

ELECTRONICS AND COMMUNICATIONS ENGINEERING PROGRAM



COURSE SYLLABI

EE 201 – COMPUTER PROGRAMMING I (3,3,1) 3 Credits
(Core course offered in Fall and spring)

Bulletin Description: 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

Prerequisites: Math 101, ELCE102

Textbooks: William J. Palm III, Introduction to MatLab 7 for Engineers, McGraw-Hill International Edition, 2005

References:

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. describe the basics of Matlab
2. apply Matlab to solve engineering problems
3. describe the fundamentals of programming
4. design simple programs
5. modularize the programs using functions

Course Topics:

- 1- Engineering Problems and the Need for Computer Solutions
- 2- Basics of MatLab: Menus – Toolbars – Computing with MatLab – Script Files and the Editor/Debugger – MatLab help System.
- 3- Arrays, Matrices and Matrix Operations.
- 4- User-Defined Functions.
- 5- Working with Data Files.
- 6- Basics of Programming: Algorithms - Pseudo Code - Flow Charts – Programming Structures.
- 7- Program Design and Development.
- 8- Relational Operations and Logical Variables.
- 9- Logical Operators and Functions.
- 10- Conditional Statements: if – else – elseif - switch
- 11- Loops: for – while – break – continue.
- 12- Debugging MatLab Programs.
- 13- Graphing Functions: XY Plots – Sub-Plots
- 14- Introducing Simulink.

Class Schedule:

Lecture: There are three hours of lectures per week. You have to attend all lectures.

Tutorials: There are two hours of lab per week, compulsory to attend. You will sign in.

Those who miss lab periods, miss points, and also suffer in the Final Exam

Course Contribution to Professional Component:

Engineering Science: 75 %

Engineering Design: 25 %

Course Relationship to Program Outcomes:

	Engineering Criteria											Program Criteria					
Program Outcomes	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	M	L	H		H						M		H	H			

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Drs Alaa Gowdah and Haitham Al-Angari

Last Updated: **October, 2007**

EE 202 – OBJECT-ORIENTED COMPUTER PROGRAMMING (3,3,1) 3 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: Object-oriented programming: classes, objects and methods. Object-oriented design. Simple data structures. Best programming practices (structured coding, documentation, testing and debugging)

Prerequisites: EE 201

Textbooks: Gary J. Bronson, A First Book of C++, 2nd ed Brooks/Cole Publishing Co, 2000.

References: Camal Gambi, Problem Solving Using C++, 3rd ed. (Arabic), Dar Al Hafiz Publishing, 1997.

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. identify different computer components including new technologies
2. recognize how computer programs work
3. analyze engineering problems
4. breakdown a problem situation into components (input, output, procedure)
5. describe the syntax and semantics of a C++ program
6. choose appropriate input and output methods and formats
7. choose appropriate control structures to account for different cases of input and different levels of accuracy
8. choose the best data type for a solution among simple and derived data types such as arrays, character strings, structures, and classes
9. modularize the programs using functions and classes in C++
10. design algorithms to solve scientific and engineering problems using computers
11. design and implement object-oriented programs

Course Topics:

1. Review basic computer information covered by level I
2. C++ program structure and data types and their operations
3. Input and Output functions
4. Assignment and Interactive input
5. Selection using if-else, nested if, and switch
6. Repetition using while, for, and do statements
7. Arrays including one dimensional and 2-dimensional arrays
8. Pointers and character strings
9. Functions, and their arguments
10. Structures and their applications
11. C++ classes and objects
12. Inheritance
13. Recursion
14. Simple algorithms (searching and sorting)

- 15. Testing and debugging
- 16. Documenting

Class Schedule:

Lecture: Two 75-minute lectures for 14 weeks
 Tutorials: One two hours lab/tutorial every week

Course Contribution to Professional Component:

Engineering Science: 75 %
 Engineering Design: 25 %

Course Relationship to Program Outcomes:

	Engineering Criteria											Program Criteria					
Program Outcomes	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	M	M	H		H				L		M		H	M			

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Dr. Ali H. Morfeg

Last Updated: October, 2007

EE 250 – BASIC ELECTRICAL CIRCUITS (4,3,2) 4 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: 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.

Prerequisites: PHYS 102, ELC 102

Textbooks: Alexander "Fundamentals of electric circuits", Second edition

References: Course website : <http://engg.kau.edu.sa/~aabdulwhab/ee250/>

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. understand fundamental electric quantities: voltage, current, electric power and energy.
2. identify the difference between dependant and independent voltage and current sources.
3. analyze and evaluate responses of circuits containing resistance, capacitance and inductance elements according to fundamental circuit laws.
4. calculate the currents and voltages in resistive circuits using Ohm's law, KCL, KVL, reduction of series and parallel resistances, and voltage and current divisions
5. find the node voltages in resistive circuits containing current sources and voltage sources using nodal analysis
6. find the mesh currents and branch currents in resistive circuits containing voltage sources and current sources using mesh analysis
7. analyze resistive circuits containing multiple sources by using superposition
8. apply Thevenin's and Norton's theorems to simplify a resistive circuit by finding the Thevenin or Norton equivalent of a two-terminal network
9. apply KVL, KCL, nodal and mesh analysis to circuits containing dependent sources.
10. apply the source transformation and Y- Δ transformation to simplify circuits.
11. evaluate maximum power transfer to a variable load resistance.
12. understand time varying voltage and current and appreciate sinusoidal signals in AC circuits.
13. evaluate effective or rms values of AC voltages and currents.
14. find the phasor voltage (current) for a given sinusoidal voltage (current), and find the sinusoidal voltage (current) for given phasor voltage (current) and frequency.
15. find the impedances of resistors, capacitors, and inductors for a given frequency
16. convert an AC steady-state circuit to a phasor circuit
17. analyze a phasor circuit using Ohm's law, KCL, KVL, reduction of series and parallel impedances, and voltage and current divisions
18. calculate AC steady-state power dissipated by the circuit elements in a circuit
19. understand the concepts of power factor, complex power, and conservation of power.
20. solve single and three phase circuits using VA method for the real, reactive and complex power supplied by, or consumed by any device in the circuit; and use reactive compensation for power factor improvement.
21. solve simple three-phase circuits to calculate any system voltage, current or power.
22. understand and be able to use per phase analysis to solve simple three-phase systems.
23. derive the voltage and current relationships for an ideal transformer.
24. work with a small team to carry out experiments in electric circuits and prepare reports that present lab work.

Course Topics:

EE 250	Topics	Time (week)
TOP_1	Fundamental electric quantities: voltage, current	0.25
TOP_2	Electric power and energy	0.25
TOP_3	Independent and dependant sources	0.5
TOP_4	Resistance, capacitance and inductance	0.67
TOP_5	Kirchhoff's laws (KVL & KCL)	0.67
TOP_6	Source equivalence and conversion	0.67
TOP_7	Mesh current (loop) analysis	1
TOP_8	Node voltage analysis	1
TOP_9	Super-position theorem	0.5
TOP_10	Δ/Y transformation	0.5
TOP_11	Thevenin's and Norton's theorems	1
TOP_12	Sinusoidal excitation, average and effective values	1
TOP_13	Complex numbers	1
TOP_14	Steady state a.c. circuit and impedance	1
TOP_15	Phasor diagrams	1
TOP_16	Maximum power transfer theorem	1
TOP_17	Power triangle and power factor correction	1
TOP_18	Balanced three phase circuits	1
TOP_19	Power measurement in three phase circuits	1
TOP_20	Ideal transformer	1

Class Schedule:

Lecture: There will be about three 50 minutes lectures per week. During the lectures, There might be a 5-minute pop quiz. Students may be asked to participate and answer questions

Tutorials: Students are highly encouraged to attend the tutorial sessions to practice solving practical problems. Lab attendance and participation is mandatory

Course Contribution to Professional Component:

Engineering Science: 85 %

Engineering Design: 15 %

Course Relationship to Program Outcomes:

Program Outcomes	Engineering Criteria											Program Criteria					
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	M	L		M	M		M		L	L	M		M	M			

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Dr. Abdulaziz Uthman Al-Abdulaziz

Last Updated: October 2007

EE 253 – ELECTRICAL AND ELECTRONIC MEASUREMENTS (4,3,3) 4 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: The course provides students with a back ground in electrical and electronic measurements and instrumentation. Terms related to electrical measurements are investigated. The function elements of a general measuring instrument, sources of error, and methods of error analysis are introduced. Principles, limitations, and applications of oscilloscopes, analog DC and AC ammeters and voltmeters will be studied. Ohmmeters, DC and AC bridges are analyzed. Power and reactive power measurements are covered. Electronic and digital measurement systems will also be given some consideration.

