Majmaah University

College of Engineering

Course Description

Electrical Engineering

Course Title: Electric Machines	
Code:	EE 389
Credit Hours:	3 (3,1,0)
Pre-requisite:	EE 288
Co-requisite:	None

Course Description

Three-phase induction machines (construction, operation, equivalent circuit, performance calculations, starting of induction motors, speed control), single-phase induction motors, reluctance motors, stepper motors, fundamentals of D.C machines, DC machines (components, classification, performance, motor characteristics, starting of DC motors, speed control of DC motors), servo motors, universal motors.

Course Objectives

- Teaching the students the concepts, principles of operation, performance characteristics and methods of control of the induction motors, d.c motors, fractional horse-power motors and servo-motors.
- Preparing the students for dealing with the different types of electrical motors which find many applications in the industries, workshops, transportation, petroleum field, and home appliances regarding the operation, the maintenance, the control and the developing of the performance.
- Covering some subjects as introduction for consequent advanced courses in the electrical machines, electric drives and power systems.

Course Outcomes

- Understanding of the construction, connections, principle of operation of three-phase induction motor.
- Understanding of equivalent circuits representing the induction motor.
- Understanding of how to calculate the performance characteristics (current/speed and torque/speed) of the three-phase induction motor.
- Understanding of the starting and speed control methods of three-phase induction motor.
- Understanding of the construction, connections, principle of operation of single-phase induction motor.
- Understanding of equivalent circuits representing the single phase induction motor
- Understanding of how to calculate the performance characteristics (current/speed and torque/speed) of the single-phase induction motor.
- Understanding D.C machines, DC machines (components, classification, performance, motor characteristics, starting of DC motors, and speed control of DC motors), servo motors, universal motors.

Textbook:

- S. J. Chapman, “Electric Machinery Fundamentals”, McGraw Hill

Reference:

- SARMA, "Electric Machines-steady state theory and dynamic performance" WEST

Course Title: Power Systems Analysis
Code: EE 372
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 288, EE 270
Co-requisite: None

Course Description

Per unit system; Power system matrices: bus admittance matrix – bus impedance matrix; Load flow analysis: Gauss-seidel method – Newton-Raphson method; Economic operation of generators: neglecting transmission line losses – including transmission line losses; Symmetrical faults: Thevenin's method – bus impedance matrix method; Unsymmetrical faults: symmetrical components – Thevenin's method – bus impedance matrix method; Stability analysis: steady state stability – transient stability – equal area criterion.

Course Objectives

- Be acquainted with the main components of a power system.
- Understand the different methods used to represent and analyze the power system in normal and abnormal (faulty) steady state conditions.
- Ability to solve problem of an existing power system.
- Ability to think creatively for solving different types of power system problems.
- Ability to apply skills when dealing with a given power system.

Course Outcomes

<u>After studying this course, the student is supposed to be able to:</u> – Understanding of the basic components of a power system and their representations using per unit system. – Understanding of the methodology of power flow solution and control. – Understanding of the theory for the economic operation of thermal power stations. – Understanding of the power system fault analysis methodologies. – Understanding of the concepts of power system stability analysis.

Textbook

- Saadat, " Power system analysis", McGraw Hill, 2nd edition

References

- Grainger and Stevenson, "Power System Analysis", McGraw Hill
- Glover and Sarma, " Power system analysis and Design", PWS, 3rd edition

Course Title: Electric Power & Machines Laboratory 2
Code & No: EE 373
Credit Hours: 1 (0,0,2)
Pre-requisite: None
Co-requisite: EE 372, EE 389

Course Description

Symmetrical and unsymmetrical fault analysis; Load-flow simulation; Transient stability simulation; Active and reactive power generator control; Characteristics of isolated and interconnected systems. Equivalent circuit of transformers; Three-phase connections and harmonic problems; Equivalent circuit of three-phase and single-phase induction motors; Load testing of induction motors; Starting of single-phase induction motors; Terminal characteristics of dc machines

Course Objectives

- Emphasized the concepts taught in the power system theoretical courses.
- To gain the laboratory benefits of modeling an actual power system under different loading conditions.
- Prepared to do experimental work in the graduation project when necessary.
- Prepared to work in the field of operation, control and maintenance of power systems.
- Giving the student the chance to recognize the induction and dc machine, and teach them how to read the name plate data of the machines and implement it.
- Teaching the students the essential experiments which are necessary to determine the parameters and the performance characteristics of the induction and dc machines
- Emphasizing the concepts taught in the machine theoretical courses, and preparing them to do experimental work in their graduation project when necessary.

Course Outcomes

After studying this course, the student is supposed to be able to:

– Familiarized with software used for load flow, faults and stability analysis.

– Ability to carry out test for protection relays and the commissioning tests in the sites.

– Ability to carry out test for power systems on the system simulator.

– Ability to recognize different electrical machines which are taught in the electrical machine courses, and teach them how to read the name plate data of the machines and implement it.

– Training for the essential experiments which are necessary to determine the parameters and the performance characteristics of the induction and

dc machines. – Be prepared to work in the field of operation, control and maintenance. – Emphasized the concepts taught in the machine theoretical courses, prepare them to do experimental work in their graduation project when necessary. – Ability to carry out necessary tests after manufacturing the machines or the commissioning tests in the sites. – The ability to select the suitable instruments and materials as per assigned objective of experiment. – Ability to prepare laboratory setup (circuits) with proper connections.

Textbook

- Saadat, "Power System Analysis", McGraw Hill.
- S. J. Chapman, "Electric Machinery Fundamentals", McGraw Hill

References

- Grainger and Stevenson, "Power System Analysis", McGraw Hill
- SARMA, "Electric Machines Steady State Theory and Dynamic Performance". WEST
- Laboratory Manual will be distributed by the Lecturer

Course Title: Power Electronics
Code: EE 374
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 288
Co-requisite: None

Course Description

Power semiconductor devices: terminal characteristics; Power converters: ac-ac converters, rectifiers, inverters, dc-dc converters and resonant converters; Applications in power systems.

Experiments -- Basic Rectifier Circuits-- Single-phase Rectifiers-- Polyphase rectifiers-- One-Quadrant Dc-Dc Conversion-- One-Quadrant Dc-Dc Conversion- Dc-Ac Conversion

Course Objectives

- Teaching the students the basics and concepts related to the semiconductor devices and converter circuits used in the power applications.
- Acquainting the students the ability of dealing with the several power-electronics based equipment and converters found in the power system.
- Enabling the students to handle and master the recent concepts of controlling the electric machines as well as the active and reactive power flow in the power networks via the power electronic switches.
- Preparing the student for the advanced courses of the electric drives and the graduation project.

Course Outcomes

- Ability to analyze an existing power electronic circuit.
- Ability to select a power electronic converter for certain application.
- Ability to analyze, design, and control the simple power electronic circuits.
- Ability to distinguish between the advantages and disadvantages of different power converters.
- Ability to design and simulate power electronic circuits using special software.
- Ability to analyze an existing power electronic circuit.
- Ability to select a power electronic converter for certain application.

Textbook

- Hart, “Introduction to Power Electronics”, Prentice Hall

Reference:

- Lander, "power Electronics", McGrow Hill

Course Title: Automatic Control Lab
Code: EE 442
Credit Hours: 1 (2,0,0)
Pre-requisite: EE 341, EE 308
Co-requisite:

Course Description

This Lab provides the introduction of hardware, and software needs for introducing fundamental control systems theory with stress on design and implementation. The labs experiments focus on technical implementation issues of classical control theory in the frequency domain and time domain in addition to modern control theory in the state-space. Design and implementation for this course is done using based on simulations with LabVIEW and/or Matlab. The Hardware for control should be a complete Educational Control Plant.

Course Objectives

This lab will include a number of experiments that aims:

- To learn how to investigate the properties of physical systems both through simulation and experimentation.
- To learn how to perform hardware identification experiments on a physical plant.
- To learn how to design and analyze control systems through simulation using both classical and modern control techniques.
- To learn how to simulate control systems using both state space and transfer function representations.
- To learn how to implement custom control algorithms in LabView and/or Matlab.
- To further develop skills for working with others in an experimental environment.

Course Outcomes

After studying this course, the student is supposed to be able to:

- Apply his theoretical knowledge in automatic control such as design techniques via root locus bode and Nyquist Plots in practice through analog and digital experiments.
- Get the practical experience to use control methodologies to analyze, identify, evaluate and design effective controllers for physical systems.
- The ability to conduct digital control experiments with PC and analyze and interpret the

experimental results in order to get the most efficient design.

Class/laboratory schedule

One 90-minute lab session per week.

Resources of the course

Textbook, Lab Manuals, references, and Modules.

Computer usage

Word Processing for report writing and Matlab or LabVIEW for analysis.

Textbook

Richard Dorf and Robert Bishop: "Modern Control Systems" , 11th Edition, 2008.

References

1. Katsuhiko Ogata:"Modern Control Engineering", International Edition, Pearson Education Press, 5th edition, Prentice Hall, 2009.
2. Gene Franklin, J.D. Powell, and Abbas Emami-Naeini:" Feedback Control of Dynamic Systems", International Edition, 5th edition, Prentice Hall, 2008.

Course Title: Modeling And Simulation Of Dynamic Systems
Code: EE 451
Credit Hours: 3 (3,1,0)
Pre-requisite: Math 204, EE 341
Co-requisite: -

Course Description

Introduction: Essentials of system modeling and analysis- Cause-Effect relationship-Variables and system classification- Basic concepts of state variable and Input/output modeling.

Background: Laplace Transform- Theory and application to solution of linear time-invariant ordinary differential equation.

Mechanical systems modeling: Basic elements and motion laws- Free-body diagrams-Systems with mass, spring and pulleys- Series and parallel combinations of Systems.

Electrical systems modeling: Passive elements and circuit laws. Input/output and state variable models. Controlled sources and Op. Amps.

Dynamic system analysis and control: Free Response in the Frequency –Domain- System Modes- Forced response in the frequency and time domain- Concept of Transfer Function. Controller design via pole-zero assignment,- Complete controlled system response- Closed loop frequency response- linearization of nonlinear systems, Time response.

Course Objectives

This Course introduces the state-of-the-art and current trends in modeling and simulation. Its objective is to cover:

- The modeling techniques of the major types of dynamic engineering systems.
- The solution techniques for the resulting differential equations for linear and nonlinear systems.
- The attendant mathematical procedures related to the presentation of dynamic systems and determination of their time and frequency response characteristics.
- It explains in detail how to select all of the system component parameter values for static and dynamic performance specifications and limits.

Course Outcomes

After studying this course, the student is supposed to be able to:

- Deduce a model of a dynamic system however its components are and writing down the corresponding differential equations from its physical components as it is or represented by block diagrams.
- Applying the numerical algorithms helping to find the open loop and closed loop response of the dynamic equations in time as well as frequency domain.
- Finding out the algorithms necessary for designing suitable controllers for the dynamic system and testing it via efficient computer packages such as any relatively recent version of Matlab.

Textbook

C.M. Close and D.F. Frederick: "Modeling and Analysis of Dynamic Systems", 3rd Edition, John Wiley.

References

1. T. Gla and Lennart, L: "Modeling of Dynamic Systems", Prentice Hall, 1994.
2. Mathworks: "MATLAB", r2010a or less versions.

Course Title: Introduction To Intelligent Systems.
Code: EE 453
Credit Hours: 3 (3,1,0)
Pre-requisite: -
Co-requisite: -

Course Description

Introduction to Artificial Intelligence (AI)- Intelligent Agent- Search- Informed Search- Uninformed (Blind) search- Propositional Logic- 1'st Order Logic- Knowledge Representation- Inference in 1'st Order Logic- Prolog, Planning- Neural Networks- Uncertainty- Machine Learning- Natural Language Processing (NLP).

Course Objectives

• To provide students a working knowledge of artificial-intelligence concepts, applications, history, and philosophical uncertainties.
• To provide students algorithms and ways of analyzing AI for: search methods as applied to problem solving, automated reasoning, learning, planning, natural-language processing, and reasoning with uncertainty.
• To provide students knowledge of knowledge-representation techniques for: logics, planning, uncertainty, games and other search based Problems.

