ELECTRIC POWER AND MACHINES 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: Objective addresses outcome slightly, M: Moderately, H: Substantially

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 structur 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: Objective addresses outcome slightly, M: Moderately, H: Substantially

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)

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:

	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		M	M		M		L	L	M		M	M			

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

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, electrodynamometer , and single phase electrodynamometer 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) electrodynamometer 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:

	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		M	M	M	M	M			M	M	M				

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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, 9^{th} 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 cutest 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			

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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-Hi1I, 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:

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

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, Elctrostatics, 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 verse
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:

	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								L				

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

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 (5^{th} 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:

	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	M		M	L	M		M		M		M				

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

Prepared by: Dr. Solimanul Mahdi

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. Bruse 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: Objective addresses outcome slightly, M: Moderately, H: Substantially

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

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: Burden RL and Faires JD, Numerical Analysis, 7th ed, Brooks/Cole Pub Co. 2000

References: Rice JR, Numerical Methods, Software, and Analysis, 2nd ed McGraw-Hill, 1992

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

Prepared by: Dr. M. Alfheid

Last Updated: October 2007

EE 341 – ELECTROMECHANICAL ENERGY CONVERSION I (4,3,2) 4 Credits
(Core course offered in Fall and Spring terms)

Bulletin Description: This course includes, magnetic circuits, principle operation of single-phase transformer and experimental tests, multi windings transformer and auto-transformer, potential and current transformer, basic principle of rotating machine, steady state operation of different types of DC-machine DC machine, steady state torque speed characteristic.

Prerequisites: EE302

Textbooks: Fitzgerlad, kingsley and Umans, "Electric machinery", 6th edition, McGraw-Hill, 2006

References:

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. describe the magnetic circuit parameters
2. summarize the mathematical relationships between the different variables of the magnetic circuits
3. differentiate between the different types of losses in the magnetic circuits
4. calculate the variables of the magnetic circuit
5. recognize the polarity of the coil turn and perform the dc resistance test for single-phase transformers
6. derive the transformer equivalent circuit
7. analyze the approximate equivalent circuit of the transformer from the engineering aspects
8. carry out the open-circuit and short-circuit tests of the single-phase transformers
9. calculate values of the transformer equivalent circuit from the above tests
10. construct the phasor diagram of the single-phase transformer under different operating conditions
11. derive the mathematical expressions of the voltage regulation
12. investigate the effect of changing the power factor on the voltage regulation of the transformer
13. investigate the construction and precaution which should be considered for potential and current transformers
14. calculate the efficiency of the single phase transformer
15. recognize the electromechnical energy conversion principles
16. derive the induced emf for the ac machines
17. identify the rotating machine concepts
18. classify the different types of the direct current (DC) machines
19. identify the effect of the armature reaction of the mmf
20. justify the main function of the series field winding in DC machine
21. asses the different problems raised due to armature reactions in the DC machines
22. develop a solution to overcome the shifting of neutral zone of DC machines

23. perform the open-circuit test on a DC machine
24. differentiate different schematic diagrams of the DC machines
25. evaluate the functions of the interpole in DC machines
26. recognize the effect of the compensating field winding to improve the mmf distributions in DC machines
27. asses the need for additional windings in DC machine for improving the mmf distributions
28. compute and predict the torque versus speed characteristics of a DC machine

Course Topics:

Course Topics	Duration in weeks
1- magnetic circuits transformers	2
2- principle operation of single phase transformer, equivalent circuit, efficiency, voltage regulation, phasor diagram and experimental tests.	3
3- multi windings transformer, auto-transformer, voltage and current transformer	2
4- basic concept of rotating machine and the mmf distribution	2
5- steady state analysis for DC machine	2
6- Dc machines Dynamic and control	3

Class Schedule:

Lecture: two 1.5 hour 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:

	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		M			M		H				

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

Prepared by: Dr. Abdulaziz Jalal Al-Sharief

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:

	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			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 networks 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: Objective addresses outcome slightly, M: Moderately, H: Substantially

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...	
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:	**1**
i. Apply engineering practices related to his specialization.	
ii. Enhance team work skills.	**6**
iii. Relate practical work to his engineering knowledge.	
iv. Use modern engineering tools such as equipment and computer software.	
v. Use project management techniques.	
vi. Complete assigned tasks on time with high quality.	
vii. Develop personal communication skills.	