Prerequisites: EE301, IE331 (Concurrent)

Textbooks: A.K. Sawhney, " A Course in Electrical and Electronic Measurements and Instrumentation", DHANPAT RAI, Seventeenth Edition, 2004

References: Martin U, Reissland, Electrical Measurements: Fundamentals, Concepts, and Applications, New Age International Publishers, New Delhi, 2003

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. describe the instrument functions and define terms related to electrical measurements
2. demonstrate the different stages of the generalized measurement system
3. illustrate the error sources in measurements
4. apply statistical analysis of errors
5. calculate the probable and limiting errors
6. apply mathematical analysis of the uncertainty
7. demonstrate a practical representation of a general purpose cathode ray tube (CRT)
8. illustrate a block diagram of a basic oscilloscope and label each block
9. demonstrate the functions of the following: vertical amplifier, horizontal amplifier, sweep generators, and trigger circuit
10. distinguish the basic principle of operation of the dual trace oscilloscope
11. apply the oscilloscope to measure: the frequency and amplitude of a signal, the phase-shift between signals
12. identify the operation controls of a triggered oscilloscope and adjust the control
13. operate DC and AC voltage and frequency measurements with the oscilloscope
14. operate frequency and phase difference measurements using Lissajous patterns
15. classify the analog instruments
16. illustrate the functions and methods of producing the following forces: deflecting, controlling, and damping force
17. demonstrate principle of operation, construction, torque equations, temperature effect correction, loading effects, errors, and applications of the following instruments: permanent magnet moving coil, series type and shunt type ohmmeters
18. propose an Ayrton shunt across a meter movement to obtain specific meter readings of current
19. propose multipliers or shunts to obtain specific meter ranges of voltage and current
20. demonstrate construction, principle of operation, limitations, waveform error, and applications of a half-wave and full-wave rectifier type meters
21. investigate the principle of operation, frequency range, torque equation, errors, and applications of: moving iron meter, electro-dynamometer, and single phase electro-dynamometer wattmeter
22. employ instrument transformers in power measurements
23. carry out measurements of power in three phase circuits using: three-wattmeter's method, two-wattmeter's method, one wattmeter method, three-phase wattmeter
24. operate measurements of reactive power in single phase and three-phase circuits

25. analyze and indicate the applications of: Maxwell's inductance bridge, Maxwell's inductance capacitance bridge, Hay's bridge, Modified De Sauty's bridge, Heaviside mutual inductance bridge, Wien's bridge, Universal bridge
26. summarize sources of error in bridge circuits
27. Illustrate the advantages of an electronic measuring instruments
28. demonstrate principle of operation and applications of: the voltage attenuator, the current to voltage converter, the ac to dc converter, the resistance to voltage converter, peak and average detectors, and true rms value detector
29. illustrate the advantages of digital instruments
30. demonstrate principle operations and constructions of : A/D converter (ramp type), the decade counter, digital display units (7-segmental display), the decoder
31. illustrate organization, principle of operation, and applications of digital voltmeter
32. prepare and design experimental measurements of: dc voltage and current, ac voltage and current indicating waveform errors, resistance and power measurements
33. demonstrate effective teamwork both in planning and in carrying out experimental activities
34. prepare an engineering report that presents and analyzes laboratory work

Course Topics

EE 253	Topics	Time (Hrs)
TOP 1	Fundamental Measurement Concepts: terms related to electrical measurements, generalized measurement system, sources of errors, statistical analysis of errors, and uncertainty analysis.	6
TOP 2	Cathode Ray Oscilloscope: construction, principle of operation, and applications.	6
TOP 3	Analog instruments: principle of operation, types, and operating forces.	3
TOP 4	DC instruments: construction, principle of operation, torque equation, extension of range, Loading effects, temperature effect correction, limitation, errors, and applications of :(a) Permanent magnet moving coil. (b) Series and shunt type ohmmeters.	7
TOP 5	AC instruments: construction, torque equation, extension of range, limitations, and applications of: (a) rectifier type. (b) moving iron. And (c) electro-dynamometer type.	7
TOP 6	Measurement of power and reactive power in single-phase and three-phase circuits.	4
TOP 7	DC and AC Bridges.	3
TOP 8	Electronic instruments: attenuators, electronic converters and detectors.	3
TOP 9	Digital instruments: digital versus analog instruments, analog-to- digital ramp type conversion, decade counter, digital display units, and digital voltmeter	5
TOP 10	Lab activities	9
TOP 11	Project	0

Class Schedule: Lecture: Two one and a half hours sessions per week
 Tutorials/Lab: one two hours lab and one-hour tutorial sessions per week

Course Contribution to Professional Component:

Engineering Science: 100 %
 Engineering Design: %

Course Relationship to Program Outcomes:

P Outcomes	Engineering Criteria											Program Criteria					
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Av. attainable level of learning (*)	M	M		M	M	M	M	M			M	M	M				

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Dr. Ahmed Milyani

Last Updated: October 2007

EE 300 – ANALYTICAL METHODS IN ENGINEERING (3,3,1) 3 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: Linear algebra: matrices and determinants, eigenvalues and eigenvectors. Complex analysis: integration in the complex plane and residue analysis. Graphs, fundamental loops, fundamental cutsets.

Prerequisites: MATH 203

Textbooks: E. Kreyzig, Advanced Engineering Mathematics, 9th Ed, Wiley, 2006

References:

1. D. Zill and P. Shanahan, Complex Analysis, Jones and Bartlett, 2003.
2. F. Ayres, Matrices, McGraw-Hill, 1974.
3. W. Chen, Applied Graph Theory, North-Holland, 1976

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. understand the concept of scalars, vectors, and matrices
2. understand and construct simple mathematical proofs that are of engineering utility
3. recognize and handle some important classes of matrices: symmetric, ske-symmetric, involutory, idempotent, nilpotent, orthogonal, and orthonormal
4. recognize the linear dependency and independency of vectors
5. determine the existence of a square matrix inverse
6. calculate the matrix inverse using Gauss-Elimination method, the Gauss-Jordan method and the Cofactor method
7. solve linear equations using Gauss-Elimination method and Cramer's rule
8. understand the concept of graphs and directed graphs
9. apply the graph theory to obtain and relate the reduced incidence matrix, the fundamental cutset matrix, and the fundamental loop matrix, based on a specific choice of datum (reference) node and spanning tree.
10. write KCL and KVL for a given directed graph and express tree currents in terms of link currents and link voltages in terms of tree voltages
11. manipulate complex numbers in different basic mathematical operations
12. compute function values of complex variables
13. differentiate and integrate complex variable functions
14. understand the geometry of analytic functions and conformal mapping
15. manipulate various types of series: power, Taylor, and Laurent
16. apply Cauchy integration formula and residual theorem
17. use contour integration to evaluate real improper integrals

18. compute matrix eigenvalues and their associated eigenvectors and eigenspaces
19. apply the fundamental concepts of matrix eigenvalues in practical problems

Course Topics:

1. Complex numbers and operations
2. Special complex functions
3. Complex derivatives and conformal mapping
4. Various types of series: power, Taylor, and Laurent
5. Integration in the complex plane
6. Residue integration and it's applications
7. Introduction to linear algebra and vector spaces
8. Basic concepts, properties, and algorithms of matrices, their inverses and determinants
9. Eigenvalues and eigenvectors and their applications
10. Introduction to graph theory

Class Schedule:

Lecture: three one-hour or two one-and-a half-hour lectures per week
 Tutorials: one 2-hour tutorial per week

Course Contribution to Professional Component:

Engineering Science: 90%
 Engineering Design: 10%

Course Relationship to Program Outcomes:

	Engineering Criteria											Program Criteria					
Program Outcomes	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	M				M								M	M			

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Prof. Dr. Ali Muhammad Rushdi

Last Updated: October, 2007

EE 301 – ELECTRICAL CIRCUITS AND SYSTEMS (3,3,1) 3 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: 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.

Prerequisites: MATH 204 , EE 250

Textbooks: C. K. Alexander & M. N. Sadiqu, Fundamentals of Electric Circuits, 2nd ed., McGraw-Hill, 2004

References:

- 1) J. W Nilsson & S. Radio, Electric Circuits, 6th ed., Addison Wesley, 2001.
- 2) R. Strum & J. Ward, Electric Circuits and Networks, 2nd ed., Prentice Hall, 1985.
- 3) C. Paul, Analysis of Linear Circuits, McGraw-Hill, 1989.
- 4) W. Hayt & J. Kemmerly, Engineering Circuit Analysis, McGraw-Hill, 1993.
- 5) L. P. Huelsman, Basic Circuit Theory, Prentice-Hall, 1984.

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. identify the two types of resonance circuits
2. analyze resonance circuits to get the resonant frequency, corner frequencies, power, bandwidth, and quality factor
3. analyze electric circuits with magnetically-coupled elements
4. analyze the ideal op-amp circuits: inverting, non-inverting, adders, subtractors, integrators, and differentiators
5. analyze op-amp circuits to calculate the transfer function
6. differentiate whether or not a circuit has initial conditions, and find them if not given
7. transfer circuit elements into Laplace domain and solve circuits using Laplace transform method
8. calculate the Fourier Series coefficients of periodic signals
9. analyze electrical circuits of multiple periodic sources utilizing Fourier Series techniques
10. mathematically derive the Fourier Transform of non-periodic signals
11. analyze electrical circuits of non-periodic sources utilizing Fourier Transform techniques
12. derive the impulse response and the transfer function of linear systems using Fourier and Laplace Transforms
13. derive the convolution integral form of two signals
14. use the convolution integral to find the response of electrical circuits
15. use the graphical method of the convolution integral to find the electrical circuit response
16. differentiate between one-port and two-port networks

17. calculate the different parameters of two-port networks: Z-parameters, Y-parameters, H-parameters, G-parameters, transmission-parameters, and the inverse-transmission-parameters
18. analyze the terminated and non-terminated two-port networks
19. analyze two-port networks in different interconnections

Course Topics:

1. Operational Amplifiers (Chapter 5)
2. Magnetically Coupled Circuits (Chapter 13)
3. Frequency Response (Chapter 14)
4. The Laplace Transform (Chapter 15)
5. Applications of Laplace Transforms (Chapter 16)
6. Fourier Series (Chapter 17)
7. Fourier Transform (Chapter 18)
8. Two-Port Networks (Chapter 19)

Class Schedule:

Lecture: Sun & Tue. : 9:30 – 11:00
 Tutorials: Tue. : 2:30 – 4:20

Course Contribution to Professional Component:

Engineering Science: 100 %
 Engineering Design: 0 %

Course Relationship to Program Outcomes:

Program Outcomes	Engineering Criteria											Program Criteria					
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	M				M								M	M			

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Dr. Muhammad Ashenkeeti

Last Updated: October, 2007

EE 302 – ELECTROMAGNETIC FIELDS (3,3,1) 3 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: An introduction to electromagnetic fields. Topics include: Revision of Wave Motion, Introduction to Transmission Lines, Revision of Vector Algebra and Calculus, Electrostatics, Magnetostatics, and Magnetic Induction.