Course Outcomes

After studying this course, the student is supposed to be able to:
• Describe an agent and its environment, design appropriate problem-solving and knowledge-representation techniques for the agent.
• Able to analyze and formalize the research problem and select the appropriate search method and write the algorithm for it.
• Able to formally state any logical deduction problem, write a knowledge base for it and develop the appropriate proof.

Textbook

S. Russell and P. Norvig: "Artificial Intelligence: A Modern Approach", 3rd Edition., Prentice Hall, 2010.

References

1. Bärbel Mertsching, Marcus Hund and Zaheer Aziz: "Advances in Artificial Intelligence: Lecture Notes in Artificial Intelligence", Proceeding of the 32nd Annual German Conference on AI, Paderborn, Germany, September 15-18, 2009.

Course Title: Applied Control	
Code: EE 475	
Credit Hours: 3 (3, 1,0)	
Pre-requisite: EE 340	
Co-requisite:	

Course Description

Introduction to control systems and their classifications. Advantages of using feedback in control systems. Basics of system modeling and analysis. Examples of applied control systems: speed control system, temperature control system, liquid-level control system. State-space models. Derivation of state-space model from transfer function and vice versa. Time response of state-space model. Transient response characteristics. Classifications of industrial controllers. Automatic controller. Basics of PID controller. PID controller design methods; Transducers and actuators; Control applications

in power systems: turbine-governor control, generator voltage control, and load frequency control.

Course Objectives

- Be acquainted with the fundamentals of feedback control systems.
- Be able to obtain the mathematical models of applied control systems.
- Be acquainted with the basic requirements of control systems design and implementation aspects.
- Be able to obtain and judge the performance of control systems in time and frequency domains.
- Be able to design a PID controller.

Course Outcomes

After studying this course, the student is supposed to be able to:

– Understanding of the basic concepts of feedback control systems.

– Understanding of the mathematical models of applied control systems.

– Understanding of the concepts and theories relevant to system stability.

– Understanding of the types of industrial controllers.

– Understanding of the fundamentals of transducers

– Understanding of the control applications in electrical power systems

– Understanding of the Methods of PID controller design

– Ability to formulate and test hypotheses

– Ability to model and analyze an applied control system

– Ability to design, for a given system an appropriate controller to achieve certain response specification

Textbook

- R. Dorf and R. Bishop, “Modern Control Systems”, Addison-Wesley,1998

References

- K. Ogata, "Control Engineering. 4th Edition

Course Title: Power Systems Protection
Code: EE 476
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 372
Co-requisite: None

Course Description

Protection system principles and components; Short circuit calculations; Protective instrument transformers: VT- CVT- CT; Protective relays: electromechanical- static- digital- numerical; Over-current protection; Distance protection systems; Power frequency and carrier systems; Protection of generators- motors- transformers- busbars- reactors- capacitors; Protection of distribution system feeders.

Course Objectives

- Be acquainted with the main components of a protection system.
- Be able to configure the CB ratings in a power system.
- Understand the different types of relays and merits and demerits of each type.
- Be able to design a protective scheme for a system component (e.g. generator, transformer, TL, bus, etc.).
- Understand the updated technology of protection schemes.

Course Outcomes

After studying this course, the student is supposed to be able to: – Understanding of the basic components of a protection system and the main function of each. – Understanding of the main types of the protective relays, the merits and demerits of each type. – Understanding of the overcurrent and the distance protection schemes. – Ability to solve and analyze faults in a real power system. – Ability to think creatively for the requirements of given power system protection scheme. – Ability to apply skills when the protection scheme of a given power system is required.

Textbook

- Badri Ram, " Power system protection and switchgear", Tata McGraw-Hill

References

- Walter Elmore "Protective Relaying: Theory and Applications", Marcel Dekker
- Blackburn "Protective Relaying: Principles and Applications", Marcel Dekker

Course Title: High Voltage Engineering Systems
Code: EE 477
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 288
Co-requisite: None

Course Description

Generation and measurements of high DC, AC and impulse voltages; Conduction and breakdown processes in gaseous, liquid, and solid insulating media; High voltage test techniques.

Course Objectives

- Be acquainted the concepts and principles of generation of high voltage whether dc, ac or impulse.
- Be able to understand the mechanism of conduction and breakdown of gaseous, liquid and solid insulators.
- Be acquainted the different methods and techniques of carrying out high voltage testing of several components of the power system such as the insulators, bushings, cables, transformers, and circuit breakers..
- Be trained how to carry out some important high voltage laboratory experiments.

Course Outcomes

After studying this course, the student is supposed to be able to:

– Understanding of the methods of generation of high voltage

– Understanding of the conduction and breakdown of gaseous, liquid and solid insulators.

– Understanding of how to carry out high voltage testing of the insulators, bushings, transformers, circuit breakers, etc.

– Ability to analyze, and determine the reasons of insulator breakdown.

– Ability to carry out high voltage testing of electrical components.

Textbook

- Naidu and Kamaraju, "High Voltage Engineering", 2nd Edition, Tata McGraw Hi

References

- Kuffel, Zaengl, Kuffel, "High Voltage Engineering - fundamentals", Butterworth Heinenmann.

Course Title: Senior Design 1
Code: EE 498
Credit Hours: 2 (2,0,1)
Pre-requisite: None

Co-requisite: None

Course Description

The student is assigned, among a team of students and one or more faculty professors, the design of an applied project which simulates the real working condition to which the student will be exposed after graduation. The project should be comprehensive and includes all the necessary preliminary field studies, feasibility studies, final design drawings, bill of quantities, and the total operating cost of the project. The graduation project shall continue for one semester. At the end of the semester, there will be a seminar held for the working team of students to present the details of the project. The working team will be orally examined and evaluated based on the presentation as well as the oral discussion.

Course Objectives

- Knowledge and understanding of comprehensive and complete information concerning a global subject in the electrical engineering field
- Ability to defend his suggestions, designs and results concerning the performance of the project object (system)

Course Outcomes

After studying this course, the student is supposed to be able to:

– Be trained to use all the engineering concepts and skills gained in the under-graduate stage to perform a comprehensive study and analysis for a selective subject.

– Acquire the ability to join and make use of the different course subjects for the purpose of studying and solving a certain engineering problem.

– Improve his ability to work in a team, and be given the chance of self-learning and fetching the information from the different available sources.

– Be trained in the field on how to define and describe the engineering problems, and acquire the skill of data collection.

– Be given the chance to express him-self and show his own abilities and

skills.
– Develop the skill of communication through the reports and seminars
– Develop his ability of demonstration and scientific justification.

Textbook

- Decided according to the subject of the project.

References

- Decided according to the subject of the project.

Course Title: Distribution System Planning
Code: EE 478
Credit Hours: 2 (2,1,0)
Pre-requisite: EE 372
Co-requisite: None

Course Description

Basic load forecast methodologies, Electric loads types and characteristics, Electric energy consumer categories, Distribution system reliability evaluation, Distribution system cost assessment, Distribution system planning: feeder expansion, distribution transformer expansion.

Course Objectives

- Understand the load types and forecasting methodology.
- Learn the different categories of electric energy consumers.
- Be able to evaluate distribution system reliability.
- Understand the cost assessment methods in distribution system.
- Be able to perform distribution system planning.

Course Outcomes

After studying this course, the student is supposed to be able to:
– Understanding of the basic load types & characteristics and methods of forecasting.
– Understanding of the main categories of energy consumers.
– Understanding of the main methods of distribution system reliability evaluation.
– Understanding of the procedures of distribution system cost assessment.
– Understanding of the distribution system planning methodologies.

Textbook

- T. Gonen, " Electric Power Distribution System Engineering", McGraw-Hill.
- Billinton, Allan, "Reliability Evaluation of Power Systems", Longman.

References

- Sullivan," power system planning", McGraw Hill

Course Title: Protection & high-voltage Laboratory
Code: EE 479
Credit Hours: 1 (0,0,2)
Pre-requisite: 477
Co-requisite:

Course Description

Characteristics of different protective relays, coordination of protective relays, relay testing, breakdown of a solid, liquid, and gas insulating medium, corona phenomena.

Course Objectives

- Emphasized the concepts taught in the power system theoretical courses.
- To gain the laboratory benefits of modeling an actual power system under different loading conditions.
- Prepared to do experimental work in the graduation project when necessary.
- Prepared to work in the field of operation, control and maintenance of power systems.

Course Outcomes

After studying this course, the student is supposed to be able to:

– Ability to carry out test for protection relays and the commissioning tests in the sites.

– Be prepared to work in the field of operation, control and maintenance of HV systems.

– The ability to select the suitable instruments and materials as per assigned objective of experiment.

– Ability to prepare laboratory setup (circuits) with proper connections.

– Ability to analyze the experimental results and get performance characteristics.

Textbook

- Badri Ram, " Power system protection and switchgear", Tata McGraw-Hill

Reference

- Aidu and Kamaraju, "High Voltage Engineering", 2nd Edition, Tata McGraw Hill
- Laboratory Manual will be distributed by the Lecturer

Course Title: Electric Energy Utilization
Code: EE 480
Credit Hours: 3 (3,0,1)
Pre-requisite: EE 270
Co-requisite: None

Course Description

Illumination: types of lamps, illumination schemes, calculation of illumination, requirements of proper lighting. Electric Heating: advantages of electrical heating, heating methods, design of resistance heating element. Electric Welding: advantages of electric welding, welding methods, comparison between AC and DC arc welding, welding control circuits. Electrolytic Processes: laws of electrolysis, process of electro-deposition, factors affecting electro-deposition, manufacturing of chemicals by electrolysis process. Refrigeration and Air Conditioning: principle of air conditioning, refrigeration cycle, eco-friendly refrigerants, electrical circuits used in refrigerator and air-conditioner. Electric Traction: advantages of electric traction, systems of electric traction, types of motors used for electric traction, starting and braking of traction motors.

Course Objectives

- Be acquainted with the main concept of illumination and its schemes.
- Recognize advantages of electric heating and heating methods.
- Understand electric welding and its practical application.
- Understand Electrolytic Processes and its rule in manufacturing chemicals.
- Be able to explain the electrical circuits used in refrigerator and air-conditioner.
- Be able to explain various types of motors used in electric traction systems

Course Outcomes

After studying this course, the student is supposed to be able to:

– Understanding of the fundamentals of illumination and its schemes.

– Understanding of principles and advantages of electric heating and welding.

– Understanding of the fundamentals of chemicals manufacturing by electrolysis process.

- Understanding of the basic operation of refrigerator, air conditioner, and electric traction.
- Acquiring essential and adequate information as pre-job requirements
- Ability to make collections from concerned alternative schemes from technical and economical considerations.

Textbook

- C.L. Wadhwa**, "**Generation, Distribution and Utilization of Electrical Energy" , Wiley Eastern Ltd., New Delhi, 1989
- N. V. Suryanarayana**,** "Utilization of Electrical Power including Electric drives and Electric traction", New Age International (P) Limited, Publishers, 1996.

References

- G. C. Garg, "Utilization of Electric Power and Electric Traction", Khanna Publishers, Delhi, India.

Course Title: Power System Planning
Code: EE 481
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 372
Co-requisite: None

Course Description

Basic power system load forecast methodologies, Electric power system loads types and characteristics, Electric power system energy consumer categories, Power system generation and transmission reliability evaluation, Power system cost assessment, Electric power system load management and energy conservation strategies. Power system generation planning, Transmission system planning, substation expansion planning.

Course Objectives

Be acquainted with the main types of load and their characteristics.

Understand the load forecasting methodology.

Learn the categories of electric energy consumers.

Be able to evaluate power system generation, transmission reliability.

Understand the assessment methods of power costs.

Understand the methodology of load management and energy conservation.

Be able to perform generation and transmission planning.

Course Outcomes

After studying this course, the student is supposed to be able to:

- Understanding of the basic load types & characteristics and methods of forecasting.
- Understanding of the main categories of energy consumers.
- Understanding of the main methods of generation and transmission reliability evaluation.
- Understanding of the procedures of power cost assessment.
- Understanding of the generation and transmission planning methodologies.
- Ability to solve planning problems of an existing power system.
- Ability to think creatively for planning any part of power system.

– Ability to apply skills when planning for a given power system.

Textbook

- Billinton, Allan, “Reliability Evaluation of Power Systems”, Longman.
- Sullivan,” power system planning”, McGraw Hill

References

- T. Gonen, “ Electric Power Distribution System Engineering”, McGraw-Hill.

