | MENG 262, MATH 205 |
| MEP 261 | Thermodynamics I | 3 | MATH 202, PHYS 281 |
| MEP 290 | Fluid Mechanics | 3 | MATH 202, PHYS 281 |
| MEP 360 | Heat Transfer | 3 | MEP261, MEP290, IE 202 |
| MEP 361 | Thermodynamics II | 3 | MEP 261, MEP 290 |
| MEP 365 | Thermal Eng Measurements | 3 | MEP261, MEP290, EE251, IE 255 |
| MEP 370 | Internal Combustion Engines | 3 | MEP 361, ChE 210 |
| MEP 390 | Summer Training | 2 | MEP370 |
| MEP 451 | Refrigeration & A/C I | 3 | MEP 360, MEP 361 |
| MEP 460 | Design of Heat Exchangers | 3 | MEP 360, MEP 361, EE 332 |
| MEP 473 | Power Plants | 3 | MEP 360, MEP 361, IE 255 |
| MEP 474 | Turbo M/C & Gas Turbines | 3 | MEP 360, MEP 370 |
| MEP 481 | Thermal Desal. Processes | 3 | MEP 360, MEP 361 |
| MEP 482 | Membrane Desal. Processes | 3 | MEP 360, MEP 361 |
| MEP 492 | Pumps and Hydraulics | 2 | MEP 361, MEP 365 |
| MEP 499 | Senior Project | 4 | MEP360, MEP361, MEP365, EE 332 |
| Total | | 71 | |

MEP 390 – the summer training, 400 hours of on-job training distributed over 10 weeks that is included in the counting of training units.

Coop students are required to take all of the above mentioned 25 courses except MEP 390 which is replaced by the following course:

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| MEP 400 | Coop Work Program | 8 | MEP 370 |

## Department Elective Courses

Regular students select 2 courses (6 credit units) out of those in the table. For coop students no elective courses are required.

| Course No. | Course Title | Cr. Hr. | Prerequisites |
|---|---|---|---|
| EE 202 | Object-Oriented Computer Programming | 3 | EE201 |
| IE 256 | Engineering Management | 2 | IE 202 |
| IE 331 | Probability and Statistics | 3 | MATH203 |
| MENG 332 | Manufacturing Technology | 3 | MENG 130, ChE 210 |
| MENG 410 | Mechanical Design | 3 | MENG 204, MENG 310 |
| MENG 470 | Mechanical Vibrations | 3 | MATH 204, MENG 364 |
| MENG 482 | Mechatronics | 3 | MENG 366 |
| MEP 392 | Biofluid Mechanics | 3 | Instructor Approval |
| MEP 452 | Refrigeration and A/C II | 3 | MEP 451 |
| MEP 463 | Modeling and Simulation of Thermal Systems. | 3 | EE 201, MEP 360, EE 332 |
| MEP 464 | Heat Transfer in Electrical Systems | 3 | MEP 360, EE 332 |
| MEP 466 | Control System Engineering | 3 | MEP 360, MEP 460 (Co-req.) |
| MEP 471 | Combustion and Pollution | 3 | MEP 361, MEP 370 |
| MEP 472 | Energy Conversion | 3 | MEP 361 |
| MEP 476 | Automotive Engineering | 3 | MEP 370 |
| MEP 478 | Renewable Energy | 3 | MEP 360, MEP 361 |
| MEP 483 | Desalination Plants | 3 | MEP 482 |
| MEP 490 | Applied Fluid Mechanics | 3 | MEP 290 |
| MEP 493 | Computational Fluid Dynamics (CFD) | 3 | MEP 360, EE 332 |
| MEP 496 | Applications in Thermal Eng. | 2 | Instructor approval |
| MEP 497 | Selected Topics in Mech. Eng. | 3 | Instructor approval |
| XXX | Any course offered by the MEP department or other departments in the Faculty of Engineering or the University. | | MEP 290, MEP 261 |

- Each one theoretical hour calculated as one credit unit
- Each two or three practical hour calculated as one credit unit
- There is no circumstance for training hour (not counted in credit calculations)

## A TYPICAL B.Sc. PROGRAM FOR MEP DEPARTMENT

### 3rd Year (Regular & Cooperative)

**5th Semester** | **6th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| MEP 261 | Thermodynamics I | 3 | ARAB 201 | Arabic Language (2) | 3 |
| MATH 204 | Differential Equations I | 3 | MEP 290 | Fluid Mechanics | 3 |
| MENG 130 | Basic Workshop | 2 | MENG 262 | Eng. Mech. (Dynamics) | 3 |
| ChE 210 | Materials Science | 4 | MATH 205 | Series and Vector Calculus | 3 |
| ISLS 201 | Islamic studies (2) | 2 | MATH 241 | Linear Algebra | 3 |
| IE 202 | Intro. Eng. Design II | 2 | IE 255 | Engineering Economics | 3 |
| | Total | ١٦ | | Total | 18 |