Prerequisites: EE 250, MATH 203

Textbook: Ulaby, F., Fundamentals of Applied Electromagnetics, Prentice-Hall, 2004 Media Edition

References: None

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. describe waves mathematically
2. classify waves in different ways of comparison
3. express time-harmonic waves in phasor form and vice versa
4. state the application criterion of transmission line theory
5. classify transmission lines according to their propagation modes
6. produce the voltage and current expressions along the transmission line
7. define the following transmission line parameters: propagation constant, phase constant, attenuation constant, and characteristic impedance
8. compute the reflection coefficient, SWR, and input impedance of the transmission line
9. identify the basic features of the standard three curvilinear coordinate systems
10. convert a vector from one coordinate system to another
11. explain the physical meaning of the gradient, divergence, and curl operations
12. compute the gradient, divergence, curl, and Laplacian of vector fields in different coordinate systems
13. compute the electric forces for system of point charges using Coulomb's law
14. compute the electric field of charge distributions using superposition integral
15. compute the electric field of symmetric charge distributions using Gauss's law
16. produce the electric potential of charge distributions using superposition
17. produce the electric potential from the electric field of charge distribution and vice versa
18. solve Poisson's or Laplace's equation to find the potential for simple symmetric cases
19. develop expressions for and apply the boundary conditions of electric field
20. explain the phenomenon of polarization inside dielectrics and its effect on the interior electric field
21. compute the capacitance of capacitors of different configurations
22. compute the stored electrostatic energy within an electric field region
23. use the image method to find the electric field of charge distributions near planar perfect electric conducting sheets
24. compute the magnetic force on a moving charge in a static magnetic field
25. compute the magnetic field due to different current distribution using Biot-Savart law
26. explain the non-divergence property of magnetic fields using Gauss's law for magnetism
27. use Ampere's law to find the magnetic field due to symmetric direct current distribution
28. develop expression for and apply the boundary conditions for magnetic fields
29. discuss the phenomenon of Hysteresis in magnetic materials
30. compute self and mutual inductance of different inductor configurations
31. compute the magnetic energy stored in static magnetic field region
32. discuss the analogy between electrostatics and magnetostatics
33. discuss Faraday's law of induction

34. compute the induced emf in stationary loops placed in a dynamic magnetic field (transformer emf)
35. compute the induced emf in a loop moving inside a stationary magnetic field (motional emf)
36. extend Ampere's law to the dynamic case
37. describe mathematically the coupling between dynamic electric and magnetic fields (Maxwell's equations)

Course Topics:

1. **Introduction to Waves & Phasors:** Dimensions, Units, & Notation; Nature of EM; Traveling Waves; The EM Spectrum; Review of Complex Numbers & Phasors
2. **Transmission Lines:** Introduction; Lumped Element Model; TL Equations; Wave Propagation on TL's; Lossless TL; Input Impedance of a TL
3. **Vector Analysis:** Vector Algebra; Coordinate Systems; Vector Calculus
4. **Electrostatics:** Maxwell's Equations; Charge & Current Distributions; Coulomb's & Gauss's Laws; Electric Scalar Potential; Electric Material Properties; Conductors & Dielectrics; Electric Boundary Conditions; Laplace's and Poisson's Equations; Capacitance; Potential Energy; Image Method
5. **Magnetostatics:** Magnetic Forces & Torques; Biot-Savart Law; Force between Parallel Conductors; Ampere's Law; Magnetic Boundary Conditions; Inductance; Magnetic Energy
6. **Time Varying Fields:** Faraday's Law; Stationary Loop in Time-Varying Magnetic Field; Ideal Transformer; Moving Conductor in Static Magnetic Field; Moving Conductor in a Time-Varying Magnetic Field; Continuity Equation

Class Schedule:

Lecture: 3 one-hour periods per week
 Tutorials: 1 two-hour period per week

Course Contribution to Professional Component:

Engineering Science: 100%
 Engineering Design: 0%

Course Relationship to Program Outcomes:

Program Outcomes	Engineering Criteria											Program Criteria					
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	L				M								L				

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Dr. Muntasir Sheikh

Last Updated: October, 2007

EE 311 – ELECTRONICS I (4,3,3) 4 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: Characteristics of diodes, bipolar junction transistors and field effect transistors. States/modes of operation of these devices. Large-signal and small signal circuit models. Application of these devices in basic electronic circuits: rectifiers, limiting circuits, regulated power supplies, logic circuits, electronic switches, amplifiers.

Prerequisites: EE 250

Textbooks: Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits (5th Ed), Oxford University Press, 2003

References: Rashid, Mohammed H., Microelectronic Circuits, PWS Publishing Company, 1998
Jacob Millman and Arvin Gabel, Microelectronic (2nd Ed), McGraw-Hill, 1987

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. reproduce the current-voltage characteristics of an ideal diode and a pn junction diode in a graph and as a functional relationship
2. identify and distinguish between different modes and regions of operation of a diode
3. Analyze diode circuits using graphical and iterative methods
4. prepare piecewise linear models of diodes and apply them to the analysis of diode circuits
5. sketch the load line and compute the operating point (bias point, quiescent point, Q-point) in a diode circuit
6. separate the complete analysis into DC analysis and AC analysis and produce the small signal model of diodes
7. analyze basic diode circuits (rectifiers, clippers, zener shunt regulators)
8. design a rectifier circuit and shunt regulated DC power supply
9. recall and sketch the Ebers-Moll model of a BJT
10. define and distinguish between different modes of operation of BJT
11. Analyze a BJT circuit having DC sources only
12. design a BJT biasing circuit
13. Analyze BJT amplifiers of various configurations
14. design a BJT amplifier with given gain, input and output resistance
15. define and distinguish between different modes of operation of FET
16. recall the current-voltage relation of FET
17. Analyze a FET circuit with DC sources only
18. design a FET biasing circuit
19. Analyze FET amplifiers of various configurations
20. design a FET amplifier with given gain, input and output resistance
21. conduct experiment to measure device (diode, BJT, FET) characteristics and report results
22. conduct experiments to measure characteristics of electronic circuits (rectifiers, clipping circuits, amplifiers) and report results

23. use ORCAD PSPICE in solving problems and designs
24. setup experiments to verify the performance of designed circuits
25. Collect info and report about an electronic device

Course Topics:

Ideal diodes and its i-v characteristic.

(2 weeks)

1. Terminal characteristic of junction diodes.
2. Techniques of the diode circuit analysis.
3. The small signal model of the diodes. (1 week)
4. Operation in the breakdown region the-zener diodes.
5. Application of diodes in typical circuits: rectifiers, regulated power supplies, logic gates, limiting circuits etc. (2 weeks)

Bipolar Junction Transistors (BJT's)

6. Physical structure, NPN and PNP transistors. (1 week)
7. Elebrs-Moll model and graphical representation of BJT characteristics.
8. Analysis of BJT circuits at DC: modes of operation, transistor as a switch, biasing the BJT. (2 weeks)
9. Transistor as an amplifier, graphical analysis, small signal equivalent circuit models. (2 weeks)
10. Analysis of basic BJT amplifier configurations.

Field Effect Transistors (FETs)

11. Current- Voltage characteristics of different types of FETs, regions of operation. (1 week)
12. Analysis of FET circuits at DC, biasing the FET. (2 weeks)
13. FET as an amplifier, graphical analysis, small signal equivalent circuit models. (2 weeks)
14. Analysis of basic FET amplifier configurations.

Class Schedule:

Lecture: two one and half hours sessions per week

Tutorials/Lab: one two-hours lab and one-hour tutorial sessions per week

Course Contribution to Professional Component:

Engineering Science: 65 %

Engineering Design: 35 %

Course Relationship to Program Outcomes:

P Outcomes	Engineering Criteria											Program Criteria					
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Av. attainable level of learning (*)	M	M	M		M	L	M		M		M		M				

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Dr. Solimanul Mahdi

Last Updated: October 2007

EE 312 – ELECTRONICS II (4,3,3) 4 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: 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, active filters. Logarithmic and exponential amplifiers, precision converters, analog multipliers, wave-shapers, sinusoidal and square wave oscillators.