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:

	Engineering Criteria											Program Criteria					
P 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	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 441 – ELECTROMECHANICAL ENERGY CONVERSION II (4,3,2) 4 Credits
(Core course offered in Fall terms)

Bulletin Description: Polyphase induction and synchronous machines. Models and performance characteristics for steady-state operations. Fractional horsepower machines, their performance and application.

Prerequisites: EE 341, EE 351

Textbooks: Fitzgerlad, kingsley and Umans, "Electric machinery", 2^{nd} ed, McGraw-Hill, 2002

References: 1. "Induction Machines: Their Behavior and Uses" by Philip L. Alger Paperback: 528 pages; Publisher: Taylor & Francis Group; 2nd edition (June 1, 1995), ISBN: 2884491996

2. "Environmental Requirements for Electromechanical and Electrical Equipment", by Ray Tricker, Samantha Tricker, Hardcover: 416 pages; Publisher: Newnes; (February 16, 1999), ISBN: 0750639024

3. "Electric Machines: Analysis and Design Applying MATLAB" by Jim Cathay Hardcover: 544 pages; Publisher: McGraw-Hill Science/Engineering/Math; 1st edition (December 18, 2000), ISBN: 0072423706

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. explain the basic principles underlying behavior of electrical machines
2. know various types of machine windings
3. compute the factors affecting winding calculation
4. demonstrate practical ability to deduce winding factors from real machines
5. realize heat transfer within the machine
6. recognize the effect of heating (cooling) time constants on maximum allowable time to use the motor
7. perform the open-circuit and short-circuit test on a synchronous machine
8. calculate values of the synchronous machine equivalent circuit from tests
9. compute and predict the real and reactive power behavior of synchronous machines
10. measure and record the torque angle of a synchronous machine under rapid loading
11. perform a computer simulation of synchronous machine dynamics
12. recognize the excitation systems and different controllers on the synchronous machine
13. differentiate between different methods of starting the synchronous machine
14. describe the equivalent circuit of the three phase induction motor
15. perform the no-load, block-rotor and the dc resistance, of the stator windings, tests on the three phase induction motors
16. differentiate between the different types of losses in the three phase induction motor
17. calculate the parameters of the equivalent circuit of the induction motor
18. recognize the effect of the motor speed on the equivalent circuit of the three phase induction motor

19. realize relation between motor speed and slip, then modify the equivalent circuit the three phase induction motor
20. analyze the different methods used for speed control of the three phase induction motor
21. predict the torque versus speed behavior of the three phase induction motor
22. differentiate between different types of the electric braking of the three phase induction motor
23. recognize different types of motor starters used for the three phase induction motor
24. realize the effect of the motor starter methods on the starting torque of the three phase induction motor
25. compute the operating Point using the circle diagram of the three phase induction motor
26. describe the different types of single phase induction motor
27. recognize appropriate physical phenomena in developing different small motors
28. predict the proper motor ratings and types to meet the requirement of the defined mechanical load
29. prepare a slide presentation on a technical topic and make an oral presentation
30. work with a small team to carry out experiments in electric machines

Course Topics:

Course Topics	Duration in weeks
General Aspects of Electrical Machines 1	3.0
General Aspects of Electrical Machines 2	3.0
Synchronous Machines	3.0
Induction Machines	3.0
Fractional Horsepower Motors	2.0
Projects	1.0

Class Schedule:

Lecture: two 1.5 hour 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:

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

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

Prepared by: Prof. Dr. Yusuf Abdulaziz Al-Turki

Last Updated: October, 2007

EE 442 – POWER ELECTRONICS I (4, 3,2) 4 Credits
(Core course offered in Spring terms)

Bulletin Description: Thyristors, theory of operation, methods of turning on, thyristor limitations, commutation methods. Single and three-phase AC voltage controllers for resistive and inductive loads. Single-phase and three-phase AC-DC converters for resistive and large inductive loads. Analysis of DC-DC converters for resistive, large inductive, and general inductive loads. Single-phase and three-phase inverters for different loads. Single-phase to single-phase cycloconverter, output voltage and frequency control.

Prerequisites: EE 311

Textbooks: Mohammad H. Rashid, "Power Electronics: Circuits, Devices, and Applications", 3rd ed, Pearson, Prentice-Hall, 2004

References:

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. define "power electronics" , indicate their applications, and demonstrate the different types of power electronic circuits.
2. indicate the different types of power semiconductor devices and their switching characteristics and specifications.
3. demonstrate the different types of power diodes and what are the main differences between general purpose, fast recovery, and schottky diodes.
4. use Fourier analysis to determine the power delivered by a converter and to analyze harmonic distortion.
5. analyze switching diode circuits, evaluate input-output performance parameters and waveforms of diode rectifiers.
6. propose steps involved in designing diode rectifiers and dc filters.
7. distinguish between the conditions for a thyristor to conduct and the conditions for a conducting thyristor to turn-off.
8. demonstrate switching operations and characteristics of the different new types of thyristors.
9. illustrate the importance of the snubber circuit and the design consideration of it.
10. propose the SCR and gate circuit protection techniques.
11. demonstrate the SCR gate circuit requirements and the isolation techniques between the high-level power circuit and low-level gate circuit.
12. illustrate applications , types, circuits , operation modes, waveforms, input-output performance parameters , and converter circuit design requirements of single phase ac-dc converters (controlled rectifiers) for resistive and high inductive loads.
13. illustrate applications , types, circuits , operation modes, waveforms, input-output performance parameters , and converter circuit design requirements of three phase ac-dc converters (controlled rectifiers) for resistive and high inductive loads.
14. analyze the single phase ac voltage controller for resistive and inductive loads using phase angle and integral cycle controls and demonstrate the ac voltage controller design requirements and applications.
15. illustrate types, applications, circuits, and parameters of the one quadrant and the two quadrant choppers for large inductive and general inductive loads .

16. design voltage commutation technique for the chopper converters.
17. Demonstrate types, applications, circuits, and output voltage control of single-phase voltage-fed bridge inverters and single-phase current-fed inverters with commutating capacitor.
18. illustrate circuit, applications, gating schemes, output voltage control, frequency control, and performance parameters of single- phase to single - phase cycloconverter.
19. propose steps involved in designing the power electronics equipments and determine thyristor voltage and current ratings .
20. conduct measurements for a power electronic circuits, including waveforms, average measurements of voltage, current, and power and rms measurements of voltage and currents.
21. demonstrate effective team work in planning and carrying out experimental activities.
22. build up and test diode and SCR circuits, with resistive, inductive and capacitive loads.
23. prepare and present a cohesive and detailed engineering report for each laboratory experiment.

Course Topics:

Course Topics	Duration in weeks
Introduction-,Diode Rectifiers.	0.5
Thyristors.	0.5
Controlled Rectifiers.	0.5
AC voltage controllers.	0.5
DC-DC Converters (Choppers).	2
Inverters (DC-AC Converters)	2
Cycloconverters.	1
Gate Circuits.	2
Lab Works.	2

Class Schedule:

Lecture: two 1.5 hour 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:

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

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

Prepared by: Dr. Muhammad M El-Hindawi

Last Updated: October, 2007

EE 451 – POWER SYSTEMS II (4,3,2) 4 Credits
(Core course offered in Fall terms)

Bulletin Description: Load Flow Analysis, Solution of Load Flow Equations, Gauss-Seidel and Newton Raphson Techniques, Asymmetrical Faults, Phase Sequence Networks, Use of Matrix Methods. Power System Stability: Steady-State and Transient.