Course Title: Control and Operation of Power Systems
Code: EE 482
Credit Hours: 3 (3,0,1)
Pre-requisite: EE 372
Co-requisite: None

Course Description

Concepts of Power System Operation; Formulation of Unit Commitment problem, Solution Methods; Principles of power system security assessment, Contingency Analysis, (DC and AC load flow methods), Correcting Generation; Introduction to OPF, Solution of the OPF, Linear sensitivity analysis, Linear programming methods, Security-constrained OPF; An Introduction to the operation of AGC, EMS and Control center, Models of Generator, Load , Prime Mover and Governer, Generation Control AGC Implementation; State Estimation: An overview of state estimation, Power system state estimation, weighted least-square estimation, state estimation of an Ac network, Application of power systems state estimation..

Course Objectives

- Be acquainted with the main concepts of power system operation.
- Recognize how to configure the commitments of generating units.
- Understand how to operate a power system economically.
- Understand the operation of AGC, EMS & Control Centers.
- Be able to explain how to estimate the power system state.
- Be able to assess the power system security level.

Course Outcomes

After studying this course, the student is supposed to be able to:

– Understanding of the fundamentals of economical operation and control of power generation systems.

– Understanding of the basics of mathematical optimization methods and apply them to practical operating problems.

– Understanding of the basic operation of AGC, EMS and control center.

– Understanding of the concept of the security analysis and the idea that power system could be constrained to operate in secure manner.

– Understanding of the fundamentals of the state estimation process and its importance for the secure operation of the power systems.

– Ability to use the exiting simulation tools to analyze and simulate an operation power system network.

– Ability to solve economical and practical problems, using mathematical optimization tools.

Textbook

- Allen J. Wood and Bruce F. Wollenberg: Power Generation Operation and Control(2nd Edit), John Willey & Sons, Inc.
- John J. Grainger and William D. Stevenson, Jr. (1994): Power System Analysis: McGraw Hill.

References

- Saadat, " Power System Analysis", McGraw Hill.

Course Title: Selected Topics in Power Systems
Code: EE 483
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 372
Co-requisite: None

Course Description

The contents of this course will be determined according to the recent topics in this field which will serve the work market or according to the interest area of the instructor to enhance the experience and knowledge of the student.

Course Objectives

- Be acquainted the recent topics in the field of electrical power which will serve the work market.
- Acquire more experience and knowledge.
- Get rid of the shortages and deficiencies in the compulsory courses.
- Be given the up to date knowledge in this field.

Course Outcomes

After studying this course, the student is supposed to be able to:

– Be acquainted the recent topics in the field of electrical power which will serve the work market.

– Acquire more experience and knowledge in power systems filed.

– Get rid of the shortages and deficiencies in the compulsory courses.

– Be given the up to date knowledge in the electrical power field.

Textbook

- Will be decided according to the selected topic.

References

- Will be decided according to the selected topic.

Course Title: Switchgear Protection In Power Systems
Code: EE 484
Credit Hours: 2 (2,1,0)
Pre-requisite: EE 476, EE 477
Co-requisite: None

Course Description

Switchgear system layout - LV, MV & HV circuit breakers (CB) – Switching phenomena – Arc extinction – HRC fuses – LV, MV & HV metal enclosed switchgear – Surge arrester – Isolator – Load break switch – Earth switch.

Course Objectives

- Be acquainted with the main components of a switchgear system and its requirements.
- Understand the different types of CB, merits and demerits of each type.
- Understand the methodology of arc extinction in different medium.
- Be able to design a switchgear scheme for a substation (including: busbars, CBs, isolators, earth switch, etc ..).

Course Outcomes

After studying this course, the student is supposed to be able to:
– Understanding of the basic components of a switchgear system and the main function of each. – Understanding of the main types of CBs the merits and demerits of each type. – Understanding of the main types of CB's and the preferred application for each type. – Understanding of the surge arrester and HRC fuses. – Ability to think creatively for the requirements of given power system switchgear scheme.

Textbook

- S. Rao, " Switchgear Protection and Power systems", Khanna publishers.

References

- Badri ram , et..al , "Power system protection and switchgear", Tata McGraw-Hill.

Course Title: Computer Applications in Power Systems
Code: EE 485
Credit Hours: 3 (3,0,1)
Pre-requisite: EE 372
Co-requisite: None

Course Description

Computer applications in power system planning, Computer applications in power flow solution and control, Computer applications in power system fault analysis, Computer applications in power system dynamics and control, Computer applications in power system economic operation.

Course Objectives

- Be acquainted with the main computer applications in power.
- Understand the load flow solution methodology.
- Learn the computer power system fault analysis.
- Be able to evaluate power system economic operation.
- Understand the assessment methods of power system dynamics.
- Understand the methodology of power system control.
- Be able to perform power system (generation, transmission & distribution) planning.

Course Outcomes

After studying this course, the student is supposed to be able to:

- Understanding of the main computer-methods in power system dynamics.
- Understanding of the computer-procedures for economic operation assessment in power systems.
- Understanding of the generation, transmission & distribution planning computer-methodologies.
- Ability to solve real problems of an existing power system using the computer.
- Ability to think creatively for any type of power system problems.
- Ability to apply skills when solving problems on a given power system.

Textbook

- Heydt," Computer Analysis Methods for Power Systems", Macmillan Pub. Co.
- Stag, El-Abiad, " Computer Methods in Power System Analysis", McGraw Hill.

References

- Saadat, " Power System Analysis", McGraw Hill, 2nd edition.

Course Title: Grounding And Safety Systems
Code: EE 486
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 477
Co-requisite: None

Course Description

Grounding aspects, grounding resistance, soil resistivity, power system grounding methods, substation grounding, equipment grounding, measurements of grounding system parameters, GIS grounding, TL tower grounding, LV grounding. Safety means in power systems.

Course Objectives

- Be acquainted the concepts and principles of grounding (earthing).
- Be able to understand the mechanism of grounding system.
- Be acquainted the different methods and techniques of measuring ground resistance.
- Be trained how to carry out some important grounding laboratory experiments.

Course Outcomes

After studying this course, the student is supposed to be able to:

- Understanding of the methods of grounding in LV, MV and HV systems
- Understanding of the effect of grounding.
- Understanding of how to carry out testing of the grounding for generators, transformers, circuit breakers, e.t.c.
- Ability to carry out grounding testing of electrical components.

Textbook

- S. Rao, " Switchgear protection and power systems", 11-ed, Khanna publishers.
- H.L. Saluja, S. Rao, " Electrical safety, fire safety engineering and management", Khanna publishers.

References

- A. Alarainy, ..et, "Fundamentals of electrical power Engineering ", King Saud Univ. academic press.

Course Title: Advanced Topics in Power System Protection
Code: EE 487
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 476
Co-requisite: None

Course Description

The contents of this course will be determined according to the recent topics in this field which will serve the work market or according to the interest area of the instructor to enhance the experience and knowledge of the student.

Course Objectives

- Be acquainted the recent topics in the field of electrical power system protection which will serve the work market.
- Acquire more experience and knowledge.
- Get rid of the shortages and deficiencies in the compulsory courses.
- Be given the up to date knowledge in this field.

Course Outcomes

After studying this course, the student is supposed to be able to:
– Be acquainted the recent topics in the field of protection schemes which will serve the work market. – Acquire more experience and knowledge in protection schemes filed. – Get rid of the shortages and deficiencies in the compulsory courses. – Be given the up to date knowledge in the power system protection field.

Textbook and References

- Will be decided according to the selected topic.

Course Title: Special Electrical Machines
Code: EE 490
Credit Hours: 3 (3,1,0)
Pre-requisite: None
Co-requisite: EE374

Course Description

reluctance motor, stepper motor, eddy current motors, hysteresis motors, ac commutator motors, universal motor, two phase servo motor, linear induction motor, linear d.c motor.

Course Objectives

- Teaching the students the necessary information about some motors which have special applications and other motors which are used in control systems.
- Enabling the students to use the special motors and the fractional horsepower motors in building some simulating hardware models for their graduation project.
- Preparing the students to deal with special drive systems found in some productive industries, and to master the different servo mechanisms in the power stations and factories.

Course Outcomes

- Understanding the classifications of special machines
- Understanding the characteristics of special machines.
- Understanding the applications of special motors.
- Understanding of the control methods of special motors.
- Ability to select the suitable motor for a certain job under given conditions.
- Understanding the classifications of special machines
- Understanding the characteristics of special machines.

Textbook and Reference:

- Electric Machinery, A. Fitzgerald, Jr. Charles Kngsley and S. D. Umans

Course Title: Selected Topics in Electrical Machines
Code: EE 491
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 389
Co-requisite: None

Course Description

The contents of this course will be determined according to the recent topics in this field which will serve the work market or according to the interest area of the instructor to enhance the experience and knowledge of the student

Course Objectives

- Be acquainted the recent topics in the field of electrical machines which will serve the work market.
- Acquire more experience and knowledge.
- Get rid of the shortages and deficiencies in the compulsory courses.

Course Outcomes

- Understanding of the engineering aspects of practical electric-machine performance such as magnetic saturation, losses, rating and heating, cooling means for electric machines, energy efficiency.
- Understanding of the advanced concepts and special Transformers such as engineering aspects of transformer analysis, parallel operation of transformers, multi-circuit transformer, V transformer, open delta transformer, Scott transformer.
- Understanding of the Synchronous Machines: interconnected synchronous generators, synchronous machine transients, dq modeling, analysis of a sudden three-phase short circuit, transient power-angle characteristics, effect of additional rotor circuits, synchronous machine dynamics.
- Understanding of the Deep bar and double cage rotor induction motors and design classes of induction motors.
- Understanding of the engineering aspects of practical electric-machine performance such as magnetic saturation, losses, rating and heating, cooling means for electric machines, energy efficiency.
- Understanding of the advanced concepts and special Transformers such as engineering aspects of transformer analysis, parallel operation of transformers, multi-circuit transformer, V transformer, open delta

transformer, Scott transformer.

- Understanding of the Synchronous Machines: interconnected synchronous generators, synchronous machine transients, dq modeling, analysis of a sudden three-phase short circuit, transient power-angle characteristics, effect of additional rotor circuits, synchronous machine dynamics.

Textbook

- A.E. Fitzgerald, Charless Kingsley, Jr, and Stephen D. Usmans, "Electric Machinery", McGraw Hill, New York

References

- S.J. Chapman, "Electric Machinery Fundamentals", McGraw Hill
- SARMA, "Electric Machines Steady State Theory and Dynamic Performance", WEST

Course Title: Electric Drive Systems
Code: EE 492
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 389, EE374
Co-requisite: None

Course Description

Drive system components, D.C motor drive systems, D.C motors fed from single-phase rectifier circuits, D.C motors fed from three-phase rectifier circuits, chopper-fed D.C motors, induction motor drive systems, induction

motors fed from A.C voltage controller, inverter-fed induction motors.

Course Objectives

- Teaching the students the concepts and principles of the electric drive systems.
- Preparing the students to work in the electric traction, industry, and oil fields.
- Preparing the students for the graduation project.

Course Outcomes

- Understanding of the basics and concepts related to the electric drives and their applications.
- Understanding of the basic information of different types of DC motor drives and their properties.
- Understanding of the Basic information of different types of AC motor drives and their properties.
- Understanding of the advantages and disadvantages of different electric drives
- Understanding of the advantages and disadvantages of different types of electrical motor braking
- Ability to analyze an existing electric drive system.
- Ability to select an electric drive for certain application.

Text Book and References:

- S.B. Dewan, G.R. Slemon and A. Staughen, “Power Semiconductor Drives,” John Wily & Sons.

Course Title: Selection and Installation of Motors
Code: EE 493
Credit Hours: 3 (3,1,0)

Pre-requisite: EE389
Co-requisite: None

Course Description

Motor duty types; motor mounting arrangement: IM code, cable selection, cable layout (power cable, control cable); motor methods of cooling: IC code, motor auxiliaries, impeded temperature detectors (ETD), requirements of motors thermal protection; short circuit protection: selection and sizing of load break switch, fuse and circuit breaker; selection and sizing of motor automatic starter: DOL, star/delta (open& closed transition) starter, auto transformer starter, SRIM starter, DC motor starter, Automatic starting of synchronous motor; selection of motor overload protection; selection and sizing of motor power factor correction capacitors; selection and sizing of motor controller.