### 4th Year (Regular and Cooperative)

**7th Semester** | **8th Semester**

| Course No. | Course Title | Cr. Hr. | Course No. | Course Title | Cr. Hr. |
|---|---|---|---|---|---|
| MEP 360 | Heat Transfer | 3 | MEP 365 | Thermal Eng Measurements | 3 |
| MEP 361 | Thermodynamics II | 3 | MEP 370 | I. C. Engines | 3 |
| MENG 364 | Machine Dynamics | 3 | MEP 451 | Refrigeration & A/C I | 3 |
| MENG 270 | Mechanics of Materials | 3 | MEP 481 | Thermal Desal. Processes | 3 |
| EE 251 | Basic Electric Eng | 4 | EE 332 | Comput. Meth. in Eng | 3 |
| ISLS 301 | Islamic studies (3) | 2 | MENG 310 | Mach. Elements Design | 3 |
| | Total | ١٨ | | Total | 18 |

The student must select Regular or Cooperative track immediately after the eights semester.

### 4th Year Summer – Training (Regular)

| | | |
|---|---|---|
| MEP 390 | Summer Training | 2 Cr. Hr. |

### 4th Year Summer – Training (Cooperative)

| | | |
|---|---|---|
| MEP 400 | Coop Work Program | 8 Cr. Hr. |

## 5th Year (Regular)

| 9th Semester | | | 10th Semester | | |
|---|---|---|---|---|---|
| **Course No.** | **Course Title** | **Cr. Hr.** | **Course No.** | **Course Title** | **Cr. Hr.** |
| MEP 499 | Senior Project | 4 | MEP 474 | Turbo M/C & Gas Turbines | 3 |
| MEP 460 | Design of Heat Exchangers | 3 | MEP 473 | Power Plants | 3 |
| MEP 492 | Pumps and Hydraulics | 2 | MEP 482 | Membrane Desal. Processes | 3 |
| | Elective 1 | 3 | ISLS 401 | Islamic studies (4) | 2 |
| | | | | Elective 2 | 3 |
| | Total | ١٢ | | Total | 14 |

## 5th Year (Cooperative)

| 9th Semester | | | 10th Semester | | |
|---|---|---|---|---|---|
| **Course No.** | **Course Title** | **Cr. Hr.** | **Course No.** | **Course Title** | **Cr. Hr.** |
| MEP 499 | Senior Project | 4 | MEP 474 | Turbo M/C & Gas Turbines | 3 |
| | | | MEP 473 | Power Plants | 3 |
| | | | MEP 482 | Membrane Desal. Processes | 3 |
| | | | MEP 460 | Design of Heat Exchangers | 3 |
| | | | MEP 492 | Pumps and Hydraulics | 2 |
| | | | ISLS 401 | Islamic studies (4) | 2 |
| | Total | 4 | | Total | 16 |

## COURSE DESCRIPTION

**MEP 261 Thermodynamics I (3:3,1)**

Concepts and definitions, Properties of pure substances, Different forms of energy, Concepts of Heat and work. First law of thermodynamics. Applications of first law on closed system and control volume. Second law of thermodynamics. Entropy, isentropic efficiency. Some power and refrigeration cycles (including Rankine Cycle, vapor compression cycle, Otto cycle, Diesel cycle, Brayton cycle).

**Prerequisite: MATH 202, PHYS 281**

**MEP 290 Fluid Mechanics (3:3,1)**

Concepts and definitions, Fluid statics. Forces on submerged surfaces and bodies. Non-viscous flow, conservation of mass, momentum and energy. Bernoulli equation. Dimensional analysis. The PI-Theorem, similarity. Viscous flow, pipe flow, losses in conduit flow. Laminar and turbulent flow.

**Prerequisite: MATH 202, PHYS 281**

**MEP 360 Heat Transfer (3:3,1)**

Principles of Heat Transfer, steady state and transient conduction in different co-ordinates, extended surfaces. Convective heat transfer. Analysis and empirical relations for forced and natural convection. Radiation heat transfer, radiation exchange between black and gray surfaces. Heat transfer applications (Heat Exchangers). Numerical methods in heat transfer with computer applications.

**Prerequisite: MEP 261, MEP 290, IE 202**

**MEP 361 Thermodynamics II (3:3,1)**

Irreversibility and availability. Thermodynamic relations. Mixtures and solutions. Chemical reactions and combustion. Phase and Chemical equilibrium. Thermodynamics of compressible flow.