Prerequisites: EE 351

Textbooks: William D. Stevenson, "Elements of Power System Analysis", 4th ed, McGraw-Hill, 1999.

References: Hadi Saadat, Power System Analysis, Second Edition, McGraw-Hill

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. recognize the common causes of faults in power systems
2. understand the models for generators during a fault and be able to use the models to calculate the fault current at any point in time for a fault applied to the terminal of a generator
3. solve for the voltages and current in a network experiencing a balanced three phase fault at any location
4. recognize the advantage of using symmetrical components to analyze unbalanced system operation
5. differentiate between phase values and symmetrical component values
6. evaluate 3-phase power in terms of symmetrical components
7. develop and solve the positive, negative and zero sequence networks for systems consisting of machines, transmission lines and transformers
8. solve for the fault voltages and currents for single line to ground faults, line to line faults, and double line to ground faults
9. realize the key needs for system grounding; and be able to determine grounding impedance
10. know how to treat unbalanced faults with fault and grounding impedances
11. understand the load flow problem in power system networks and be able to appreciate the need for load flow analysis
12. calculate the bus admittance matrix for a three phase system consisting of transmission lines, transformers and capacitors
13. solve linear and non-linear simultaneous equations
14. formulate the power flow problem and be able to develop a solution algorithm using both the Gauss-Seidel and the Newton-Raphson methods
15. develop a simple power flow program implementing the Gauss-Seidel method
16. develop a power flow program implementing the Newton-Raphson method
17. recognize the approximations used in the fast decoupled power flow, and be able to solve small systems by hand using this algorithm
18. apply a standard power flow program to model a small power system to solve simple design problems, such as sizing of capacitors needed to correct low bus voltages or generation re-dispatch to remove transmission line constraints
19. develop a computer program for a comprehensive plan to design a suitable power system network to meet the increasing energy requirements of regional consumers over a 5-year plan period
20. recognize the basic principles of power system stability of power networks
21. derive power balance equations of synchronous generators and motors
22. analyze and obtain the steady-state stability limits of a synchronous generator feeding inductive, synchronous motor and infinite bus networks
23. understand the steady-state stability problem of a point-to-point transmission system and the importance of system transfer reactance
24. understand how steady-state stability limits of power system networks may be improved
25. understand the principles of transient stability of power systems
26. analyze the principle of the equal area criterion for assessing the transient stability of an alternator feeding a large power system network

27. evaluate the swing curve under transient disturbances of a synchronous generator feeding a large power system network using step-by-step technique and angular momentum
28. evaluate applications on transient stability problem, e.g. critical fault clearing time, auto reclosures and sudden increase in prime mover power
29. understand design techniques for improving transient stability of power systems

Course Topics:

Topics	Weeks
Cases of faults in power system networks: external, internal	1.0
Symmetrical components: fortes cues theorem	1.0
Phase sequence impedances: Sequence Component Networks for generators, lines and transformers	0.5
Unbalanced faults: single, line-to-line	1.0
Double line-to-ground, three-phase-isolated	0.5
Grounding and fault impedances: in balanced faults for interconnected power systems	1.0
Basic definition of load flow problem: Formulation of System Admittance Network	1.0
Numerical technique for iterative solution of linear and non-linear simultaneous equations	1.0
Gauss - Siedel and Newton - Raphson methods for load flow analyses, convergence and acceleration forces	1.5
Fast decoupled technique for load flow	1.5
Stability problem: an overview, power balance equations	0.5
Two machine systems, transmission tie - infinite bus system	0.5
Steady state stability limit, stability improvement, Transient stability, basic definition, an overview	1.0
Equal area criterion, Inertia constant and angular momentum	1.0
Swing and step-by-step method of solution, Critical clearing angle and time	1.0
Stability on fault clearance and reclosure, Improvement of Transient Stability Limit.	1.0