Course Objectives

- Be taught complete and comprehensive information about the selection of motors regarding the mounting, method of cooling and insulation type.
- Be acquainted how to choose the motor feeders and switchgears such as the starters, e.t.c.
- Be prepared for working in industries, field of electric traction, field of electrified drives and oil fields.

Course Outcomes

– Understanding of the Motor duty types. – Understanding of the motor mounting arrangement: IM code, cable selection, cable layout (power cable, control cable). – Understanding of the motor methods of cooling: IC code. – Understanding of the Impeded temperature detectors (ITD), requirements of motors thermal protection; short circuit protection: selection and sizing of load break switch, fuse and circuit breaker; selection of motor overload protection. – Understanding of the Selection and sizing of motor automatic starter: DOL, star/delta (open& closed transition) starter, auto transformer starter, SRIM starter, DC motor starter, Automatic starting of synchronous motor. – Understanding of the selection and sizing of motor power factor correction capacitors – Understanding of the selection and sizing of motor controller

Textbook and Reference:

- Electrical installations handbook, John Wiley & sons.
- Modern industrial/electrical motor controls, operation, installation, and troubleshooting, by Thomas E. Kissell
- National Electric Code (NEC)
- IEC 947

Course Title: Fundamentals of Electric Circuits
Code: EE 101
Credit Hours: 3(3,1,0)
Pre-requisite: MATH 107
Co-requisite: None
Level: 4

Course Description:

Basic circuit elements and concepts; Basic laws of circuit theory: Ohm's law, Kirchoff's law; Circuit theorems: superposition principle, Thevenin and Norton theorems; maximum power transfer theorem; techniques of circuit analysis: Nodal and mesh analysis.

Course Objectives:

• Knowing basic Electric circuit elements.
• Learning the basic concepts of electric circuits.
• Mastering basic electric circuit theorems.
• Learning the basic techniques of circuit analysis.
• Understanding the concept of phasor and vectors in circuit analysis.
• Learning the concept of power in electric circuits.

Course Outcomes

• Constructing an electric circuit using basic circuit elements.
• Employing basic circuit theorems to find circuit parameters.
• Analyzing basic electric circuits.
• Dealing with electric circuit phasors and vectors.
• Analyzing electric circuit active and reactive powers.

Textbook

Sadiku, Fundamentals of Electric Circuits, 3rd Edition, McGraw-Hill Science, 2005.

References

Boylestad, ”Introductory Circuit Analysis”, Prentice Hall, 1999.

Course Title: Analysis Of Electric Circuits

Code: EE 202
Credit Hours: 3(3,1,0)
Pre-requisite: EE 101
Co-requisite: None

Course Description

Frequency response of RLC and resonance circuit: concept of transfer function, resonance, Bode plots, introduction to filters; Two-Port networks; Mutual inductance and transformers; Transient analysis of first and second order circuits; Three phase circuits; Introduction to Op-Amp, ideal characteristics with simple applications; Diode characteristics, clipping and rectification.

Course Objectives

• *Provid the students with RLC principles.*
• *Understanding resonance circuits.*
• *Mastering filter principles.*
• *Understanding two port networks.*
• *Knowing first and second order networks.*
• *Understanding op amp networks and diode characteristics.*

Course Outcomes

After studying this course, the student is supposed to be able to: • Using RLC circuits.
• Using resonance circuits.
• Using filters.
• Using two port networks.
• Using op amp circuits.
• Using diode circuits.

Textbook

Nilsson, “Electric Circuits“, Addision Wesley, 1996.

References

Sadiku, Fundamentals of Electric Circuits, 3rd Edition, McGraw-Hill Science, 2005.

Course Name: Electric Circuit Lab
Code: EE 205
Credit Hours: 1(0,0,2)
Pre-requisite:
Co-requisite: EE 202

Course Description

General introduction to the laboratory Voltage, current, and power in DC circuits using KVL and KCL. Superposition, Thevenin's, and Maximum power transfer theorems in DC circuits; Series and parallel AC circuits; Maximum power transfer theorem.

Course Objectives

- Knowing basic Electric circuit elements.
- Learning the basic concepts of electric circuits.
- Mastering basic electric circuit theorems.
- Learning the basic techniques of circuit analysis.
- Understanding the concept of phasor and vectors in circuit analysis.
- Learning the concept of power in electric circuits.

Course Outcomes

- Constructing an electric circuit using basic circuit elements.

• Employing basic circuit theorems to find circuit parameters.
• Analyzing basic electric circuits.
• Dealing with electric circuit phasors and vectors.
• Analyzing electric circuit active and reactive powers.

Textbook

Sadiku, Fundamentals of Electric Circuits, 3rd Edition, McGraw-Hill Science, 2005.

References

Boylestad, "Introductory Circuit Analysis", Prentice Hall, 1999.

Course Title: Electromagnetics I
Code: EE 206
Credit Hours: 3 (3,1,0)
Pre-requisite: MATH 107
Co-requisite: None

Course Description

Vector Algebra; Coordinate Systems and Transformation; Vector Calculus; Coulomb's Law; Electric Fields; Electric Flux Density; Gauss's Law-Maxwell's Equation; Electric Potential; Maxwell's Equations; Properties of Materials; Conductors; Dielectrics; Continuity Equation; Boundary Conditions; Poisson's and Laplace's Equations; Uniqueness Theorem; Biot-Savart's Law; Ampere's Circuit Law and its Applications; Magnetic Flux Density; Magnetic Torque and Moment; Magnetic Dipole; Magnetization in Materials; Magnetic Energy; Magnetic Circuits.

Course Objectives

- *To use complex number algebra and complex vectors*
- *To understand basic electromagnetic concepts and parameters necessary for the analysis and design of electromagnetic systems*
- *To analyze the relationships between fields and flux densities in material media*

- *To understand the coupling between electric and magnetic fields through Maxwell's equations*

Course Outcomes

After studying this course, the student is supposed to be able to:

- Represent fields in either the standard Cartesian, cylindrical, or spherical coordinate systems.
- Understand the physical meaning as applied to fields of the gradient, divergence, and curl
- Understand the physical meaning of Coulomb's Law, Gauss' Law.
- Express Maxwell's Equations in either integral or differential form
- Understand the source of magnetic fields is moving charge or current
- Understand the physical meaning of the Biot-Savart law

Textbook

M.N.O. Sadiku, Elements of Electromagnetics, 3rd Edition, Oxford University Press.

References

1. Field and Wave Electromagnetics, D. K. Cheng, Prentice Hall, 1989.
2. Fundamentals of Applied Electromagnetics, F. T. Ulaby, Pearson Prentice Hall, 2004.

Course Title: Principles of Electric Machines
Code: EE 288
Credit Hours: 3 (3,1,0)
Pre-requisite: EE205
Co-requisite:

Course Description

Transformers (construction, operation of single-phase transformers, equivalent circuit, voltage regulation and efficiency, auto-transformers, three-phase transformers), AC machinery fundamentals, Synchronous machines (components, internal voltage, equivalent circuit, phasor diagram, performance of turbo-alternator, generator operating alone, parallel operation of AC generators, synchronous motors, steady-state operation, motor starting), synchronous machine dynamics: the swing equation, steady state and transient stability

Course Objectives

- Teaching the students the concepts, principles of operation, performance characteristics and methods of control of the transformers and synchronous machines.
- Preparing the students for dealing with the transformers and alternators in the power stations and the transformer substations regarding the operation, the maintenance, the control and developing the performance.
- Acquainting the students the ability to deal with the synchronous motors as important drives in the industry mining and transportation fields.
- Covering some subjects as introduction for consequent advanced courses in the electrical machines, electric drives and power systems.

Course Outcomes

- Understanding of the construction, connections, principle of operation of single-phase, three-phase and autotransformers.
- Understanding of the Equivalent circuits representing the transformers.
- Understanding of how to calculate the performance characteristics (voltage regulation and efficiency) of the transformers.
- Understanding of the fundamentals of the ac machines such as the concept of the rotating flux, the induced voltage and torque.
- Understanding of the construction, principle of operation, modeling of the synchronous generator.
- Understanding of how to calculate the voltage regulation of the alternator using the phasor diagram or the complex numbers
- Understanding of the power-delta relation and how to determine the steady state stability of the alternator.

Textbook:

S. J. Chapman, “Electric Machinery Fundamentals”, McGraw Hill

Reference:

SARMA, "Electric Machines-steady state theory and dynamic performance" WEST

Course Title: Electromagnetics II
Code: EE 234
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 205
Co-requisite: None

Course Description

Time varying fields; Faraday's law. Transformer and motional emfs; Displacement current; Maxwell's equations and time harmonic fields; Wave equation; Power transfer and Poynting vector; Plane wave propagation in free space, in lossy dielectrics and in good conductors; Polarization; Reflection of plane wave at normal and oblique incidence; Transmission lines; Impedance matching; waveguides. Introduction to radiation and antennas; Antenna parameters; Wire antennas.

Course Objectives

- To understand basic concepts of wave propagation
- To Understand and apply mathematical concepts of vector analysis to the time dependent solution of electromagnetic engineering.
- To Apply higher level mathematics in the solution of engineering problems making use of Maxwell's equations in applications involving reflection, transmission, and oblique incidence of plane waves, transmission lines, waveguides, and boundary value problems in electromagnetics.

Course Outcomes

After studying this course, the student is supposed to be able to:

- List Maxwell's equations and solve them for specific regular geometries
- Understand general electromagnetic wave propagation and how the plane wave solution can be used to approximate real situations.
- Interpret the dielectric and magnetic properties of given materials
- Describe the boundary conditions for electric and magnetic fields at dielectric interfaces
- Analyze the use of rectangular waveguide to guide electromagnetic waves.
- Understand different antenna parameters and analyze short dipole antenna.

Textbook

M.N.O. Sadiku, Elements of Electromagnetics, 3rd Edition, Oxford University Press.

References

1. Field and Wave Electromagnetics, D. K. Cheng, Prentice Hall, 1989.

2. Fundamentals of Applied Electromagnetics, F. T. Ulaby, Pearson Prentice Hall, 2004.

Course Title: Signals and Systems Analysis
Code: EE 221
Credits:3 (3,1,0)
Pre-requisite: MATH 204.
Co-requisite:

Course Description

Students in this course are introduced to learn: Motivation and Applications, Signal Classifications, Signal Operations, Singularity Functions; Linear time-Invariant Systems and Convolution; Correlation; Fourier Series and Transform for continuous and discrete time signals; Applications; Laplace transform and applications; Introduction to z-transform.

Course Objectives

1- To learn the principles of continuous and discrete-time signals. 2- To have an understanding of basic system properties. 3- To be able to analyze the response of linear & time-invariant systems using the convolution. 4- To be able to represent time-domain signals using Fourier representations and to be familiar with the basic properties of such Fourier representations 5- To understand the principles of sampling of continuous-time signals. 6- To be able to analyze the response of linear & time-invariant systems in the frequency domain (using Fourier transforms). 7- To have a basic understanding of other representations such as the Laplace and Z transforms.

Course Outcomes

(a) An ability to apply knowledge of math, science and engineering. In this course, various mathematical concepts and tools are used to analyze engineering systems. **(c) An ability to design a system, component, or process to meet desired needs.** Through this course, the students learn how to design continues and discrete time systems that meet certain time and frequency domain requirements. **(e) Identify, formulate and solve engineering problems.** This course shows how to solve various engineering problems using frequency and time-domain tools. Examples include electric circuit analysis and amplitude modulation systems.

Textbook

- *Haykin and Veen, Signals & Systems, John Wiley, 1998.*

References

- *A. V. Oppenheim, Signals & Systems, Prentice Hall, 1997*

Course Title: Fundamentals of Electrical Power Systems
Code: EE 270
Credit Hours: 3 (2,1,0)
Pre-requisite: EE 206
Co-requisite: None

Course Description

Power system components and elements: generation – transmission - distribution; Generation of electrical energy: main sources – alternative sources; Transmission line conductors; Electric insulators: types – parameters; Transmission line parameters: series impedance, shunt admittance; Analysis of transmission lines: short line – medium line – long line; Power cables parameters: series impedance, shunt admittance; Analysis of distribution systems: radial system – ring system.

Course Objectives

1- Be acquainted with the main components of a power system (generation, transmission & distribution).