Prerequisites: EE 311

Textbooks: Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits (5th Ed), Oxford University Press, 2003

References: Rashid, Mohammed H., Microelectronic Circuits, PWS Publishing Company, 1998

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. identify the components that influence the bandwidth of single and multistage common-emitter and common-collector BJT amplifiers
2. calculate the bandwidth of a given single and multistage BJT amplifier
3. design a single and multistage CE-CC BJT amplifier with specified bandwidth
4. identify the topology of amplifiers with feedback
5. convert feedback amplifiers into equivalent amplifiers without feedback
6. calculate the gain, input and output resistances of BJT feedback amplifiers
7. describe the external characteristics of op-amps
8. analyze the operation of linear analog circuits using ideal op-amps
9. design linear analog building blocks using op-amps, e.g., general adder/subtractors, differentiators, integrators, precision rectifiers, instrumentation blocks, analog computers, digital-to-analog and analog-to-digital converters
10. classify the type of a given filter
11. determine the type and the order of the filter needed to meet the specifications
12. calculate the poles of the required transfer function
13. design analog active filters with given specifications
14. estimate the implementation cost of BJT amplifiers, op-amp application and active filters
15. simulate and verify amplifiers and filters using CAD tools
16. prepare a PCB for a given analog design using CAD tools
17. work in a team effectively

Course Topics:

1. Review of basic BJT Amplifiers
2. Frequency response
3. Feedback Amplifiers
4. Operational Amplifiers
5. Filters and Tuned Amplifiers

6. Signal Generators
7. Project

Class Schedule:

Lecture: two one and half hours' sessions per week

Tutorials/Lab: one two hours lab and one-hour tutorial sessions per week

Course Contribution to Professional Component:

Engineering Science: 65 %

Engineering Design: 35 %

Course Relationship to Program Outcomes:

	Engineering Criteria											Program Criteria					
P Outcomes	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Av. attainable level of learning (*)	M	M	H	M	H						M						

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Dr. Ashraf Uddin

Last Updated: October 2007

EE 321 – INTRODUCTION TO COMMUNICATIONS (4,3,3) 4 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: 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, TDM, PCM.

Prerequisites: EE 301

Textbooks: B. P. Lathi, “Modern Digital and Analog Communication Systems”, Oxford University Press, 3rd edition, 1998.

References: 1. S. Haykin, “Communication Systems”, 4th edition, Wiley.
2. A. Bruce Carlson, Paul B. Crilly, Janet C. Rutledge, “Communication Systems: An Introduction to Signals and Noise in Electrical Communications”, 4th edition, McGraw-Hill, 2002

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. classify a signal as an energy or power signal
2. classify a system as linear or non-linear, time-varying or time-invariant, causal or non-causal
3. define impulse response and transfer function of a system
4. evaluate impulse response and transfer function of a LTI system
5. compute the output of a system for a given input
6. classify a filter as low-pass, band-pass, band-reject, or high-pass
7. apply Fourier series and transform to analyze LTI systems with periodic and non-periodic inputs
8. apply convolution to evaluate the output of a LTI system
9. define and find the bandwidth of a LTI system
10. define modulation
11. explain the need for, and list basic applications of, modulation
12. define and write mathematical expressions for different types of AM modulation
13. analyze AM modulated signals in time and frequency domains
14. compute the power and bandwidth of an AM modulated signal
15. analyze of operation of AM modulators and demodulators
16. define and write mathematical expressions for angle modulation
17. analyze angle-modulated signals in time and frequency domains
18. compute the power and bandwidth of an angle-modulated signal
19. analyze of operation of angle modulators and demodulators
20. analyze or design a frequency division multiplexer
21. analyze or design a superheterodyne receiver

22. explain the sampling theorem and its applications in A/D conversion and time division multiplexing
23. explain the principles of PAM, PWM, PPM, PCM
24. analyze a PAM/TDM system

Course Topics:

1. Classifications of signals and systems. Energy and power signals, Linear time invariant systems (LTI), Fourier series representation, Fourier transform, Spectral properties and bandwidth, unit step and unit impulse functions, Impulse response and transfer function of linear systems, Filters (LPF, HPF, and BPF)
2. Amplitude modulation (Double side-band - Large carrier (DSB-LC)), Double side-band - Suppressed Carrier (DSB-SC), Single side-band (SSB); Hilbert Transform , Vestigial side-band (VSB); Spectral analysis, modulators, demodulators, Super heterodyne receiver.
3. Frequency modulation, Phase modulation; spectral analysis, bandwidth, generation, detection, discriminators, phase-locked-loop (PLL), Frequency division multiplexing (FDM)
4. Sampling theorem, Pulse amplitude modulation (PAM), Time-division multiplexing (TDM), Pulse width modulation (PWM), Pulse position modulation (PPM), Pulse code modulation (PCM)

Class Schedule:

Lecture: 3 one-hour periods per week

Tutorials/Lab: one two hours lab and one-hour tutorial sessions per week

Course Contribution to Professional Component:

Engineering Science: 85 %

Engineering Design: 15 %

Course Relationship to Program Outcomes:

	Engineering Criteria											Program Criteria					
Program Outcomes	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	M		M		M								L	M			

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Dr. Abdullah Dobaie

Last Updated: October 2007

EE 331 – PRINCIPLES OF AUTOMATIC CONTROL (4,3,2) 4 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: 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

Prerequisites: MATH 204, EE 300, and EE 301

Textbooks: B.C. Kuo, Automatic Control Systems, 7th ed., Prentice-Hall, 1995.

References: K. Ogata, Modern Control Engineering, 3rd ed, Prentice Hall, 1991

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. describe some practical examples and draw the corresponding block diagram
2. explain the difference between the open and closed loop control system
3. apply the MATLAB in solving mathematical problems
4. develop mathematical models (differential equations, state - variables, transfer functions) for a variety of dynamic physical systems
5. apply the theory of Signal Flow Graph in finding the transfer function of the systems
6. analyze the control system using the state - variables approach
7. analyze the control system in the time domain (steady state error and transient response)
8. analyze the stability of linear control system using (direct method, Routh - Hurwitz Test, and the Root Locus plot)
9. designing feedback control systems
10. gain experience in technical writing, and improve communication skills

Course Topics:

1. Introduction (1 week)
2. Mathematical Background (2 weeks)
3. Transfer Function, Block Diagram, and Signal Flow Diagram (2 weeks)
4. Modeling of Physical Systems (2 week)
5. State Variable (2 weeks)
6. Time Domain Analysis (1 week)
7. Stability of Linear Control Systems (1 week)
8. Root Locus Techniques (2 weeks)
9. Designing of feedback systems (2 weeks)

Class Schedule:

Lecture: two of one-and-a-half hour lectures per week
Tutorials: a two-hours lab/tutorial per week

Course Contribution to Professional Component:

Engineering Science: 90 %

Engineering Design: 10 %

Course Relationship to Program Outcomes:

	Engineering Criteria											Program Criteria					
Program Outcomes	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	L		M		M		M				M		M	M			

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Prof. Dr. Ali Hasan Bamani**Last Updated: October, 2007**

EE 332 – COMPUTATIONAL METHODS IN ENGINEERING (3,3,1) 3 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: Introduction, The IMSL library, 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. Circuit applications

Prerequisites: EE 201, MATH 204

Textbooks:

References:

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. describe concepts and techniques for numerical analysis, methods and algorithms
2. define solutions of equations in one variable
3. define solutions of equations in multi variables
4. apply the curve fitting method for experimental data
5. define the numerical differentiation and integration
6. apply the initial value problem
7. solve simple problems given at the end of each topic using hand and scientific calculator
8. apply the various learned algorithms and methods using structured programming

Course Topics:

1. Mathematical backgrounds
2. Solution of equations in one variable. It is also called root-finding problem: the Bisection algorithm, fixed point Iteration, the Newton Raphson Method, the Secant Method, the Graphical Method.
3. Direct Methods Of Solving Linear Systems: Linear System of Equations, Gaussian Eliminations and Backward Substitution and Gauss-Jordan Methods, Linear Algebra and Matrix Inversion, the Determinant of a Matrix, Iterative Techniques for Solving Linear Systems. (Gauss-Siedel Algorithm).
4. Numerical Solutions Of Non-Linear Systems Of Equations: Fixed Points for Functions of Several Variables, Newton's Method.
5. Curve Fitting: Lagrange Method, Divided-Difference Method, Discrete Least Squares Approximation.
6. Numerical Differentiation and Integration: Numerical Differentiation, Numerical Integration, Composite Numerical Integration.
7. Initial Value Problems (Single And Multi-Variables) (Out Of Text): Euler Method, 2nd-order Runge-Kutta Method, 4th-order Runge-Kutta Method.
8. Overall review and applications

Class Schedule:

Lecture: two one and half hours sessions per week

Tutorials: one two hours session per week

Course Contribution to Professional Component:

Engineering Science: 75 %

Engineering Design: 25 %

Course Relationship to Program Outcomes:

	Engineering Criteria											Program Criteria					
Program Outcomes	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	L	M	H	H	M	M	H	M	M		M		M	M			

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Dr. M. Alfheid**Last Updated: October 2007**

EE 351 – ELECTRICAL POWER SYSTEM I (4,3,2) 4 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: 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.

Prerequisites: EE 250

Textbooks: Hadi Saadat, "Power System Analysis", McGraw-Hill, 2nd ed, 2004.