Class Schedule:

Lecture: wo 1.5 hour 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:

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

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

Prepared by: Dr. Ahmed Y Saber, Last Updated: October, 2007

EE 452 – HIGH VOLTAGE TECHNIQUES I (3,2,2) 3 Credits
(Elective course offered in Fall terms)

Bulletin Description: Insulation Coordination High Voltages Engineering, Voltage Stresses, Testing Voltages, Testing with Power Frequency Voltages, Series Resonant Circuits, A.C. to D.C. Conversion, D.C.Voltages, Testing with Lightning Impulse Voltages, Testing with Switching Impulses, , Measurement of High Voltages.

Prerequisites: EE 351

Textbooks: 1- E. Kuffel, W S Zaengl, , High Voltage Engineering Fundamentals,Pergamon 1st ed. 1984,1986
2- M.S. Naidu, High Voltage Engineering McGraw-Hill Professional,1st ed. 1981

References:

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. Recognize the system over voltages, temporary power frequency over voltages, switching over voltages, lightning over voltages.
2. Understand the standard high voltage tests techniques (Power frequency voltages A.C test, Lighting Impales voltages test, Switching Impulse voltages test,and D.C voltages test)
3. Understand Single unit testing transformers construction.
4. Models of Series Resonance Principle.
5. Understand the Cascaded Transformers construction.
6. Understand the equivalent circuit of straight test set.
7. Understand the basic of Generation of high voltage impulse voltage.
8. Understand the definitions of the lighting impulse wave shape.
9. Recognize the wave chopped at front and wave chopped at tail.
10. Understand the definitions of the switching wave shape.
11. Understand the basic the trigatron spark gap.
12. Recognize the generation of h .v direct current.
13. Models of rectification (half wave and full wave circuits).
14. Understand the Villard circuit, Grenirch Doupler circuit.
15. Understand the basic of Electrostatic Generation.
16. Recognize the Van DeGraff and Felici and Sames.
17. Understand the insulation coordination.
18. Recognize the gas, liquid and solid breakdown.
19. Understand the basic of High voltage lab.
20. Models of the type test, and on site test.

Course Topics:

1. Introduction (weeks 1 – 4)
    a. Generation and transmission of electric energy
    b. Voltage stresses.
    c. Testing voltages.
    d. Testing with Power frequency voltages.
    e. Testing with lightning impulse voltages.

f. Testing with switching impulse.

2. Generation of Alternating High Voltages (weeks 5 – 8)
    a. Alternating Voltages testing transformers
    b. Single unit testing transformers
    c. Cascaded transformers
    d. Series Resonant Circuits Basic

3. Generation of Impulse High Voltages (weeks 9 – 12)
    a. Impulse Voltages
    b. Impulse Voltage Generator Circuits.
    c. Impulse and Switching wave shape.
    d. Design and Construction of Impulse Generators
    e. Spark Gaps

4. Generation of High Voltages Direct current. (weeks 13 – 15)
    a. Rectification , half wave and full wave circuits.
    b. Villard circuit, Grenirch Doupler circuit.
    c. Electrostatic Generation
    d. Van DeGraff and Felici and Sames.

Class Schedule:

Lecture: 2 (1.30 hour) sessions per week
Tutorials: 1 Lab. 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**
Average attainable level of learning (*)	M	H	M		M	H	H	M		L	L		M	M

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

Prepared by: Prof. Dr. Anwar Hassan Mufti

Last Updated: May 2008

EE 453 – POWER TRANSMISSION AND DISTRIBUTION (3,3,1) 3 Credits
(Core course offered in Spring term)

Bulletin Description: Transmission line parameters, Mechanical design of overhead transmission lines, Underground cables, Distribution Systems. Distribution substation design. Surges on transmission systems, System earthing.