2- Be able to identify the type of a generating station (thermal, nuclear & hydro) and its main components.

3- Be able to explain the distribution systems.

4- Be able to explain the transmission line (OHTL) or under-ground cables (UGC) components (conductors, insulators, etc) and its parameters models.

5- Understand the appropriate method used for the transmission of electrical energy.

Course Outcomes

After studying this course, the student is supposed to be able to:

- Understanding of the basic components of a power system.
- Understanding of the methodologies for main and alternative sources of electrical energy.
- Understanding of the main concepts of different systems of supplying electrical energy.
- Understanding of the theory of transmission lines and underground cables construction and their analysis.
- Understanding of the basic distribution systems structure and their analysis.

Textbook

A. Alarainy, et…," Fundamentals of electrical power engineering", King Saud Univ., academic press.

References

3. Ashfaq Husain, "Electrical power systems", CBS, 4th edition
4. Gonen "Electric power distribution: System engineering", McGraw Hill

Course Title: Electric Power & Machines Laboratory
Code: EE 271
Credit Hours: 1 (0,0,2)
Pre-requisite: None
Co-requisite: EE 284, EE 270

Course Description

Determination of Transmission Lines (TL) parameters; TL loading characteristics; TL reactive power compensation; TL insulators voltage characteristics; Reactive power compensation for industrial loads; Equivalent circuit of transformers; Three-phase connections and harmonic problems; Equivalent circuit of three-phase synchronous machine; Parallel operation of sysnchronous generator. Steady state operation of synchronous motor, Starting of synchronous motor.

Course Title: Automatic Control Systems.
Code: EE 341
Credit Hours: 3 (3,1,0)
Pre-requisite: EE221
Co-requisite:

Control Systems- Closed-Loop Control versus Open-Loop Control, Modeling of Dynamic Systems: Transfer Function and Impulse-Response Function- Modeling of Mechanical and Electrical, Fluid and Thermal Systems- Signal Flow Graphs. Transient and Steady-State Response Analyses: First, Second and Higher-Order Systems- Transient-Response Analysis- Routh's Stability Criterion- Steady-State Errors. Root-Locus Analysis: Root-Locus Plots- Positive-Feedback Systems-

Conditionally Stable Systems- Control Systems Design by the Root-Locus Method. Frequency-Response Analysis: Bode Diagrams- Polar Plots- Nyquist Stability Criterion- Stability Analysis- Closed-Loop Frequency Response. Control Systems Design by Frequency Response: Lead Compensation- Lag Compensation- Lag-Lead Compensation. Application of MATLAB/SIMULINK

Course Title: Automatic Control
Code: EE 343
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 340, EE 308
Co-requisite:

Course Description

Introduction to Control Systems- Mathematical Models of Systems- State Variable Models- Feedback Control System Characteristics- The Performance of Feedback Control Systems- The Stability of Linear Feedback Systems- The Root Locus Method- Frequency Response Methods- Stability in the Frequency Domain-The Design of Feedback Control Systems-The Design of State Variable Feedback Systems-Introduction to Robust Control Systems-Introduction to Digital Control Systems.

Course Objectives

• Applying the concept of control systems theory as it has been developed in the frequency and time domains.
• Coverage of classical control through root locus design, frequency and response design using Bode and Nyquist plots.
• Understanding modern control methods based on state variable models including pole placement design techniques with full-state feedback controllers and full-state observers.

Course Outcomes

After studying this course, the student is supposed to be able to:
• Understand the basic concepts of control engineering
• Able to find out mathematical models for the physical systems.
• Able to apply the classical control methods to design stable control system in time domain and frequency domain.
• Able to apply the modern control to design a stable control system.
• Implement digital computers to write simple programs for the design of a classical as well as modern control system.
• Understanding the basic principles of robust and digital control design. More details of these topics will be deepen in separate selective courses.

Textbook

Richard Dorf and Robert Bishop: "Modern Control Systems" , 11th Edition, 2008.

References

5. Katsuhiko Ogata:"Modern Control Engineering", International Edition, Pearson Education Press, 5th edition, Prentice Hall, 2009.
6. Gene Franklin, J.D. Powell, and Abbas Emami-Naeini:" Feedback Control of Dynamic Systems", International Edition, 5th edition, Prentice Hall, 2008.

Course Title: Analog And Digital Measurements.
Code: EE 307
Credit Hours: 3(3,1,0)
Pre-requisite: EE 203
Co-requisite:

Measurements fundamentals: units and standards, errors, statistical analysis; DC/AC meters construction; loading effect; insertion loss; Difference and instrumentation amplifiers; Oscilloscope: CRT, amplifiers, triggered sweep circuits, attenuation, specifications; Spectrum analyzer, Transducers and sensors: passive and self-generating transducers; Liquid crystal displays (LCDs), CCDs, and optical fiber sensors; Digital measurements: Data conversion principles; Digital voltmeter; grounding, shielding, and noise.

Course Title: Measurements & Control Lab.
Code: EE 308
Credit Hours: 1 (0,0,2)
Pre-requisite: -
Co-requisite: EE 307, EE 340

Course Description

This lab course includes various experiments to study various aspects of measurements and control that applied these processes: Pressure, Torque, Load, Temperature, Strain, Level, Displacement, Air velocity. MEASUREMENT AND CONTROL with Micro Processor Controls: Pressure - Control with tank and other accessories- Flow Control- Level Control- Temperature Control.

Course Objectives

- Providing a "hands-on" experience with Measurements and control.
- Practicing the measurements and control of many industrial processes via interfacing with PC supported by a computer Package that suite the Microprocessor control and measurements such as LabVIEW.

Course Outcomes

After studying this course, the student is supposed to be able to:

- Establishing practical experiments aided with analysis , recording, and controller design the following industrial processes: Pressure, Torque, Load, Temperature,

Displacement, Level, Strain, Air velocity.

Class/laboratory schedule

One 90-minute lab session per week.

Resources of the course

Textbook, Lab Manuals, references, and Modules.

Computer usage

Word Processing for report writing.

Textbook

Alan S Morris: "Measurement and Instrumentation Principles", Third Edition, Butterworth-Heinemann; 3 edition, April 10, 2001

References

7. James A. Blackburn: "Modern Instrumentation for Scientists and Engineers", Springer; 1 edition, November 21, 2000.

Course Title: Communications Principles
Code: EE 322
Credits: 3(3,1,0)
Pre-requisite: EE 221 - STAT 201
Co-requisite:

Course Description

.students in this course are introduced to learn: Overview and Basic elements of communication systems; Signal Analysis; Transmission through Systems and Channels; Modulation; AM; Frequency Conversion; FM and PM; Super-heterodyne

Receiver; FDM; Stereo Broadcasting; Sampling; Pulse Modulation (PAM, PWM, PPM); TDM; Pulse Code Modulation (PCM); DPCM and DM; Regenerative Repeaters; Advantages of Digital Communication; Line Coding (Binary Signaling); Introduction to Digital Modulation (ASK, FSK, PSK). Effect of noise on analog modulation systems

Course Objectives

1. Understand the basic concept of information.
2. Understand how information is put into electronic for storage and delivery.
3. Have detailed understanding of amplitude and frequency modulation and demodulation methods including synchronous demodulation, nonlinear demodulation and phase-locked loops (PLL).
4. Have an understanding of design considerations for multiple access/use spectrum and multiplexing.
5. Have detailed understanding of digital communication basics.
6. Understand basic principles of Gaussian noise processes and their use/utility in communication system design.

Course Outcomes

(a) an ability to apply knowledge of Mathematics, science, and engineering. This course focuses on mathematical formulation of communication systems.
(c). An ability to design a system, component, or process to meet desired needs. The homework assignments explain how to design simple communication systems. An optional project is given to students to design and test an AM or FM transmitter.
(e). Identify, formulate and solve engineering problems. The class includes various examples of analysis of engineering problems related to analog and digital communication systems.
(h). Broad education necessary to understand the impact of engineering solutions in a global and societal context.

The impact of applying communication theories on modern technologies is discussed throughout the course.
(k). Use of modern engineering tools The students are urged to read communication magazines.

Textbook

S. Haykin, An Introduction to Digital and Analog Communications, *John Wiley, 2007.*

References

- S. Haykin, Communication Systems, John Wiley, 2001.
- B P Lathi, Modern Digital and Analog Communications Systems, Oxford University Press, 1998.

Course Title: Basic Electronic Devices and Circuits Laboratory
Code: EE 212
Credits:1 (0,0,2)
Pre-requisite:
Co-requisite: EE 111

Course Description

Students in this course are introduced to learn: Introduction to the lab tools. I-V characteristics of diode. Clipping circuits using diodes. Rectification using diodes. Zener diode and regulators. BJT dc biasing. CE BJT amplifier. MOSFET dc biasing. CS MOSFET amplifier. Simple AM receiver circuit, MOS digital circuits.

Course Objectives

1.	distinguish the basic principle of operation of the dual trace oscilloscope
2.	apply the oscilloscope to measure: the frequency and amplitude of a signal, the phase-shift between signals
3.	familiarize the students with Diode Characteristics
4.	demonstrate construction, principle of operation, limitations, waveform error, and applications of a half- wave and full-wave rectifier.
5.	Studying the Bipolar Junction Transistor (BJT) input/output Characteristics
6.	Studying the Field Effect Transistor (FET) input/output Characteristics

Course Outcomes

An ability to design and conduct experiments, as well as to analyze and interpret data
An ability to design a system, component, or process to meet desired needs
An ability to function on multi-disciplinary teams
An understanding of professional and ethical responsibility
An ability to communicate effectively

Textbook

- Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits (6[Th] Ed), Oxford University Press, 2010

Course Title: Communications Principles Laboratory
Code: EE 323
Credits: 1(2,0,0)
Pre-requisite:
Co-requisite: EE 322

Course Description

Students in this course are introduced to learn: Design methods and laboratory experiments dealing with practical aspects of analog and digital communications schemes. Experiments involve component-level circuit construction, interconnection of modular subsystems, and use of interactive, graphics-based, system simulation software packages for the following topics: Amplitude Modulation AM, Frequency Modulation FM, Phase Modulation PCM. Sampling. Pulse Amplitude Modulation, Pulse time Modulation, Pulse width Modulation. Pulse Code Modulation, Delta Modulation. Amplitude Shift Keying ASK. Frequency Shift Keying FSK. Phase Shift Keying. TDM. FDM. Fiber optic transmitter. Fiber optic receiver. Fiber optic characteristics.

Course Objectives

1. To develop skills in component-level circuit construction, as well as modular interconnection of subsystems, needed to build physical communications systems.
2. To develop skills in the use of industry-relevant electronic test and measurement equipment typically encountered by a design engineer.
3. To use industry-relevant software communications systems simulation methods for the purpose of evaluating overall communication system performance.
4. To understand the functionality of analog and digital communications modulation and demodulation by building, testing and analyzing circuits.
5. To study and implement essential subsystems such as carrier acquisition and recovery, receiver front-end, and superheterodyne receiver architectures.

Course Outcomes

1. An ability to use electronic test and measurement equipment over frequencies from baseband to RF.
2. An ability to design, build, test and analyze circuits and systems relevant to communications systems.
3. An ability to write informal and formal technical reports.
4. An ability to orally present technical concepts to a group.

Textbook

- P. H. Young, *Electronic Communication Techniques*, Prentice-Hall, 2004.

References

- C. W. Sayre, *Complete Wireless Design*, McGraw Hill, 2001.

J. G. Proakis, M. Salehi and G. Bauch, *Contemporary Communication Systems Using MATLAB and Simulink,* Thomson Engineering, 2004

- M. C. Jeruchim, P. Balaban and K. S. Shanmugan, *Simulation of Communication Systems*, Plenum Press, 1992.

Course Title: Microprocessors.
Code: EE 360
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 203, EE 111
Co-requisite: -

Course Description

Basic microprocessor architecture, timing and signaling for interface applications and control, instruction execution cycles and sequencing, interrupts, memory systems design and organization, basic peripheral interfacing and interface design, software topics including assembly language programming, interrupt handlers, fast arithmetic algorithms and hardware description languages (HDL).

Course Objectives

• Introduction to the Basic Concepts Related to Architecture and Programming Microprocessor Systems.
• Understanding the Hardware and Software Design and Implementation Process.
• Understanding Assembly Language and Computer Organization.