**Prerequisite: MEP 261, MEP 290**

**MEP 365 Thermal Engineering Measurements (3:3,1)**

Introduction on the use of computers in the Lab Error analysis. Temperature measurement. Pressure measurement. Flow measurement (mass flow rate, velocity, flow visualization). Torque. Speed, power measurements. Introduction to Data Acquisition Systems. Experiments for basic and comparative calibration of different instruments and their applications.

**Prerequisite: MEP 261, MEP 290, EE 251, IE 255**

**MEP 369 Power Plants for Electrical Engineers (3:3,1)**

Steam power plants: plant components and subsystems. Plant efficiency calculations, Diesel and gas turbine power plant auxiliary systems. Load curves. Economy of power generation. Experiments on power plants.

**Prerequisite: MEP 261**

**MEP 370 Internal Combustion Engines (3:3,1)**

Spark ignition and compression ignition engine types, design and operating parameters; thermo chemistry of fuel-air mixture and thermodynamic models of working fluids and engine cycles. Gas exchange processes and volumetric efficiency. Carburetors and electronic fuel injection. Performance parameters. Combustion chamber design, and octane number. Diesel fuel injection, supercharging of 4-stroke and 2-stroke S.I. and C.I. engines.

**MEP 361, ChE 210 Prerequisite:**

**(2:0,4) Summer Training MEP 390**

400 hours (10-weeks) of training in industry under the supervision of a faculty member. Students have to submit a report about his achievements during training in addition to any other requirements as assigned by the department.

**MEP 370 Prerequisite:**

**(3:3,1) Bio-Fluid Mechanics MEP 392**

Introduction to thermodynamics: work and energy, specific heat and static pressure and enthalpy, Laminar flow and turbulent, fluids motion in body, properties of blood and viscous liquids, Heat transfer biological tissues, mathematical modeling of heat transfer in the human body.

**Instructor Approval Prerequisite:**

**(8:0,16) Coop Work Program MEP 400**

1000 hours (25-weeks) of training in industry under the supervision of a faculty member. Students have to submit a report about his achievements during training in addition to any other requirements as assigned by the department..

**MEP 370 Prerequisite:**

**(3:3,1) Refrigeration & Air Conditioning MEP 451**

Review of basic thermodynamics, vapor compression cycles, multi-stage and cascade vapor compression refrigeration. Refrigerants and their characteristics. Basic vapor compression equipment, Introduction to absorption refrigeration. Psychrometry and psychrometric processes. Human comfort. Heat gain-through walls and fenestrations. Cooling load calculations. Calculation using software packages.

**MEP 360, MEP 361 Prerequisite:**

**(3:3,1) Refrigeration & Air Conditioning II MEP 452**

Cascade V.C. cycle, Gaseous air refrigeration cycles. Absorption refrigeration systems. Thermoelectric cooling. Cold storage and applications. Refrigeration control systems, Air distribution systems (duct design).Air conditioning systems and their representation on psychometric chart. Air conditioning control. Air conditioning equipment.

**MEP 451 Prerequisite:**

**(3:3,1) Design of Heat Exchangers MEP 460**

Classification of Heat Exchangers, Design Correlations and Fouling, Basic Thermal Design Methods and Iterative Techniques, Double-Pipe Heat Exchangers, Shell-and-tube Heat Exchangers, Compact Heat Exchangers, Other Heat Exchangers, Correlations for Two-Phase Flow, Condensers and Evaporators.

**MEP 360, MEP 361, EE 332 Prerequisite:**

**(3:3,1) Modeling and Simulation of Thermal Systems MEP 463**

Basic considerations and types of modeling, Numerical modeling and simulation of thermal systems, Optimization and search techniques, Examples and applications using computer.

**MEP 360, EE 332 Prerequisite:**

**(3:3,1) Heat Transfer in Electrical Systems MEP 464**

Introduction. Packaging and Thermal Management Trends. Interface Resistance. Conduction in Fins and Heat Sinks. Forced Convection. Fan Selection. Natural Convection, Passive Immersion Cooling, Heat Pipes. Vapor Compression Refrigeration. Thermoelectric Coolers.

**MEP 360, EE 332 Prerequisite:**

**(3:3,1) Control System Engineering MEP 466**

Control and dynamic system. Laplace transforms and transfer function. Basic control systems. Dynamic thermal systems. Control system components, System simulation, Simulation error analysis, Stability analysis, Transient and frequency domain methods, Control system design by the root locus method, Application for thermal system control, computer applications.

**MEP 360, MEP 460 (Co-req.) Prerequisite:**

**(3:3,1) Combustion and Pollution MEP 471**

Liquid fuels: chemical composition and reaction, properties and tests. Combustion theory. Laminar and turbulent flames. Combustion in C.I. and S.I. engines. Combustion in furnace. Furnaces design. Pollutant formation and control for NOx. CO and VHC; and particulate emissions.