Prerequisites: EE 351, IE 331

Textbooks: Freeman, Electric Power Transmission & Distribution, Harrap, 1984

References: 1. Gonen Modern Power System Analysis, John Wiley & Sons, Inc.,1988
2. Gonen Electric Power Distribution System Engineering, McGraw-Hill, 1986
3. William H. Kersting, Distribution System Modeling and Analysis, CRC Press, 2002
4. Zaky and Megahed Electric Power Engineering, Al maaref Establishment, 1972

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. comprehend the different method of line supports and their materials for low, medium and high voltage.
2. appreciate different types of insulators and their applications in transmission and distribution systems.
3. derive and calculate the voltage distribution along a string of insulators to assess their stress capabilities.
4. optimize the voltage distribution across insulator units for equalizing the voltage stresses across various units.
5. design a suspension insulator string based on voltage distribution across the string.
6. select conductor materials for overhead lines (OHL) according to conductor characteristics, sizes, and conductor costs.
7. evaluate current-carrying capacity of OHL conductors and their corresponding thermal limits.
8. design an overhead conductors of various cross-sectional areas and identify their current carrying capacity.
9. perform sag and tension calculations on OHL conductors for identical and different support levels and routes.
10. comprehend and develop calculations of sag and tension of OHL at erection considering temperature, wind and ice loading changes.
11. develop a computer program for the evaluation of the effective span and sag and submit it in a formal technical report that includes a practical example.
12. apply and evaluate various statistical factors to define load demand characteristics and load duration curve.
13. compute and design dc and ac distribution feeders fed from supply terminal(s) to satisfy consumer's voltage regulation requirements.
14. recognize the different sub-transmission and bus schemes and differentiate between them.
15. recognize design features for sub-transmission systems, distribution substations, primary feeders and distribution transformers.
16. design as many as necessary power substations in order to meet the required electric power of an entire town.
17. compare and contrast underground cables (UGC) and overhead lines for transmission and distribution of electric power
18. identify different types of insulators for UGC for low, medium and HV applications designating single and three-core designs and their cooling methods.
19. compute insulation resistance and capacitance and evaluate voltage stresses for underground cables
20. recognize the phenomenon of corona discharge and factors influencing its on set
21. comprehend the effect of overvoltages produced by fast transient in power transmission system.

22. compute the transient overvoltages in power transmission buses.
23. understand the importance of system grounding and its impact on human and equipment safety and significance of grounding resistance
24. realize application of grounding techniques to transmission line and substations in power networks

Course Topics:

Topics	Weeks
Overhead Line Supports	0.3
Overhead Line Insulators	0.7
Conductor Materials	0.3
Thermal Limits to Conductor Current-carrying Capacity	0.3
Sag and Tension Calculations	2.0
Load Characteristic	2.0
Distributors	1.0
Sub-transmission Lines and Distribution Substations	3.0
Underground Cables	2.0
Corona	0.3
Transients in Transmission Systems	1.0
Grounding Systems	1.0

Class Schedule:

Lecture: Two one and a half sessions per week
Tutorials: one two hours sessions 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**
Average attainable level of learning (*)	M		H		M		H	M	M	M	H	H		

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

Prepared by: Dr. Abdulaziz U Al-Abdulaziz

Last Updated: June, 2008

EE 454 – SWITCHGEAR AND PROTECTION OF POWER SYSTEMS I (4,3,2) 4 Credits
(Core course offered in Fall term)

Bulletin Description: Switch gear, busbar systems, couplers, cubicles, auxiliaries, single line diagram. Relays, electromagnetic, static, thermal relay, overcurrent, voltage, directional. Distance relays. Differential relays. Feeder protection system. Transformer protection system. Generator protection system.