Course Outcomes

After studying this course, the student is supposed to be able to:
• Gain the basic knowledge of microprocessor architecture.
• Practice of the instruction set for 80x86 micro-processors.
• Able to write and debug assembly programs.
• Learn the basic knowledge of the memory and I/O interfaces, address decoding, and bus transactions.
• Learn the interrupt-based control model, including software and hardware interrupts.

Textbook

Jon Stokes: "Inside the Machine: An Illustrated Introduction to Microprocessors and Computer Architecture", No Starch Press; 1 edition November 30, 2006.

References

8. Richard Detmer: " Introduction to 80x86 Assembly Language and Computer Architecture", Jones & Bartlett Publishers; 2 edition, February 26, 2009.

Course Title: Microprocessors Lab.
Code: EE 361
Credit Hours: 1 (0,0,2)
Pre-requisite: -
Co-requisite: EE 360

Course Description

This lab course includes various experiments to study various aspects of Microprocessors (MP) that cover these topics: Function of microprocessors, Interfacing; Memory organization; Machine cycles; Timers.

Course Title: Analog and Digital Electronic Circuits

Code: EE 314
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 111
Co-requisite:

Course Description

Description: Introduction to various analog and digital circuits such as: op-amp, ideal op-amp characteristics and applications, non-ideal op-amp, difference amplifier and multistage amplifiers. Current mirrors and current sources. Feedback. CMOS digital circuits. BJT digital circuits; TTL and ECL gates.

Course Objectives

• To understand the characteristics of different op-amp circuits and its application
• To teach the students the skills in how to analyze and deal with electronic circuits and systems such as current mirrors and current sources, CMOS digital circuits, BJT digital circuits etc.
• To teach the students how to analyze and design some of the electronic circuits systems and their applications such as the TTL and CMOS.

Course Outcomes

The student will Be familiar with the different op-amp characteristics and circuits
Build the different analog and digital electronic circuits
Design electronic circuits using op-amp
Simulation of electronic circuits and analysis

Textbook:

Paul Horowitz, The Art of Electronics, Winfield Hill, 2nd edition, 1996.

Course Title: Analog and Digital Electronic Circuits Lab
Code: EE 315
Credit Hours: 1 (0,0,2)
Pre-requisite:
Co-requisite: EE 313

Course Description

Introduction to the lab contents, the different devices used for analysis and measurements of analog and digital electronics. Ideal Op-Amp characterization and implementation, Non-ideal op Amp characterization and implementation, Execution of different Op-amp circuits, current mirrors, sources, and analog and digital BJT, CMOS, TTL and ECL. Extensive use of PSpice and LabView in circuit analysis.

Course Objectives

Emphasized the concepts taught in the analog and digital electronic course.
To gain the laboratory benefits of modeling an actual Ideal and Non-Ideal Op-amp circuits and its applications.
Analysis of different analog and digital electronic circuits such as BJT, CMOS, TTL and ECL.
Using PSpice program in analysis of the different electronic circuits.
Emphasizing the concepts taught in the theoretical courses, and preparing them to do experimental work in their graduation project when necessary.

Course Outcomes

After studying this course, the student is expected to be able to:
Familiarized with analog and digital electronics lab and its equipment.
Ability to carry out Different measurements for volt, current and frequency using the test

equipment used in the lab.
Ability to analyze the different analog and digital electronic circuits through the implementation of the practical circuits and measuring its output.
Ability to use the program of PSpice in the analysis of analog and digital electronic circuits.
Be prepared to work in the field of operation and maintenance.
Emphasized the concepts taught in the analog and digital electronic theoretical courses, prepare them to do experimental work in their graduation project when necessary.
The ability to select the suitable instruments and components as per assigned objective of experiment.
Ability to prepare laboratory setup (circuits) with proper connections.

Textbook

1. Jaeger, R.C,"_Microelectronic Circuit Design, 2nd Edition", McGraw Hill,2004

References

Support Software:

Herniter, M.E., Schematic Capture with Cadence PSpice, Prentice-Hall, 2nd Edition, 2003, ISBN 0-13-048400-8.

Course Title: Digital Signal Processing
Code: EE 324
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 221
Co-requisite: None

Course Description

Introduction to digital signal processing and applications - Digital processing of continuous-time signals - Discrete-time signals and systems - convolution and correlation - z-Transform - Discrete-time LTI systems in Transform Domain - Basic digital filter structures - IIR digital filter design; FIR digital filter design - Discrete-time Fourier transform - Discrete Fourier transform.

Course Objectives

• *To analyze discrete signals and systems.*
• *To understand time and transform domain techniques.*
• *To understand and apply the appropriate mathematical techniques and skills needed in the design of IIR (infinite impulse response) digital filters.*
• *To understand and apply the appropriate mathematical techniques and skills needed in the design of (finite impulse response) FIR digital filters.*
• *To choose an appropriate structure for the implementation and design of digital filters.*

Course Outcomes

After studying this course, the student is supposed to be able to: • Explore the essential features of sampling & quantization as employed in the design of real time DSP systems.
• Analyze and describe discrete-time signals and systems as mathematical functions and transformation respectively.
• Understand the concept of z-Transform and its applications in the analysis and design of DSP systems.
• Design IIR digital filters using various techniques, and realization using various hardware structures.
• Design FIR digital filters using various techniques, and realization using various hardware structures.
• Use MATLAB to simulate discrete-time signals and systems and their interaction for various signal processing tasks.
• Understand the concept of discrete Fourier transform (DFT), and use it in the analysis of discrete-time signals and systems.

Textbook

Sanjit K Mitra, Digital Signal Processing, A computer based approach, 3rd Edition, McGraw Hill, 2006.

References

9. Ashok Ambardar, Analog and Digital Signal Processing, 2nd Edition, Thomson Publishing, 2002.

E.C. Ifeachor, and B.W. Jervis, Digital Signal Processing – A Practical Approach, 2nd Edition, Prentice Hall, 2002.

Course Title: Digital Communications
Code: EE 325
Credits: 3 (3,1,0)
Pre-requisite: EE 322
Co-requisite:

Course Description

Students in this course are introduced to learn: Basic elements of communications systems; Review of probability theory; base-band pulse transmission (matched filters, inter-symbol interference); Eye pattern, Nyquist criteria; Equalization; Digital Pass-band transmission: Coherent PSK, FSK, QPSK, MSK; Non-coherent orthogonal modulation; Power spectra and bandwidth efficiency of binary and quaternary modulation schemes; Information theory: Mutual information and channel capacity; Source coding; Error control coding (channel coding).

Course Objectives

1. Learn the fundamental concepts of a digital telecommunication system.
2. Characterize sampling and quantization of analog signals to generate pulse modulation.
3. Analyze baseband transmission of digital signals.
4. Study the geometric representation of signals.
5. Analyze and design bassband digital communications techniques.
6. Describe the architecture of common digital communication systems.
7. Determine the bit error rate of basic modulation formats when operating in white Gausian Noise environments.
8. Determine the advantages of error correcting codes on the performance of digital communication systems.
9. Design digital communication systems to operate in noisy environments and to achieve basic system specifications on bandwidth usage, data rate, and error rate performance.
10. Understand basic concepts of source coding.

Course Outcomes

(a) An ability to apply knowledge of math, science and engineering. This course has extensive mathematical modeling of various elements of Digital communication systems.
c. An ability to design a system, component, or process to meet desired needs. Explain the parameters and tradeoffs involved in communication system design. Give examples for various system tradeoffs (e.g., transmission rate vs. bandwidth). Design coherent and noncoherent receivers, calculate probability of bit error for various systems and select the appropriate modulation technique to meet the required performance and channel bandwidth.
h. Broad education necessary to understand the impact of engineering solutions in a global and societal context Familiarity with current and future applications of digital communications, and their larger impact on society.
J. Knowledge of contemporary issues. Attention is given on contemporary issues such as the application of adaptive modulation techniques in some of the new communication systems.

Textbook

- *S. Haykin*, Communication Systems, *John Wiley, 2001.*

Course Title: Antennas and Wave Propagation
Code: EE 435
Credit Hours: 3 (3,1,0)
Pre-requisite: EE 234
Co-requisite: None

Course Description

Basic propagation modes and antenna parameters; Ground wave propagation; Sky wave propagation; Space wave propagation; Statistical models and diversity principles; Propagation models in mobile radio systems; Antenna engineering in LF, MF, HF, VHF and UHF systems; Reflector antennas, linear and planar antenna arrays.

Course Objectives

• *To understand the fundamentals of antenna theory.*
• *To expose students to examples of applications and various antenna types including linear and planar microstrip configurations.*
• *To understand the relation between the transmission and reception of antenna signal.*
• *To improve the design and problem solving skills*

Course Outcomes

After studying this course, the student is supposed to be able to: • Understand the function of antennas
• Understand the different types of antennas and the radiation mechanism
• Design various types of linear and planar antennas.
• Calculate fields from antennas and antenna systems
• Understand electromagnetic field problems that arise in various branches of engineering

Textbook

C. Balanis, Antenna Theory Analysis and Design, 3rd Edition, John Wiley.

References

1. Antennas By John D Kraus & R J Marhefka 3rd Edition, 2002 (TMH)
2. Electromagnetic waves and radiating systems By Jordan and Balmain (PHI)
3. Antennas By G.Markiv (Progress publishers).

Antenna and wave propagation By G.S.N. Raju 2005 (Pearson Education)

Course Title: Wireless Communications
Code: EE 426
Credits: 3
Pre-requisite: EE 325
Co-requisite:

Course Description

Students in this course are introduced to learn: Practical and theoretical aspects of wireless communication system design are studied; particular emphasis is on mobile communications. frequency reuse, hand-off, cell splitting, indoor/outdoor

propagation, co-channel interference, frequency management channel assignment techniques cell-site antennas, handset antenna/human body interaction, switching and traffic, AMPS, GSM, TDMA, and CDMA are studied.

Course Objectives

1. Understand the basics of propagation of radio signals
2. Understand how radio signals can be used to carry digital information in a spectrally efficient manner.
3. Understand how radio signals can be used to carry digital information in a power efficient manner.
4. Gain insights into how diversity afforded by radio propagation can be exploited to improve performance
5. Have an understanding of design considerations for how to effectively share spectrum through multiple access
6. Have an understanding of the basic principles behind radio resource management techniques such as power control, channel allocation and handoffs.
7. Gain knowledge and awareness of the technologies used in Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA) and WiFi Networks.

Course Outcomes

1. An ability to design a system or process to meet given specifications with realistic engineering constraints.
2. An ability to function as a member of an engineering design team.
3. An ability to utilize technical resources both from prior relevant coursework, as well as from sources students must seek out on their own (e.g., various technical literature, data sheets, webinars, etc.)
4. An ability to write technical documents and give oral presentations related to design project results.

Textbook

- T. Rappaport, Wireless Communications: Principles and Practice, Prentice Hall, 2001.

References

- Goldsmith, *Wireless Communications*, Cambridge University, 2006.

Course Title: Communication And Signal Processing Laboratory
Code: EE 427
Credit Hours: 1 (0,0,2)
Pre-requisite: EE 324 – EE 325
Co-requisite: None

Course Description

Experiments on communication and digital signal processing. The communication part includes: Amplitude Shift Keying (ASK); Frequency Shift Keying (FSK); Phase Shift Keying (PSK); Fiber optic transmitter; Fiber optic receiver; Fiber optic characteristics. The digital signal processing part includes: Digital systems; Finite Impulse Response (FIR) digital filter design; Infinite Impulse Response (IIR) digital filter design; Discrete Fourier transform (DFT).

Course Objectives

• To develop skills in modular interconnection of subsystems, needed to build physical DSP and communications systems.
• To develop skills in the use of industry-relevant electronic test and measurement equipment typically encountered by a design engineer.
• To use industry-relevant software communications systems simulation methods for the purpose of evaluating overall communication and DSP system performance.
• To understand the functionality of digital communications modulation and demodulation by building, testing and analyzing circuits.
• To implement time and transform domain techniques.
• To understand and apply the appropriate practical techniques and skills needed in the design of IIR (infinite impulse response) digital filters.
• To understand and apply the appropriate practical techniques and skills needed in the design of (finite impulse response) FIR digital filters.