References: William D. Stevenson., "Electrical of Power System Analysis", fourth edition, Mc Graw-Hill, 1982

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. apply concepts from basic electromagnetics to determine the inductance, capacitance, and resistance of single and three phase transmission lines.
2. derive the relationships between the voltage and current on a transmission line, and be able to solve for the voltage or current at any point along the line
3. derive the model for short, medium and long transmission line
4. know the standard model for a real transformer and understand how winding losses, eddy currents, hysteresis losses, leakage flux, and finite magnetic permeability affect the model parameters
5. derive the voltage and current relationships for the ideal and practical transformer models
6. understand the rationale behind per unit analysis, and be able to use per unit analysis to solve single and three phase circuits
7. understand the single line diagram and be able to derive the impedance and reactance diagrams
8. Analyze power systems under abnormal operating conditions (symmetrical short circuit)
9. assess tariff systems
10. understand basic protection systems
11. calculate the most economical cross sectional area of a conductor

Course Topics:

Topics	Weeks
1. Basic concepts	2.0
2. Impedance of transmission lines (introduction)	1.0
3. Inductance of transmission lines	1.0
4. Three phase inductance of transmission lines	0.5

5. Three phase inductance of parallel transmission lines	0.5
6. Capacitance of transmission lines	1.0
7. Three phase capacitance of transmission lines I & 2	1.0
8. Transmission line modeling	0.5
9. Medium transmission line modeling	0.5
10. Long transmission line modeling	0.3
11. Long transmission line Hyperbolic form of the equations	0.3
12. Power flow through a transmission line	0.3
13. Transformer modeling	1.0
14. Per-Unit Representation	1.0
15. Power System Representation	1.0
16. Short circuit conditions (symmetrical three phase S/C)	2.0
17. Most economical cross sectional area of a conductor	0.3
18. Tariff	0.3
19. Power system protection	0.3

Class Schedule:

Lecture: three 50 minutes sessions per week

Tutorials/Lab: one two hours session per week

Course Contribution to Professional Component:

Engineering Science: 100 %

Engineering Design: %

Course Relationship to Program Outcomes:

Program Outcomes	Engineering Criteria											Program Criteria					
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	M				L			L			M		L	L			

* L: Objective addresses outcome slightly, M: Moderately, H: Substantially

Prepared by: Dr. Ahmed Abdulwahab

Last Updated: October, 2007

EE 360 – DIGITAL DESIGN I (4,3,2) 4 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: Digital Design I is a study of the basic principle of logic design. It enables the student to apply switching theory to the solution of the logic design problems, network design using a variety of algebraic and graphical techniques such as Boolean Algebra and Karnaugh Maps among others. A wide variety of multiple-output networks such a MUX, Decoder, ROM, and PLA are made handy to the student for designing complex combination networks. Special emphasis on the study of flip-flops memory devices enables the student to design several sequential network such as counters, code converters, shift registers and similar networks.

Prerequisites: EE 311

Textbooks: Charles H. Roth Jr., Fundamentals of Logic Design, 4th Ed. Thomson Brooks, 2004. ISBN: 0534 37804 4

References: M. Mano, Digital Design, Prentice Hall Inc., 2002

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. describe and convert the different number systems and codes
2. apply various techniques to simplify Boolean functions
3. design multi-level and multiple output gate networks
4. use multiplexers and decoders to design basic combinational circuits
5. design a ROM to realize given Boolean functions
6. design a PLA to realize given Boolean functions
7. design combinational Networks
8. compare between the functions of different Flip-Flops, their merits and applications
9. use Flip-Flops to design digital Counters
10. design shift registers and similar sequential networks
11. design and implement sequential networks such as counters, code converters, shift registers and similar networks
12. use software tools to design, simulate, test, and document digital systems

Course Topics:

1. Number systems and codes
2. Boolean Algebra, Logic Gates, Karnaugh Maps
3. Mutli-level gate network, Multiple output networks
4. Multiplexers, Decoders
5. Read-only memories (ROM), Programmable Logic Arrays (PLA)
6. Design of Combinational Networks
7. Flip-Flops, Design of Digital Counters
8. Design of Shift Registers and similar Sequential Networks

Class Schedule:

Lecture: two 1.5 hour sessions per week
 Tutorials: One two lab/tutorial hours per week

Course Contribution to Professional Component:

Engineering Science: 75 %
 Engineering Design: 25 %

Course Relationship to Program Outcomes:

	Engineering Criteria											Program Criteria					
Program Outcomes	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	M	H	H		H	L	H		L		H		H	M			

*L: Low level (Knowledge & Comprehension), M: Medium (Application & Analysis), H: High (Synthesis & Evaluation)

Prepared by: Dr. Adnan Kaki

Last Updated: October 2007

EE 390 – SUMMER TRAINING (10 weeks) (2,0,0) 2 Credits
(Core course offered in every summer)

Bulletin Description: 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.

Prerequisites: EE 321, EE 331, IE 331

Textbooks: None.

References: None.

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

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.

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: <ul style="list-style-type: none"> 1. Apply engineering practices related to his specialization. 2. Enhance team work skills. 3. Relate practical work to his engineering knowledge. 4. Use modern engineering tools such as equipment and computer software. 5. Use project management techniques. 6. Complete assigned tasks on time with high quality. 7. Develop personal communication skills. 	6

Class Schedule:

Lecture:

Tutorials/Lab: Oral Presentation after submitting a written training report; both evaluated by at least 2 faculty members

Course Contribution to Professional Component:

Engineering Science:

Engineering Design: 100 %

Course Relationship to Program Outcomes:

P Outcomes	Engineering Criteria											Program Criteria					
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)			M	M	M	H	H	M	M	M	H						

* L: Objective addresses outcome slightly, M: Moderately, H: Substantially

Prepared by: Dr. Bahattin Karagözoğlu

Last Updated: June 2008

EE 411 – DIGITAL ELECTRONICS (4,3,3) 4 Credits
(Core course offered in both Fall and Spring term)

Bulletin Description: Switching of electronic devices. Integrated circuit gates, multivibrators, registers, charge coupled device. Memories. Digital to analog and analog to digital converters.

Prerequisites: EE 311, EE 360

Textbooks: Weste & Harris, CMOS VLSI Design: A Circuits and Systems Perspective, Addison Wesley, 3rd ed, 2005.

References: M. Morris Mano, Digital Design, 3rd ed, Prentice Hall; 2001.

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. map gate level designs into transistor level in different logic families
2. describe the general steps required for processing of CMOS integrated circuits
3. have an understanding of the characteristics of MOS transistors
4. estimate and optimize combinational circuit delay using RC delay models and logical
5. estimate and optimize interconnect delay and noise
6. design for higher performance or lower area using alternative circuit families
7. describe and avoid common CMOS circuit pitfalls and reliability problems
8. use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnects
9. create models of moderately sized CMOS circuits that realize specified digital functions
10. apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality and timing
11. understand the concepts and techniques of modern integrated circuit design and testing (CMOS VLSI)
12. have experience designing and simulating integrated circuits using Computer Aided Design (CAD) tools
13. complete a significant VLSI design project having a set of objective criteria and design constraints
14. estimate and optimize circuit area

Course Topics:

Topic	Weeks in teaching
1. MOS Transistors	1.0
2. CMOS Logic	1.0
3. CMOS fabrication and layout	1.0
4. CMOS ideal I-V characteristics	1.0
5. CMOS C-V characteristics	0.5
6. CMOS nonideal I-V effects	1.0
7. DC transfer characteristics	0.5
8. Switch-level RC delay models	1.0
9. Delay estimation	1.0
10. Logical effort and transistor sizing	1.0
11. Interconnect delay estimation	0.5
12. Wire engineering	0.5
13. Combinational circuit design	2.0
14. Sequential circuit design	1.0
15. verilog simulation tool	0.5
16. magic layout tool	0.5

Class Schedule:

Lecture: two one and half hours sessions per week

Tutorials/Lab: one two hours session per week

Course Contribution to Professional Component:

Engineering Science: 60 %

Engineering Design: 40 %

Course Relationship to Program Outcomes:

Program Outcomes	Engineering Criteria											Program Criteria		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Average attainable level of learning (*)	M		H		M		M					M		M

* L: Objective addresses outcome slightly, M: Moderately, H: Substantially

Prepared by: **Dr. Mohammad H. Awedh**

Last Updated: **June, 2008**

EE 413 – COMMUNICATION CIRCUITS (4,3,3) 4 Credits
(Core course offered in both Fall and Spring term)

Bulletin Description: Behavior of Transistors at high frequencies. Analysis and design of electronic circuits employed in electronic and communication systems.