Prerequisites: EE 341, EE 351

Textbooks:

References:

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. recognize the function of switchgear in power systems
2. recognize the function of system layout
3. recognize the function of industrial substation
4. recognize the function and types of circuit-breakers
5. develop the principles and application of current transformers
6. develop the principles and application of voltage transformers
7. comprehend the general philosophy of power system protection
8. understand the fundamental principles of protective relaying
9. design relay time grading scheme
10. design relay current grading scheme
11. design relay time-current grading scheme
12. describe the most common protective relays used in generation for electromechanical and microcomputer based system
13. describe the most common protective relays used in transmission and distribution for electromechanical and microcomputer based system
14. apply protective relay principles to generation, transmission, transformer, substation, and distribution systems
15. apply non-linear resistor in differential scheme
16. recognize system protection against transients and surges
17. apply carrier current protection to transmission lines
18. carry out test on commercial relays to demonstrate their protective capabilities and to verify theoretical studies
19. carry out test hardware in both the electromagnetic and digital relays
20. compose reports describing the lab work
21. design and define a seminar in one of the course topics
22. conduct a field visit for substation system protection

Course Topics:

1. General background, Function and usage of switch-gear; fuses, switches, Cir Breakers.

2. Current, Voltage Transformers and substation layout.
3. Typical relay and circuit breaker connection
4. Construction of over-current relay and their types
5. Grading of over-current relay on radial and ring systems.
6. Differential relays; their significance and applications and the use of Merz-Price system.
7. Distance relays; their significance, types, relay settings and relay over/under reach calculations.
8. Differential and distance relay schemes
9. Carrier Current scheme
10. Transformer / generator protection scheme and other protective relays.

Class Schedule:

Lecture: Two one and a 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**
Average attainable level of learning (*)	M	M	H	H	M	H	H		M	M	M		H	

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

Prepared by: Dr. Abdurrahman Al-Masood

Last Updated: October 2007

EE 455 – ECONOMIC OPERATION OF POWER SYSTEMS (3,3,1) 3 Credits
(Elective course offered in Spring term)

Bulletin Description: Operating constraints. Short-term load forecast. Load curve analysis. Economical load sharing between units and between stations. Tariffs. incremental costs. Unit commitment and generator scheduling. Voltage and VAR control. Energy conservation.

Prerequisites: EE 451, IE 331

Textbooks: Allen J. Wood, Bruce F. Wollenberg, *Power Generation, Operation and Control,* John Willy & Sons, 1996

References:

Course Learning Objectives (CLO)

After finishing the course successfully, the student shall

1. differentiate discrete, continuous and combinatorial optimizations,
2. understand Economic Load Dispatch (ELD), fuel cost functions,
3. handle operational constraints of ELD, and understand incremental cost, penalty function,
4. solve ELD problems using different methods,
5. understand Unit Commitment (UC) and constraints of UC problem,
6. solve UC problems using different methods,
7. be able to write computer program for large scale UC scheduling up to 7-day,
8. understand load forecasting and attributes of load forecasting,
9. be able to forecast electrical load using modern method.

Course Topics (TOPs)/ duration:

1. Discrete, continuous and combinatorial optimizations;	1-week
2. Economic Load Dispatch (ELD), Fuel cost functions;	1-week
3. Operational constraints of ELD, Incremental cost, Penalty Function,	1-week
4. Methods to solve ELD problem,	3-week
5. Unit Commitment (UC), Constraints of UC problem;	1-week
6. UC problem using different methods;	4-week
7. Large scale UC scheduling up to 7-day	1-week
8. Load forecasting, attributes of load forecasting;	1-week
9. Load forecasting methods.	2-week

Class Schedule:

Lecture: Two one and a 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 (*)	H	M	M		M		M					M	L				

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

Prepared by: Dr. Ahmed Y Saber

Last Updated: May 2008

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:	3
- Knowledge integration	
- Operational and realistic constraints	
- Design objectives	
- Evaluation criteria	
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:

	Engineering Criteria											Program Criteria					
P 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	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