Course Outcomes

After studying this course, the student is supposed to be able to:
• An ability to use electronic test and measurement equipment over frequencies from baseband to RF.
• An ability to design, build, test and analyze circuits and systems relevant to communications systems.
• An ability to write informal and formal technical reports.
• An ability to orally present technical concepts to a group.
• Analyze and implement discrete-time signals and systems.
• Design and implement digital filters using software and hardware techniques.

Textbook

- P. H. Young, *Electronic Communication Techniques*, Prentice-Hall, 2004.
- Sanjit K Mitra, Digital Signal Processing, A computer based approach, 3rd Edition, McGraw Hill, 2006.

References

- C. W. Sayre, Complete Wireless Design, McGraw Hill, 2001.
- J. G. Proakis, M. Salehi and G. Bauch, Contemporary Communication Systems Using MATLAB and Simulink, Thomson Engineering, 2004.
- M. C. Jeruchim, P. Balaban and K. S. Shanmugan, Simulation of Communication Systems, Plenum Press, 1992.
- Ashok Ambardar, Analog and Digital Signal Processing, 2nd Edition, Thomson Publishing, 2002.

Course Title: Antenna And Wave Propagation Lab
Code: EE 436
Credit Hours: 3 (3,1,0)
Pre-requisite: None
Co-requisite: EE 435

Course Description

The dipole in free space. Dual sources. Gain, directivity and aperture. Ground reflections. The monopole. Phased monopoles. Resonance, impedance and standing waves. Return loss and VSWR measurements. Parasitic elements. Stacked and bayed arrays. The horn antenna. The log periodic antenna. The dish antenna.

Course Objectives

•	To characterize the antennas used in the microwave transmission system.
•	To explore the concept of polarization.
•	To design and plot the radiation pattern of an antenna.
•	To understand the wide range of options for antenna.
•	To illustrate the relationship between antenna size, gain and beam width.

Course Outcomes

After studying this course, the student is supposed to be able to:	
•	Explain the basic knowledge of propagation phenomena in communication systems.
•	Understand the fundamental antenna parameters.
•	Compute the parameters for selected antenna structures.
•	Familiarizes the students with different characteristics of different antennas.

Textbook

Student manual, feedback instruments Ltd, Park road, UK.

Course Title: VLSI
Code: EE 415
Credit Hours: 3(3,1,0)
Pre-requisite: EE 313
Co-requisite:

Course Description

Introduction to VLSI systems - review of digital systems - CMOS logic and fabrication - MOS transistor theory -Layout design rules - Circuit characterization and performance estimation - Circuit simulation -Combinational and sequential circuit design - Static and dynamic CMOS gates - Memory system design -Design methodology and tools

Course Objectives

• Introduced digital integrated circuits
• Introduce CMOS devices and manufacturing technology.
• Introduce CMOS logic gates and their layout
• Ability to find Propagation delay, noise margins, and power • dissipation in the digital VLSI circuits
• Ability to design Combinational (e.g., arithmetic) and sequential circuit.
• Ability to design Memory in VLSI circuits.

Course Outcomes

• Upon completion of this course, students should be able to: • Analyze the CMOS layout levels, how the design layers are used in • the process sequence, and resulting device structures (i.e. crosssectional • views).
• Implement digital logic designs of various types (i.e. combinational • logic, multiplexers).
• Complete a moderately complex design project involved with data • path operators, data registers, serial/parallel conversion, • clocking/timing details and feedback.
• Identify the interactions between process parameters, device • structures, circuit performance, and system design.

Textbook:

Neil Weste and David Harris, CMOS VLSI Design: A Circuits and Systems Perspective, Addison Wesley, 2005

Reference:

Jan M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits:

A Design Perspective, (2003), 2nd Edition, Prentice Hall.

Course Title: Industrial Electronics
Code: EE 416
Credit Hours: 3 (3,1,0)
Pre-requisite:

Co-requisite:

Course Description

Power semiconductor devices: terminal characteristics; Power converters: ac-ac converters, rectifiers, inverters, dc-dc converters and resonant converters; Applications in power systems. Experiments -- Basic Rectifier Circuits-- Single-phase Rectifiers-- Polyphase rectifiers-- One-Quadrant Dc-Dc Conversion-- One-Quadrant Dc-Dc Conversion- Dc-Ac Conversion

Course Objectives

• Teaching the students the basics and concepts related to the semiconductor devices and converter circuits used in the power applications.
• Acquainting the students the ability of dealing with the several power-electronics based equipment and converters found in the power system.
• Enabling the students to handle and master the recent concepts of controlling the electric machines as well as the active and reactive power flow in the power networks via the power electronic switches.
• Preparing the student for the advanced courses of the electric drives and the graduation project.

Course Outcomes

• Ability to analyze an existing power electronic circuit.
• Ability to select a power electronic converter for certain application.
• Ability to analyze, design, and control the simple power electronic circuits.
• Ability to distinguish between the advantages and disadvantages of different power converters.
• Ability to design and simulate power electronic circuits using special software.
• Ability to analyze an existing power electronic circuit.
• Ability to select a power electronic converter for certain application.

Textbook

Hart, “Introduction to Power Electronics”, Prentice Hall

Reference:

Lander, "power Electronics", McGrow Hill

Course Title: Electronic Communication
Code: EE 417
Credit Hours: (3,1,0)
Pre-requisite:
Co-requisite:

Course Description

Introduction to RF and power amplifiers, oscillators, phase-locked loops, filters, carrier modulators and demodulators, analog-to-digital and digital-to-analog converters, examples of commercially available integrated circuits for communication systems.

Course Objectives

Teaching the principles of RF and its application in communication
Explain the power amplifier circuits and its role in communication systems
Analysis of different Oscillators and phase-locked loops electronic circuits and emphasize on its application in communications
Explain the different types of filter circuits, such as, low pass, high pass, band pass and band rejection filters. Highlighting on its importance in decreasing the noise effect.
Explain the main electronic circuits of the modulators and demodulators Emphasizing on its application in communication
Introducing the main electronic circuits of A/D and D/A converters

Course Outcomes

After studying this course, the student is supposed to be able to:

Familiarized with electronics circuits applicable in communication systems.
Ability to design the power amplifier circuits for communication systems
Ability to design the different oscillator circuits and know how to integrate it in communication systems
Ability to select the right filters for the different application
A good understand of modulation and demodulation circuits and its characterization.
Design of A/D and D/A electronic circuits.

Textbook:

Kennedy G, "Electronic Communication Systems", Third Edition, McGraw-Hill, 1994.

References:

Young Paul H, " Electronic Communication Techniques, Third Edition, MerrillPublishing Company, 1990.

Course Title: FPGA
Code: EE 418
Credit Hours: 3 (3,1,0)
Pre-requisite:
Co-requisite:

Course Description

This course introduces fundamentals and circuit architectures of field programmable gate arrays (FPGAs), design tools supporting FPGA-based system designs, and their applications in reconfigurable computing. Students will gain hands-on experience of designing system with FPGAs, and learn the basics of design tools targeted for FPGA based designs. The applications of FPGAs in various custom computing environments will also be examined.

Course Objectives

• Learn the design of major components of computer architecture

• Learn fundamental concepts of hardware description language
• Learn FPGA technology and impact of using FPGA in logic design

Course Outcomes

After studying this course, the student is supposed to be able to:
• Have a real-world experience on FPGA logic design and the necessary training with industry widely used design tools
• Learn how to access complex integrated designs without the high engineering costs
• Design software delivers the highest productivity and performance for FPGAs
• Describe the advantages and disadvantages associated with the use of FPGAs

Textbook

Hdl Chip Design: A Practical Guide for Designing, Synthesizing & Simulating Asics & Fpgas Using Vhdl or Verilog by Douglas J. Smith

References

1. Programmable Logic: Plds and FPGAs by Richard C. Seals, G. F. Whapshott
2. Verilog Hardware Description Language by Zainalabedin Navabi
3. Reconfigurable Computing by Scott Hauck and Andre Dehon, Morgan Kaufmann
4. The Student's Guide to VHDL, by Peter J. Ashenden

Course Title: Analysis Of Electronic Circuits Using Computer
Code: EE 419
Credit Hours: 3 (3,1,0)
Pre-requisite: None
Co-requisite: None

Course Description

Solve equations of electrical circuits. The formulation of equations of electrical circuits in a graphic form. Drafting General equations for electrical circuits. Simulation of large circuits, defining network equations, Sensitivity - the expense of sensitivity using a computer: (sensitivity of the linear systems as well as the associated systems, sensitivity to amplifier processes and parasitic elements, derivatives, differential of the higher orders. Circuit analysis as a function of frequency. Numerical integration of differential equations. Models of electronic components. Analysis and design of analog and digital circuits, analysis and Computer Aided Design with a focus on amplifier circuits with higher performance.

Course Objectives

• Introduce the student to the mathematical description and procedures used in designing electronic systems.
• Teach the student the basic parameters, definitions, procedures, and principles of designing electronic circuits and systems and applying modern modeling software.
• Develop in each student the basic skills of problem solving and critical thinking. Students must solve problems involved in electronic circuit design.

Course Outcomes

After studying this course, the student is supposed to be able to: • Gain a solid knowledge-base in the fundamentals of electrical and computer engineering.
• Gain experience in team work on electronics project.
• Gain experience in designing, testing, and evaluating electronic circuits
• Develop the student's knowledge base and experience in the design and analysis of modern electronic circuits and systems.

Textbook

Electronic Circuit Analysis and Design, by Hayt

References

1. Electronic Circuit Analysis and Design by Don Neamen McGraw-Hill Education
2. Microelectronic Circuit Design, Jaeger and Blalock, 4th Edition, McGraw Hill

Course Title: Communication Networks
Code: EE 428
Credit Hours: 3 (3,1,0)

Pre-requisite: None
Co-requisite: None

Course Description

Introduction to data networks; Data transmission over the telephone networks; Modems, multiplexers, concentrators and communication processors; Local area networks; Interfaces and protocols; Packet switching; Analysis of multiple access algorithms

Course Objectives

• To design, implement, and analyze communication network.
• To understand the various standards and protocols
• To understand the computer and networked system organization and architecture
• To explain internet protocols and network security.
• To appreciate usefulness and importance of computer communication in today life and society

Course Outcomes

After studying this course, the student is supposed to be able to: • Understand the fundamentals of data communication and communication networks
• Design and analyze data transmission protocols and data link control protocols.
• Design and evaluate new protocols
• Implement networking protocols
• Understanding of network security issues.

Textbook

Computer Networks, Andrew S. Tanenbaum, Prentice Hall

References

1. Data and Computer Communications, by William Stallings
2. Data Networks by Bertsekas and Gallager, Prentice Hall

Computer Networks: A Systems Approach by Peterson and Davie

Course Title: Simulation of Communication Systems using MATLAB

Code: EE 429
Credit Hours: 3 (3,1,0)
Pre-requisite: None
Co-requisite: None

Course Description

Role of simulation in communication systems engineering, Simulation approaches and methodologies, Signal and system representations, filter models, noise generation, modeling and simulating nonlinear and time-varying systems, Waveform level and discrete channel models, Co-channel interference in wireless communication systems

Course Objectives

• To develop accurate simulation models of communication systems built with MATLAB.
• To design and analyze a communication system
• To help student participates in a project
• To develop further understanding of the global context of engineering practice.

Course Outcomes

After studying this course, the student is supposed to be able to: • Gain some experience programming in MATLAB,
• Analyze basic communication systems involving random signals, filtering, sampling, and modulation.
• Design basic communication systems.
• Implement advanced communication systems that deliver optimal performance.

Textbook

Principles of Communication Systems Simulation with Wireless Applications by William H. Tranter, K. Sam Shanmugan, Theodore S. Rappaport, Kurt L. Kosbar.

References

3. Simulation Techniques, Models of Communications, Signals and Process, F.M. Gardner, J. D. Baker, John Wiley & Sons Inc.
4. Principles of Communication Systems Simulation with Wireless Applications, W. H.
5. Tranter, K. S. Shanmugan, T. S. Rappaport, K. L. Kosbar, Prentice Hall.

Simulation of Communication Systems, Modeling, Methodology, and Techniques, M. C. Jeruchim, P. Balaban, K. S. Shanmugan, Cluwer Academic Publishers.