Prerequisites: EE 312

Textbooks:

References:

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. analyze single and multistage band-pass amplifiers consisting of parallel resonant circuits, mutual inductance, BJT, and FET
2. design single and multistage band-pass amplifiers with specific gain, center frequency, and bandwidth
3. analyze class A transformer coupled, class AB transformer coupled, and complementary symmetry power amplifiers
4. design power amplifiers with specified output power and load resistance
5. analyze Colpitts, Clapp, Hartley, collector-tuned, and crystal oscillators
6. design an oscillator with specified frequency and load resistance
7. analyze the nonlinear characteristics of BJT, FET, and different amplifiers
8. design a frequency multiplier
9. analyze BJT and FET mixer circuits
10. design a mixer circuit
11. analyze differential-pair and tuned-circuit AM modulators
12. design an AM modulator
13. analyze FM modulator circuits with varactor diodes or reactance modulators
14. design an FM modulator
15. analyze a balanced modulator/demodulator IC under different input conditions
16. employ a balanced modulator/demodulator IC for the generation and detection of AM signals and as a phase detector
17. design an FM detector using PLL
18. build and test some of the circuits designed above
19. simulate some the circuits designed above

Course Topics:

Topic	Weeks in teaching
1. Bandpass amplifiers: capacitance coupled and mutual inductance coupled single tuned circuits, impedance level control using t	3.0
2. Nonlinearity in amplifiers: harmonic distortion, intermodulation and cross modulation distortions, mixers, up-conversion, dow	1.0
3. Typical balanced modulator-demodulator IC: analysis and applications. Modulation and demodulation circuits for DSB/SC AM sign	2.0
4. Phase-locked loops: lock-in range, capture range and applications, frequency synthesis, FM detection.	2.0
5. Angle modulator circuits: generation of NBFM and NBPM using varactor diodes, BJT and FET angle modulators. Direct and indirec	1.0
6. Pulse Modulation circuits.	1.0
7. AM and FM demodulators: envelope detector, slope delector, balanced discriminator, zero-crossing FM detector.	1.0
8. Audio power amplifiers: maximum-dissipation hyperbola, inducator- and transformer-coupled classes power amplifiers, class B p	2.0
9. Receivers: superheterodyne recievers, choice of intermediate and local oscillator frequencies, image and other spurious respo	1.0
10. Noise: power spectral density, thermal noise, available noise power, noise voltage, other types of noise, noise equivalent ba	1.0

Class Schedule:

Lecture: two one and half hours sessions per week

Tutorials/Lab: one two hours session per week

Course Contribution to Professional Component:

Engineering Science: 65 %

Engineering Design: 35 %

Course Relationship to Program Outcomes:

Program Outcomes	Engineering Criteria											Program Criteria		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Average attainable level of learning (*)	M	H	H		M							H		M

* L: Objective addresses outcome slightly, M: Moderately, H: Substantially

Prepared by: Prof. Dr. Khalid Nabulsi

Last Updated: October, 2007

EE 418 – Microwave and Optical Devices (3,3,1) 3 Credits
(Elective course offered in Spring terms only)

Bulletin Description: 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 Tunnel. 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.

Prerequisites: EE 423

Textbooks:

References:

Course Learning Objectives (CLO)

1. The ability of the students to distinguish between 2-Terminals & 3-Terminals Microwave Devices.
2. The students will be in position to distinguish between Wide-Gap Semi-Conductor's Devices such as Ga N-Gunn Diode, 3C SiC and Ga N- Impatt Diode and Normal-Gap Semi-Conductor Devices both in terms of power, frequency and applications
3. The students will be able to select the proper active device and Circuitry which goes with it in order to meet the required performance and according to both the given specifications and applications.
4. The students will be able to calculate most of the parameters which influence the oscillator performances such as the quality factor of the oscillator, temperature stability, frequency and power stabilities, long and short stabilities, noise and tunability.
5. The Students will be able to calculate the quality factor of the negative resistance Oscillators.
6. The Students will be capable to derive detailed expressions for temperature, power & frequency stabilities and tunability of the oscillator.
7. Each student will be familiar in selecting the proper methods of stabilizing the oscillator (these methods can be injection locking, Transmission & Reflection type's cavity, using Delay line, Discriminator and Phase lock ...etc.)
8. Each individual student will be able to choose one of the proper methods of tuning the negative resistance oscillator (These methods can be either electronically by using varactors diode or digitally by using pin diode, or optically by using LED diode, or by using laser tuning, or magnetic tuning, or by using YIG Sphere or by using bias tuning or by using mechanical tuning).
9. The students will be in position to know the content of negative resistance.
10. The students will be able to design more stable, low noise, high gain and reliable 2-Terminal amplifier.

11. The students will be capable of designing 3-Terminal microwave devices with high reliability, high gain, low FM noise, and low temperature noise and with good matching networks.
12. The students will be able to compute all kind of the amplifier's noises, Intermodulation Distortion, and compression gain, scattering matrix and the input & output matching networks, maximum gain amplifiers, gain compression unilateral gain and the noise figure.
13. Identification of the difference between the negative resistance oscillators and amplifiers.
14. Calculation of the amplifier stability, gains and noise circles.
15. Test for Unconditional Stability of the amplifiers and calculating the unilateral figure of merit.

Course Topics:

Topic	Weeks in teaching
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, HFET and HEMT. Design of a high quality stable and tunable microwave oscillators. Design a high gain, low both FM noise and noise Figure .Low intermodulation distortion	2.0
2. Structure, Analysis and Principle of operation of some selected 2-terminal Devices such as Gunn diode, Impatt diode . . . etc.	1.0
3. Analysis and the principle of operation of some selected 3-terminal Devices such as MESFET, HEMT, and 3H-SiC FET. Etc.	1.0
4. Studying the oscillator long term and short term stabilities, Power Stability, Power supply stability, frequency stability, Temperature Stability, Pushing and Pulling Factors and Tenability of the oscillator.	1.0
5. Oscillator's Structure (2-Terminal or 3-Terminal Active Source, Heat Sink, A suitable circuit which consists of a Low Pass Filter which is to allow the DC Power Supply through and attenuated the R F Signal +Transformer in order to match the impedance of the active element to the circuit + DC Block to stop the DC supply to go to the output + MOS Connectors, Tuning Element, Power Supply either Current or Voltage Source and A jig to support the circuitry).	2.0
6. Microwave Oscillator's Stability Type (Optical Stability, Reflection Type cavity stability, Transmission Type cavity stability, Dielectric resonator stability, Discriminator stability, Delay line stability, Laser injection locking stability, optical injection locking stability, Amplitude and Phase locking) .	1.0
7. Small- signal Amplifier Design (Stability considerations-Parameters for 3-Terminal Active Source, Power Gain Concepts, Impedance Matching, Concept for Low -Noise Amplifiers, Concept Module For Power Amplifiers, Planar Lines Design and Two Port S- Parameters, Low Noise Figure, Low Temperature Noise and Low Intermodulation Distortion).	4.0
8. Analysis and design of 2-Terminal Amplifier (Reflection and Transmission types+ linear amplifier)	3.0

Class Schedule:

Lecture: two one and half hours sessions per week

Tutorials/Lab: one two hours session per week

Prepared by: Prof. Dr. Adnan Affandi

Last Updated: June, 2008

EE 421 – COMMUNICATION THEORY I (4,3,3) 4 Credits
(Core course offered in both Fall and Spring term)

Bulletin Description: 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.

Prerequisites: EE 321, IE 331

Textbooks: A. B. Carlson, P. B. Crilly, and J. C. Rutledge, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, McGraw-Hill, 4th ed, 2002.

References:

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. define and compute the autocorrelation function of a power signal, energy signal, or periodic signal
2. define and compute the cross-correlation between two power signals, energy signals, or periodic signals
3. explain the physical meanings of autocorrelation and cross-correlation
4. compute the energy, power and spectral density of a signal
5. compute the autocorrelation and spectral density of the output of a LTI system given the input
6. compute the cross-correlation between the input and output of a LTI system
7. define a random variable
8. compute the mean, variance and standard deviation of a random variable
9. describe uniform, Gaussian and exponential distributions
10. describe binomial and Poisson distribution
11. compute the probability density of a function of a random variable
12. define a random process
13. define ergodic, stationary, and wide-sense stationary random processes
14. define the autocorrelation of a random signal and the cross-correlation between two random signals
15. analyze the response of a LTI system to a random signal
16. analyze the Gaussian random process through LTI systems
17. define and compute the power spectral density of a random signal
18. define white noise
19. define noise-equivalent bandwidth of a system
20. compare 3dB bandwidth and noise equivalent bandwidth of a system

21. define narrow-band and wide-band noise
22. derive the low-pass equivalent model for a band-pass noise process
23. derive the optimum receiver for a given transmitted signal
24. implement the matched filter using a tapped-delay-line filter
25. apply probability theory to analyze the performance a communication system
26. analyze the effects of noise on baseband systems
27. design a tapped-delay-line equalizer for a baseband system
28. explain the types and sources of distortion in signals
29. analyze, and compute bit error probability for, binary and M-ary digital systems
30. analyze and compute the signal to quantization noise in PCM
31. analyze and compute the signal to quantization noise in DPCM and delta modulation
32. analyze the bit error rate for generative and non-regenerative repeaters
33. analyze the effects of noise on analog modulation systems
34. compare different transmission systems with respect to their noise immunity

Course Topics:

1. Review of Fourier Analysis and Linear System Theory (0.5 week)
2. Correlation and Spectral Density (1 week)
3. Sampling and Pulse Modulation (1.5 week)
4. Review of Probability and Random Variables (1.5 week)
5. Random Signals and Noise (3 weeks)
6. Noise in Analog Modulation (3.5 weeks)
7. Baseband Digital Transmission (2 weeks)
8. Digitization Techniques for Analog Messages and Networks (1 week)

Class Schedule:

Lecture: three 50 minutes sessions per week
 Tutorials/Lab: one two hours session per week

Course Contribution to Professional Component:

Engineering Science: 90 %
 Engineering Design: 10 %

Course Relationship to Program Outcomes:

Program Outcomes	Engineering Criteria											Program Criteria		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Average attainable level of learning (*)	M	M	M		M			L			H	H	H	H

* L: Objective addresses outcome slightly, M: Moderately, H: Substantially

Prepared by: Dr. Ahmed Balamesh, Last Updated: October, 2007

EE 423 – ELECTROMAGNETIC WAVES (4,3,3) 4 Credits
(Core course offered in both Fall and Spring term)

Bulletin Description: 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.