**MEP 361, MEP 370 Prerequisite:**

**(3:3,1) Energy Conversion MEP 472**

Review of indirect energy conversion systems, (ICE, gas turbine engines, steam pp): energy storage; thermoelectric; photovoltaic; magneto hydrodynamic gen.; fuel cells; other energy conversion systems.

**MEP 361** **Prerequisite:**

**(3:3,1) Power Plants MEP 473**

Energy demand and power generation systems. Steam and gas power cycles. Fuels and combustion. Basic and auxiliary systems of a steam p.p. Steam generator analysis. Steam turbines and their controls. Diesel engine and gas turbine power plants. Overall plant performance. Economics of power plants.

**MEP 360, MEP 361, IE 255** **Prerequisite:**

**(3:3,1) Turbo-machinery and Gas turbines MEP 474**

Fluid mechanics and energy transfer in turbo – machines, Centrifugal and axial compressors. Centrifugal and axial flow turbines. Applications, including industrial gas turbine engines and aircraft engines.

**MEP 360, MEP 370** **Prerequisite:**

**(3:3,1) Automotive Engineering MEP 476**

Alternative prime movers and electric vehicles; Spark ignition engine and Diesel engine fuel economy. Transmission system; Vehicle aerodynamics; Vehicle design; case studies.

**MEP 370** **Prerequisite:**

**(3:3,1) Renewable Energy MEP 478**

Review of heat transfer, solar angles, and solar radiation on earth's surface. Solar radiation on tilted surfaces. Radiation measurements. Solar collectors and concentrators, storage, photovoltaic, wind energy, geothermal energy. Other renewable energy sources.

**MEP 360, MEP 361** **Prerequisite:**

**(3:3,1) Thermal Desalination Processes MEP 481**

Electrolytic solutions, collegative properties, chemical treatment, venting. Multiple effect systems (MED), Multistage-flashing systems (MSF), Vapor compression systems VC, Dual-purpose plants (DPP), introduction to corrosion, Computer applications..

**MEP 360, MEP 361** **Prerequisite:**

**(3:3,1) Membrane Desalination Processes MEP 482**

Intake, pumping, Filtration, ion exchange, pretreatment, Membranes, Membrane technology, Reverse Osmosis systems (RO), principles, system design, RO membranes characteristics. Electrodialysis (ED), Other membrane processes, introduction to fouling, Computer applications.

**MEP 360, MEP 361** **Prerequisite:**

**(3:3,1) Desalination Plants MEP 483**

Comparison of different desalination systems. Development of desalination processes, characteristics of varies systems. System design and selection, intake and disposal, water pretreatment, post treatment processes, corrosion and material selection. Desalination system economy.

**MEP 482** **Prerequisite:**

**(3:3,1) Applied Fluid Mechanics MEP 490**

Differential forms of the governing equations for fluid flow. Inviscid flow, compressible flow, boundary layer flow. Flow machines, Flow in pipe networks with applications using computer codes.

**MEP 290** **Prerequisite:**

**(3:3,1) Pumps and Hydraulics MEP 492**

Pumps, Pumps types, Pump components, Pumps characteristics Curves. Systems Curves. Pumps Selections, Pumps connections: series and parallel. Hydraulics cycles. Design project.

**MEP 361, MEP 365** **Prerequisite:**

**(3:3,1) Computational Fluid Dynamics (CFD) MEP 493**

Introduction to CFD, Navier Stokes and Energy Equations, Partial Differential Equations (PDE's), Basics Of numerical methods for solving PDE's, Finite difference Methods for Hyperbolic, Parabolic, and Elliptic PDE's, Finite Volume Methods, Numerical Grid Generation, Applied CFD using a Commercial Package.

**MEP 360, EE 332** **Prerequisite:**

**(2:2,1) Applications in Thermal Eng. MEP 496**

The contents are directed to a particular application in the field of thermal engineering and prepared by the department.

**Instructor Approval** **Prerequisite:**

**(3:3,1) Selected Topics in Mech. Eng. MEP 497**

The content of this course will be prepared each year by the Thermal Eng. and Desalination. Tech. Dept.

**Instructor Approval** **Prerequisite:**

**(4:2,4) Senior Project MEP 499**

Selection of topic; literature review; project design planning arranging for data collection and experimental work, Interim report, Experimental work and data collection or field study (if any) Data processing Analysis and results. Preparation of the first draft of final report. Presentation of the project, Final report..

**MEP360, MEP361, MEP365, EE 332** **Prerequisite:**