Course Title: Speech Signal Processing
Code: EE 430
Credit Hours: 3(3,1,0)
Pre-requisite: Digital Signal Processing
Co-requisite: None

Course Description

Fundamentals of speech science ; Modeling speech production; Short-term processing of speech; Linear prediction analysis; Cepstral analysis; Speech coding; Speech synthesis; Speech enhancement; Speech Recognition.

Course Objectives

• To provide students with the knowledge of basic characteristics of speech signal in relation to production and hearing by humans.
• To describe basic algorithms of speech signal processing and analysis common to many applications.
• To give an overview of applications (Speech recognition, Speech synthesis, Speech coding, Speech enhancement).
• To inform about practical aspects of speech algorithms implementation.

Course Outcomes

After studying this course, the student is supposed to be able to: • Using principal methods and algorithms of speech signal processing.
• *Understand and use the methods of speech recognition and synthesis*

systems.
• *Understand and use the methods of speech coding and enhancement.*
• *Deepen their knowledge in signal processing. They will acquire new skills in math and Matlab. During projects, they will get acquainted with independent development work.*
• *Understand some current speech processing research.*

Textbook

- *B Gold and N Morgan, Speech and Audio Signal Processing, Wiley and Sons, 2000.*

References

- *D G Childers, Speech Processing and Synthesis Toolboxes, Wiley and Sons, 2000.*
- *J R Deller, J R Proakis, and J H L Hansen, Discrete-Time Processing of Speech Signals, Prentice-Hall 1993.*
- *L R Rabiner and R W Schafer, Digital Processing of Speech Signals, Prentice-Hall 1978.*
- *K N Stevens, Acoustic Phonetics, MIT Press 1998.*

Course Title: Digital Image and Video Processing
Code: EE 431
Credit Hours: 3 (3,1,0)
Pre-requisite: None
Co-requisite: None

Course Description

Review the basics of digital signal processing one-dimensional, the two-dimensional systems and signals, two-dimensional templates, two-dimensional filters and wavelet, designs and applications of linear filters, the formation of digital images, quantification of sample images, retrieval and image enhancement, coding, basic

ways to analyze the images, extract features, the discovery and identification of the border and forms, compressed-domain video processing, and digital TV.

Course Objectives

• To Learn basics of two dimensional signal processing
• To Learn 2-D filtering and image enhancing
• To Learn feature extraction and pattern classification
• To design digital video processing algorithms.
• To implement different techniques for manipulating digital images.

Course Outcomes

After studying this course, the student is supposed to be able to: • Understand fundamental concepts on image and video processing
• Learn and understand the Image Enhancement.
• Describe features of images
• Understand the Image Restoration, and Recognition.
• Understand the various compression techniques.

Textbook

Digital Video Processing by M. Tekalp, Prentice Hall

References

6. Data Fundamentals of Digital Image Processing by A.K. Jain, Prentice Hall
Video Processing and Communications by Yao Wang, Joern Ostermann, and Ya-Qin Zhang, Prentice Hall

Course Title: Exchange and Switching
Code: EE 432
Credit Hours: 3 (3,1, 0)
Pre-requisite:

Co-requisite:

Course Description

This course will emphasize the very different roles of voice networks in the telecom/datacom industry - the different approaches and technologies used to support these approaches. Switched voice Network and VoIP networks - the legacy Class 5/4 switches - compare legacy PSTN switches to IP soft switches - essential role of network planning and operational excellence in the support of such networks. Structure of a voice network and its elements –introduction to VoIP Signaling protocols (H.323 and SIP) and their architecture – Introduction to Quality of Service (QoS) and various QoS protocols - The role of the network operations center will be examined, as will the requirements for high availability in networks.

Course Objectives

Explain the basic infrastructure of the PSTN network, Understanding the terms and concepts associated with legacy PSTN network
Explain the difference between circuit switching and packet switching. Brief overview of the switching systems
Explain the PSTN signalling system and signalling exchange techniques between legacy PSTN and VoIP network
Explain the various factors affecting the quality of voice in the VoIP
To study the Sampling and PCM techniques. Overview of the compression techniques used in various codec.
Explain the need for QoS in the VoIP network and different QoS techniques

Course Outcomes

Upon successful completion, students will be able to: 1. Compare the features of the traditional voice telephony networks to modern switching networks
2. Differentiate between the telecommunication structures of Centrex and PBX, Learn about Centrex services
3.Compare digital voice & video in standard networks such as T1, T3, ISDN, and BISDN
4. Configure the call flows for Plain Old Telephone Service (POTS), VoIP, and default dial peers

5. Compare the centralized and decentralized call control and signaling protocols
6. Understand the analog and digital voice characteristics, processes and standards for voice digitization, compression, digital signaling, and Fax transport as they relate to Voice over IP
7. Compare the functionality of legacy PSTN switch to IP soft switch
8. Compare and configure the quality of Service techniques for "non-quality-of-service" Networks (such as IP and Frame Relay)
9.Understand the Voice Over IP environments (SIP, H.323, MGCP), Integrated voice/data network design and optimization, Voice/data network configuration and troubleshooting

Textbook

1- Manoj Bhatia, Jonathan Davidson, Satish Kalidindi, "Voice over IP Fundamentals, 2nd Edition", Cisco Press., ISBN: 1587052571.
2- Bates, Regis J., Gregory, Donald W, "Voice & Data Communications Handbook" 4th Edition, McGraw Hill, ISBN 0-07-213188-8

References

Stephen Foy, Kelly McGrew, Stephen McQuerry, "Cisco Voice over Frame Relay, ATM, and IP", Published by Cisco ,ISBN: 1578702275

Course Title: Electronics of Microwave
Code: EE 437
Credit Hours: 3 (3,1,0)
Pre-requisite:
Co-requisite:

Course Description

The course covers following topics. Theory and design of passive and active microwave components and monolithic integrated circuits including: micro- strip, lumped inductors and capacitors, GaAs FETs, varactor and mixer diodes, monolithic phase shifters, attenuators, amplifiers and oscillators. Experimental characterization of the above components using network analyzer, spectrum analyzer, power and noise meter

Course Objectives

Calculate radio, microwave and radar link power and noise budgets.
Design narrowband LC and distributed matching networks
Implement lumped and distributed microwave filters
Design microwave transistor amplifiers and be able to optimise them for Gain, port matching and noise figure
Design microwave transistor oscillators and mixers.
Interpret and manipulate network analyser measurements

Course Outcomes

• Be familiar with electronics component used in microwave
• Be able to integrate the different electronic components in assembling microwave amplifiers, oscillators, filters and attenuator
• Can optimize and analyze the microwave filters
• Can use the measurement techniques used in microwave like, network analyzer, spectrum analyzer, etc.

Textbook:

G. Gonzalez 'Microwave transistor amplifiers, Analysis and Design', 2nd Edition, Prentice Hall.

References:

David M. Pozar, 'Microwave Engineering' , 2nd Edition, John Wiley and Sons.

Agilent-EEsof Advanced Design System (ADS) Manual.

Course Title: Microwave circuits and devices
Code: EE 438
Credit Hours: 3 (3,1,0)

Pre-requisite:
Co-requisite:

Course Description

Describes the principles of device operation and circuit characteristics for the microwave/millimeter-wave FET, IMPATT, TRAPATT, Gunn diode, varactor diode, p-i-n diode and tunnel diode. Sub-millimeter-wave and terahertz-wave devices are also considered. The emphasis is on physical explanations of how devices and systems work rather than on elaborate mathematical models.

Course Objectives

To explain how the various devices of a microwave/millimeter-wave circuit operate and how they are assembled into a system
To explain how microwave/millimeter-wave devices and circuits are characterized in terms of their "S"-parameters.
To describe the new devices that are extending this technology to sub-millimeter wavelengths (terahertz frequencies).
To illustrate the current state-of-the-art by reference to journal articles and to example of use today

Course Outcomes

• Be familiar with different microwave devices and circuits
• Be able to analyzes microwave circuits using the S parameters
• Knowing how to deal and the design requirements for high frequency component

Textbook:

S.Y. Liao, Microwave Devices and Circuits. third edition, Prentice Hall, 1990.

Reference:

David M. Pozar 'Microwave Engineering' by, 2nd Edition, John Wiley and Sons.
Agilent-EEsof Advanced Design System (ADS) Manual.

Course Title: Optical Fiber Communications
Code: EE 439
Credit Hours: 3 (3,1,0)
Pre-requisite: None
Co-requisite: None

Course Description

Introduction of optical fiber communications, Ray optics and wave equations, Wave equations for slab waveguide and optical fibers, Wave solutions for optical fibers, LP modes, Dispersions, Fiber loss and fiber manufacturing, Optical transmitters, Laser diodes, Laser modes and optical receivers, Photo-detectors, Noises and sensitivity, System performance, Light-wave systems, Optical amplifiers.

Course Objectives

• To understand the principle of optical fiber waveguide.
• To understand transmission characteristics of optical fibers
• To understand the principle of optical sources.
• To understand the principle of optical detectors.
• To understand the principle of optical recievers.

Course Outcomes

After studying this course, the student is supposed to be able to:
• Explain the operation of optical fibers and their characteristics such as attenuation and dispersion
• Understand the operation of active optoelectronic semiconductor components such as diode lasers, Light Emitting Diodes (LEDs) and photodetectors.
• Describe the operating principles of optical components such as couplers and optical amplifiers
• Use the operating characteristics of these devices to design an optical link for specific distance and bandwidth goals
• Explain the operation of Wavelength Division Multiplexed (WDM) optical networks.

Textbook

Optical Fiber Communications, Gerd Keiser, McGraw-Hill

References

7. Fiber Optic Communications, Joseph C. Palais, Prentice-Hall
8. Optoelectronics and Photonics, S.O. Kasap, Prentice-Hall
9. Optical Fiber Communication, A. Selvarajan et. al., McGraw-Hill
10. Optical Electronics in Modern Communications, Amnon Yariv, Oxford

Course Name: Robotics and Mechatronics Lab
Code & No: EE 464
Credit Hours: 1 (0,0,2)
Pre-requisite: -EE 361, EE 362, EE 307, EE 308
Co-requisite: -

Course Description

This Robotics and Mechatronics Lab can be considered as a design project course. The lab will focus on the application of theoretical principles in electrical engineering and computer science to control a mechatronics system. The designed mechatronics should include sensors, actuators and intelligence. The student will have the chance to use his theoretical knowledge of electronics, filtering and signal processing, control, electromechanics, microcontrollers, and real-time embedded software in designing a small robot that may be used in racing.

Course Objectives

This lab will include 7 experiments leading finally to be able to design a racing robot:

- 1st Experiment: C Programming: To introduce the students to the systems we will be using for the course, we will create our first C program in any platform and get an introduction into "Make files". We will also experiment with manipulating binary and hexadecimal numbers.
- 2nd experiment: Data Acquisition (Joystick): We will use the Sensoray card to sample data from analog potentiometers (joystick) and digital switches (buttons) in a simple joystick device.
- 3rd experiment: Data Acquisition (Sensor): In this lab a sensor is used to measure magnetic forces. The force – distance measurements will be linearized.
- 4th experiment: Digital filtering: Sensors in practice are often significantly different than sensors in theory, due to noise. In this lab, we will implement two digital filters.
- 5th experiment: Digital filtering applied to sensors: In this lab the digital filters are tested on the sensor.
- 6th experiment: Actuator: The students will communicate with a piezoelectric stepping drive and analyze the system response.
- 7th experiment: PID control: This lab will implement the theoretical PID control

knowledge for motor control to including system models and sensor feedback.

Course Outcomes

After studying this course, the student is supposed to be able to:
• Understand how to write c programs able to process data between microcontrollers and mechatronics.
• Understand the rule of digital filters, sensors, and actuators.
• Execute the communication links related to controlling stepper motor and other small motors used to determine the motion and trajectory or mechatronic.
• Implement DAS with sensors and filters and actuators.
• Able to build a robot whose motion and trajectory can be controlled through suitable sensors and actuators.

Class/laboratory schedule

One 90-minute lab session per week.

Resources of the course

Textbook, Lab Manuals, references, and Modules.

Computer usage

Word Processing for report writing and Matlab or LabVIEW for analysis.

Textbook

Robert H. Bishop: "The Mechatronic Handbook - Mechatronic System Control, Logic and Data Acquisition", CRC Press, 2008.

References

1. Craig, J.: " Introduction to Robotics: Mechanics and Control ", Addison- Wesley, 1986.