Prerequisites: EE 302, MATH 204

Textbooks: A. B. Carlson, P. B. Crilly, and J. C. Rutledge, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, McGraw-Hill, 4th ed, 2002.

References:

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. produce the general equations for electromagnetic wave propagation
2. explain electromagnetic wave propagation in dielectrics and define loss tangent
3. explain electromagnetic wave propagation in conductors and define skin depth
4. describe electromagnetic wave power transmission using the Poynting theorem
5. define the polarization of an electromagnetic wave
6. describe reflection and transmission of waves incident from one material to another
7. use the Smith chart to develop impedance matching networks
8. identify design and analysis equations for microstrip transmission lines
9. explain the behavior of transient signals on a terminated transmission line
10. investigate the dispersion of a signal pulse as it travels along a transmission line
11. develop equations governing wave propagation in rectangular waveguide
12. describe propagation modes, cut-off frequency, impedance, and wave propagation in rectangular waveguide
13. discuss propagation modes and field distribution in dielectric waveguide
14. define the sources of noise that lead to electromagnetic interference
15. develop circuit models to account for non-ideal behaviour of conductors, resistors, capacitors, and inductors
16. use Fourier series to determine the frequency components present in a digital signal, and hence determining the possibility of causing interference

17. define electrical grounds and provide guidelines for their design
18. use shields and filters to decrease electromagnetic interference
19. design the dielectric-constant profile of an optical fiber to achieve optimal dispersion characteristics

Course Topics: (each topic is covered in approximately one week)

1. Review of Maxwell's Equations and Their History
2. Review of Linear Systems In Time and Frequency Domains
3. Plane Waves In Multi Regions (Normal Incidence)
4. Electric Field Polarization and Poynting Theorem and Power flow
5. Plane Waves In Multi Regions (Oblique Incidence)
6. Optics(Snell's) Laws of Reflection and Refraction
7. Parallel Plate Waveguide (TE&TM modes)
8. Rectangular Waveguide (TE&TM modes)
9. Circular Cylindrical Waveguide (TE&TM modes) : Bessel Functions
10. Rectangular and Circular Cylindrical Cavity Resonators (TE&TM modes)
11. Transmission Line Theory: Voltage and current equations
12. Lossy and Lossless Lines, Attenuation and Propagation
13. Input and Characteristic Impedances of the Line
14. Smith Chart and Matching Techniques
15. Measurements Techniques

Class Schedule:

Lecture: three 50 minutes sessions per week
 Tutorials/Lab: one two hours session per week

Course Contribution to Professional Component:

Engineering Science:
 Engineering Design:

Course Relationship to Program Outcomes:

Program Outcomes	Engineering Criteria											Program Criteria		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Average attainable level of learning (*)	L		H		L						L		M	M

* L: Objective addresses outcome slightly, M: Moderately, H: Substantially

Prepared by: Prof. Dr. Khalid Nabulsi
Last updated: October, 2007

EE 424 – ANTENNAS AND PROPAGATION (3,3,1) 3 Credits
(Core course offered in both Fall and Spring term)

Bulletin Description: 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.

Prerequisites: EE 423

Textbooks:

References:

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. describe the mechanism of radiation and current distribution on thin wire antennas
2. define the following antenna parameters: radiation pattern, radiation power density, radiation intensity, beamwidth, directivity, antenna efficiency, gain, beam efficiency, bandwidth, polarization, input impedance, antenna radiation efficiency, antenna ve
3. apply the concepts of wave and antenna polarization to obtain the polarization loss factor and efficiency of transmitting/receiving antenna pairs
4. derive expressions for antenna input impedance based on transmitting and receiving equivalent circuits
5. derive expressions of radiated electric and magnetic fields using vector potentials for electric and magnetic sources
6. develop expressions for the radiated fields of infinitesimal and small dipoles
7. identify the antenna radiation regions (reactive near-field, radiating near-field, and far-field)
8. develop an approximation for the current distribution of finite-length dipoles and use it to derive expressions for radiated fields in the far-zone
9. produce finite-length dipole parameters (power density, radiation intensity, radiation resistance, directivity, directivity, and input resistance)
10. discuss the effect of increasing dipole length on radiation pattern and input impedance
11. develop expressions for the radiated fields and input impedance of small circular loop antennas
12. identify the equivalence of radiated fields of the small circular loop with those of the infinitesimal magnetic dipole
13. develop expressions for the radiation pattern of an equally-spaced linear array of identical elements
14. discuss the principle of pattern multiplication
15. define the important array factor parameters: side-lobe-level, grating lobes, first-null beamwidth
16. choose the spacing and progressive phase shift of a uniform linear array to produce desired pattern characteristics (i.e., broadside, endfire, and scanning arrays)
17. choose the number of elements of a uniform linear array to achieve the desired directivity, in conjunction with other design parameters
18. discuss the concept of the array "visible region" and use it to produce the polar plot of the array factor pattern from the rectangular plot
19. develop expressions for the array factor of equally-spaced non-uniformly excited arrays

20. design binomial and Dolph-Chebychev arrays according to one or more of the following parameters: number of elements, SLL, HPBW, directivity, and FNBW
21. use the concept of pattern multiplication to obtain the array factor of a planar array
22. discuss the concept of operation and produce design parameters of the Yagi-Uda antenna
23. discuss the concept of antenna synthesis for continuous and discrete sources and show that the space factor is the Fourier Transform of the current distribution
24. discuss the aspects of the different methods of antenna synthesis: null positioning, overall pattern approximation using LMSE, and pattern sampling
25. use the different synthesis methods to design the current excitations of array elements according to the design specifications
26. discuss features and applications of Smart Antennas

Course Topics:

Topic	Weeks
1. Review of Maxwells equations and by the scalar and Vector Potentials A and F	1.0
2. Scalar Green's function for free space, Solution of A and F using The free space green's function	2.0
3. Exact and far field expressions, Infinitesimal dipole, near and far fields, radiated power, Radiation resistance, Radiation p	2.0
4. Finite length dipole with sinusoidal current distribution, vertical and horizontal electric and magnetic sources above ground	2.0
5. Small and large loops with constant currents	2.0
6. Antenna arrays, element factor and array factor, nulls and maxima for array patterns , linear, circular, and planar arrays, b	2.0
7. Helical, biconic, folded dipole antennas, travelling wave antennas	2.0
8. Yagi/Yuda antenna design of linear and circular elements, Aperature antennas and the parabolic dish.	2.0

Class Schedule:

Lecture: three 50 minutes sessions per week
 Tutorials/Lab: one two hours session per week

Course Contribution to Professional Component:

Engineering Science: 60 %
 Engineering Design: 40 %

Course Relationship to Program Outcomes:

Program Outcomes	Engineering Criteria											Program Criteria		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Average attainable level of learning (*)	L		M				M			L	L		M	M

* L: Objective addresses outcome slightly, M: Moderately, H: Substantially

Prepared by: Prof. Dr. Khalid Nabulsi, Last Updated: October, 2007

EE 425 – COMMUNICATION SYSTEMS (4,3,3) 4 Credits
(Core course offered in both Fall and Spring term)

Bulletin Description: 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.

Prerequisites: EE 312, EE 421, EE 423

Textbooks: W. Tomasi, Electronic Communications Systems: Fundamentals through Advanced, Pearson, Prentice-Hall, 5th ed, 2004.

References: 1. T. Pratt, C. Bostaian, and J. Allnut, Sattelite Communications, 2nd ed, 2003.
2. T. S. Rappaport, Wireless Communications, : Principles and Practice, 2nd ed, 2001.
3. G. Keiser, Optical Fiber Communications, 3rd ed. McGraw-Hill, 2000.

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. identify sources of noise in communication systems
2. compute noise power in communication systems
3. perform link budget analysis of a communication system
4. explain the principles of satellite communication systems
5. compute the antenna look angles for an earth station
6. design a satellite communication link
7. explain the principles of cellular communications
8. perform traffic engineering for a mobile cell
9. explain the different types of interference in mobile communications and how to reduce them
10. perform a preliminary cell planning for a mobile communication system
11. explain the fundamentals of an optical communication system
12. explain the sources of attenuation and distortion in optical fibers
13. list and compare different types of fibers, optical sources, and optical detectors
14. compute the maximum allowable data rate for an optical link

Course Topics:

Topic	Weeks
1. Introduction, Noise in Communication Systems	1.0
2. Link Budget Analysis	1.0
3. Digital Modulation	1.0

4.	Optical Communications	3.0
5.	Satellite Communications	4.0
6.	Mobile Communications	4.0

Class Schedule:

Lecture: three 50 minutes sessions per week

Tutorials/Lab: one two hours session per week

Course Contribution to Professional Component:

Engineering Science: 75 %

Engineering Design: 25 %

Course Relationship to Program Outcomes:

Program Outcomes	Engineering Criteria											Program Criteria		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Average attainable level of learning (*)	M		M		M	L		L			M	M	M	H

* L: Objective addresses outcome slightly, M: Moderately, H: Substantially

Prepared by: Dr. Solimanul Mahdi

Last Updated: October, 2007

EE 426 – DIGITAL COMMUNICATIONS (3,3,2) 3 Credits
(Core course offered in Spring terms)

Bulletin Description: 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.

