B. Tech. Degree

in

ELECTRICAL AND ELECTRONICS ENGINEERING

SYLLABUS
FOR
CREDIT BASED CURRICULUM
(For students admitted in 2013-14)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620 015
TAMIL NADU, INDIA
CURRICULUM

The total minimum credits required for completing the B.Tech. programme in Electrical and Electronics Engineering is **182 (45 + (137))**

**SEMESTER III**

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# To be evaluated at the beginning of VII semester by assessing the report and conducting seminar presentations.
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* GLOBAL ELECTIVES ALSO
# LIST OF ELECTIVES

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### LIST OF ADVANCED LEVEL COURSES FOR B.Tech. HONOURS

i. For the students with consistent academic record of GPA ≥ 8.5 from I to IV semesters, and applied for B.Tech Honours.

ii. Can opt to study any 3 of the listed advanced level courses from V semester

iii. In 7th semester, B.Tech Honours students are permitted to take one M.Tech. (Power Systems/Power Electronics) core course offered during that semester.

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### COURSES OFFERED TO OTHER DEPARTMENTS

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**MA205 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**

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<th>Course</th>
<th>To study the application of transform techniques to solve linear ordinary and partial differential equations and to solve boundary value problems by using Fourier series</th>
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<td><strong>Prerequisites:</strong></td>
<td>Knowledge of Integral Calculus, Ordinary differential equations, Complex variables</td>
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Laplace Transform of Standard functions, derivatives and integrals – Inverse Laplace transform – Convolution theorem-Periodic functions – Application to ordinary differential equations and simultaneous equations with constant coefficients and integral equations

Fourier series – Dirichlet’s conditions - Half range Fourier cosine and sine series - Parseval’s relation - Fourier series in complex form - Harmonic analysis

Fourier transforms - Fourier cosine and sine transforms - inverse transforms - convolution theorem and Parseval's identity for Fourier transforms - Finite cosine and sine transforms

Formation of partial differential equations eliminating arbitrary constants and functions - solution of first order equations - four standard types - Lagrange’s equation - homogeneous and non-homogeneous type of second order linear differential equation with constant coefficients

One-dimensional wave equation and one-dimensional heat flow equation - method of separation of variables - Fourier series solution

**Text Books:**


**Reference Books:**


**COURSE OUTCOMES:**

Upon completion of this course, students will be able to

1. Understand the basics of transformation techniques.
2. Apply the transform techniques for solving ordinary differential equations and partial differential equations.
Course Objectives: This course aims to equip the students with a basic understanding of DC machines and Transformer fundamentals, machine parts and help to gain the skills for operating DC machines and Transformers. The course also equips students with ability to understand and analyze the equivalent circuits of DC machines and Transformers.

Prerequisites: Engineering Physics and Basic Electrical Engineering

Principles of Energy conversion – basic magnetic circuit analysis Faradays law of electromagnetic induction – singly and doubly excited magnetic field systems – torque production in rotating machines and general analysis of electro mechanical system.

DC Generator – construction, principle of operation – emf equation – types Characteristics commutation - armature reaction.


Three phase transformer connection-Scott connection – all day efficiency - Sumpner's test - parallel operation of transformers

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon the completion of the course, The student will be able to
1. Understand the constructional details and principle of operation of DC machines and Transformers.
2. Analyze the performance of the DC Machines under various operating conditions using their various characteristics.
3. Evaluate the performance of Transformers using phasor diagrams and equivalent circuits.
4. Select appropriate DC motor as well as to choose an appropriate method of speed control for any industrial application
EE203 CIRCUIT THEORY

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Course: To provide the key concepts and tools in a logical sequence to analyze and understand electrical and electronic circuits.

Objectives: Higher secondary mathematical concepts such as solution of ordinary differential equations, calculus, matrix algebra and elementary concepts of physics such as electricity and magnetism

Prerequisites: Fundamental concepts of R, L and C elements, DC circuits, series and parallel circuits - loop and nodal analysis, A.C circuits - complex impedance - phasor diagram, real and reactive power - loop and nodal analysis applied to AC circuits.

Voltage source –current source transformations, Various Network theorems and applications to dc and ac circuits, star-delta transformations.

Resonance in series and parallel circuits, self and mutual inductances, coefficient of coupling - dot convention - analysis of coupled circuits.

Three - phase star and delta circuits with balanced and unbalanced loads power measurements - power factor calculations.