Prerequisites: EE 421

Textbooks: B. Sklar, *Digital Communications: Fundamentals and Applications*. 2nd Ed., Prentice-Hall, 2001.

References: 1. W. H. Tranter, et al, *Principles of Communications Systems Simulation with Wireless Applications*.
2. J. G. Proakis and M. Salehi, *Contemporary Communication Systems using MATLAB*. Brooks/Cole, 2000.

Course Learning Objectives (CLO)

After finishing the course successfully, the student will be able to

1. describe the fundamental blocks of a general digital communications system and explain the function of each block, including source formatting, channel encoding, modulation, and channel.
2. explain the difference between digital and analog sources, channels, and systems; and explain the advantages and disadvantages of digital and analog communications systems.
3. analyze any digital modulation system and find/estimate its symbol error probability, bit error probability, and bandwidth; and draw a complete block diagram for the modulator and demodulator and specify the parameters of each block.
4. explain the difference between coherent and non-coherent detection and the merits of each; and be able to decide when to use either of them.
5. describe each of the following bandpass digital modulation systems (ASK, PSK, QAM, FSK, MSK); derive their performance parameters; and draw complete block diagrams for the modulators and demodulators.
6. compare different bandpass digital modulation methods and select suitable methods for various situations.
7. analyze a linear block channel code; decide the linearity of the code, find its minimum distance, error-correcting capability, and error-detecting capability; estimate the message error probability and bit error probability; and find the performance of the code with any modulation method.

8. analyze a linear cyclic block channel code; decide the linearity of the code, find its minimum distance, error-correcting capability, and error-detecting capability; estimate the message error probability and bit error probability; and finds the performance of the code with any modulation method.
9. select a suitable Hamming or BCH code for a given performance and derive its details.
10. design a digital communication systems for a given bit error probability and bandwidth.

Course Topics:

Topic	Weeks
1. Basic Concepts	1
2. Formatting and Baseband Modulation	2
3. Baseband Demodulation/Detection	2
4. Detection of Signals in White Gaussian Noise	6
5. Bandpass Modulation Techniques	2
6. Channel Coding: Part 1	2
7. Channel Coding: Part 2	1
8. Modulation and Coding Trade-offs	1
9. Case Studies	2

Class Schedule:

Lecture: three 50 minutes sessions per week
 Tutorials: one two hours session per week

Course Contribution to Professional Component:

Engineering Science: 85 %
 Engineering Design: 15 %

Course Relationship to Program Outcomes:

Program Outcomes	Engineering Criteria											Program Criteria		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Average attainable level of learning (*)	H		M	M	H	M	L	L	M	L	H	H	M	M

* L: Objective addresses outcome slightly, M: Moderately, H: Substantially

Prepared by: Dr. Ahmed Balamesh

Last Updated: June, 2008

EE493 – MICRO-ELECTRONICS PROCESS INTEGRATION (4 Credits)

Bulletin Description: The major objective of this subject is to introduce the students to the materials and engineering aspects of microelectronic device integration such as IC fabrication. Module technologies will be introduced, following by thin film processes used in device integration and IC technologies. The students will get in-depth understanding of microelectronic device module and integration, and help them to appreciate the materials requirements of IC fabrication processes.

Prerequisites: EE 312

Textbooks: [1] S. A. Campbell, “The Science and Engineering of Microelectronic Fabrication” Oxford University Press, 2001 (Chapter 15, 16 & 18).

References: [1] S. M. Sze, “VLSI Technology” McGraw-Hill, 1988; (Chapter 11, “VLSI Process Integration” Chapter 11);
[2] S. Wolf, “Silicon Processing”, Vol.3 – The Submicron MOSFET, Lattice Press 1995; (Chapter 6 & 7, page 321 – 522);

Course Learning Objectives (CLO)

After finishing the course successfully, the student will learn:

1. Current trends in ULSI device technology development and MOS process integration
2. The process sequence and mask layout used to fabricate an integrated circuit
3. Design rule, device scaling and critical issues in IC fabrications
4. Well formation for CMOS: P-N-well CMOS. Twin-well CMOS. Retrograde-well CMOS. Triple-well CMOS
5. Source/Drain formation. Isolation module: Shallow/ Moderate-depth trench and refill isolation for CMOS
6. Gate/Gate-dielectric materials. Characteristics of ultrathin dielectric. High density plasma damage on the gate dielectrics. Cobalt silicidation process
7. The overview of gate oxide; Gate Oxide characteristics needed for submicron MOSFETs
8. Physical and Chemical Properties of SiO₂; The Si/SiO₂ Interface
9. Technology of thin oxide growth; Factors impacting gate oxide thickness uniformity
10. The gate oxide growth processes
11. Carrier Injection in the Si/SiO₂ System; The Phenomenon of Oxide Breakdown
12. Metal-Semiconductor Junction Theory, Schottky contact and Ohmic contact, Junction Spiking, Silicidation, Contact Formation
13. Source and Drain Engineering
14. The role of contact structures in device and circuit behavior
15. The impact of the intrinsic series resistance on MOS transistor performance
16. Materials for metallization: Cu metal line (Electroplating and MOCVD) and Low-K dielectrics
17. Diffusion barrier by atomic layer deposition
18. Metallization systems and processes: Cu Dual-damascene process. Multi-level interconnects

19. The Global planarization by CMP
20. The reliability of stress migration and electromigration in metal films
21. Signal delay time and cross talk

Course Topics:

1. The ULSI device technology development and MOS process integration.
2. The process sequence and mask layout used to fabricate an integrated circuit. Design rule, device scaling and critical issues
3. Well formation for CMOS: P-/N-well CMOS. Twin-well CMOS. Retrograde-well CMOS, Triple-well CMO
4. The Source/Drain formation. Isolation module: Shallow/ Moderate-depth trench and refill isolation for CMOS
5. The Gate/Gate-dielectric materials, Characteristics of ultrathin dielectric. High density plasma damage on the gate dielectrics, Cobalt salicidation process **(5 weeks)**
6. The overview of gate oxide; Gate Oxide characteristics needed for submicron MOSFETs; Physical and Chemical Properties of SiO₂
7. The Si/SiO₂ Interface; Technology of thin oxide growth; Factors impacting gate oxide thickness uniformity; Gate oxide growth processes
8. Carrier Injection in the Si/SiO₂ System; the Phenomenon of Oxide Breakdown. **(3 weeks)**
9. Metal-Semiconductor Junction Theory, Schottky contact and Ohmic contact, Junction Spiking, Silicidation, Contact Formation, Source and Drain Engineering
10. The role of contact structures in device and circuit behavior. The impact of the intrinsic series resistance on MOS transistor performance **(3 weeks)**
11. Materials for metallization: Cu metal line (Electroplating and MOCVD) and Low-K dielectrics. The diffusion barrier by atomic layer deposition
12. The Metallization systems and processes: Cu Dual-damascene process. Multi-level interconnects
13. The global planarization by CMP
14. Reliability of stress migration and electromigration in metal film.
15. The signal delay time and cross talk. **(4 weeks)**

Class Schedule:

Lecture: two lectures per week (one hour sessions per lecture)

Tutorials: one tutorial class per week (one hour session)

Course Contribution to Professional Component:

Engineering Science: 60 %

Engineering Design: 40 %

Course Relationship to Program Outcomes:

Program Outcomes	Engineering Criteria											Program Criteria					
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	M	M	M		M	L	M	L	L		M		M	L			

* L: Objective addresses outcome slightly, M: Moderately, H: Substantially

Prepared by: Dr. Ashraf Uddin

Last Updated: December 2007

EE 499 – SENIOR PROJECT (4,2,4) 4 Credits
(Core course)

Bulletin Description: 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.

Prerequisites: EE 321, EE 331, IE 331

Textbooks: B. Karagözoğlu, "A Guide to Engineering Design Methodologies and Technical Presentation", KAU Press, 2008.

References: None.

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

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 multi-disciplinary team management techniques that integrate, evaluate, and improve different skills of team members.

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: <ul style="list-style-type: none"> - Knowledge integration - Operational and realistic constraints - Design objectives - Evaluation criteria 	3
5. Design options and initial layout	2
6. Work plan and budgeting	1
7. Progress report and oral presentation	1
8. Implementation phase	7
9. Design refinement	3
10. Final report and oral presentation	3

Class Schedule:

Lecture: 12 1-hour active learning classes

Tutorials/Lab:

Course Contribution to Professional Component:

Engineering Science:

Engineering Design: 100 %

Course Relationship to Program Outcomes:

P Outcomes	Engineering Criteria											Program Criteria					
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Average attainable level of learning (*)	M	H	H	H	M	H	H	M	M	M	H	M	M				

* L: Objective addresses outcome slightly, M: Moderately, H: Substantially

Prepared by: Dr. Bahattin Karagözoğlu

Last Updated: June 2008