Time response of RL, RC and RLC circuits for step and sinusoidal inputs.

Text Books:

Reference Books:

COURSE OUTCOMES:

Upon completion of this course the students will be able to,
1. Understand the technical representation of common electrical systems.
2. Analyze and compute the time domain behavior of linear (AC and DC) electric circuits with single or multiple power sources.
3. Compute the performance of AC Networks (1 port) which may be 1-phase or 3-phase using phasor analysis.
4. Understand flow of real and reactive power components in AC systems.
5. Analyze simple electro-magnetic circuits.
EE205 ELECTRON DEVICES

Course: To educate on the construction and working of common electronic devices and to prepare for application areas.

Objectives: Semiconductor materials

Prerequisites: Semi-conductors - charge carriers, electrons and holes in intrinsic and extrinsic semi-conductors – Hall effect

Diodes – PN junction – current equation – junction capacitance - breakdown characteristics, Zener, tunnel, Schottky diodes

Bipolar junction transistors – Characteristics – analysis of CB, CE, CC amplifier configurations

Unipolar devices – FET, MOSFET, UJT and Opto-Electronic devices – theory and characteristics

Rectifiers and switched mode power supplies – theory and design, filter circuits, applications

Text Books:

Reference Books:

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Understanding the semiconductor physics of the intrinsic, p and n materials and various devices and characteristics.
2. Analyze simple diode circuits under DC and AC excitation.
3. Analyze and design simple amplifier circuits using BJT in CE, CC and CB configurations
4. Understand the analysis and salient features of CE, CC & CB amplifier circuits.
5. Understand the construction and characteristics of FET, MOSFET and UJT
EE207 DIGITAL ELECTRONICS

Course 
This subject exposes the students to digital fundamentals

Objectives: 
Review of number systems, binary codes, error detection and correction codes. Digital Logic Families – Introduction to RTL, DTL, TTL, ECL and MOSL families – wired and operation, characteristics of digital logic family – comparison of different logic families

Prerequisites: Basics of Electron Devices

Combinational logic - representation of logic functions – SOP and POS forms K-map representations – minimization using K maps - simplification and implementation of combinational logic – multiplexers and demultiplexers – code converters, adders, subtractors.


Synchronous Sequential Logic circuits-state table and excitation tables-state diagrams-Moore and Melay models-design of counters-analysis of synchronous sequential logic circuits-state reduction and state assignment.

Asynchronous sequential logic circuits-Transition table, flow table – race conditions – circuits with latches, analysis of asynchronous sequential logic circuits – introduction to design –implication table-hazards-programmable logic array and devices.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course, students will be able to
1. Interpret, convert and represent different number systems
2. Manipulate and examine Boolean algebra, logic operations, Boolean functions and their simplification
3. Design and analyze combinational and sequential logic circuits
Course Objectives:  
- To achieve an understanding of principles of thermodynamics and to be able to use it in accounting for the bulk behavior of the simple physical systems.
- To provide in-depth study of thermodynamic principles, thermodynamics of state, basic thermodynamic relations, Properties of pure substances
- To enlighten the basic concepts of air standard cycles
- To provide basic awareness about fluid properties and its flow
- To impart knowledge about hydraulic machines

Prerequisites:  
Concepts and principles dealing with thermodynamic cycles, thermodynamic relations and generalized charts, mixtures of fluids, chemical reactions, chemical and phase equilibrium, thermodynamic aspects of fluid flow.
Basic knowledge of mathematics.

Basic concepts: Thermodynamic equilibrium, quasi-static process, zeroth law, work and heat interactions, first law for a cycle and a process, steady flow processes, second law statements, reversibility, Carnot theorem, Clausius inequality, entropy principle.

Heat engines: Otto, diesel and dual cycles, Brayton cycle with regeneration, inter cooling reheat, Joule-Thompson effect, Rankine cycle, reheat and regenerative cycle, properties of ideal gas, Stirling and Ericson cycles

Available energy: Availability and irreversibility, properties of pure substances, phase equilibrium diagrams.

Classification of fluids and their physical properties, Fluid statics, manometers, pressure on submerged bodies. Basics of fluid properties - Vapour Pressure – Pressure at a point its variation – Measurement with Piezo meter, manometers and gauges - Continuity equation in one dimension – Bernoulli’s equation – Venturi meters and Orifice meters


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon the completion of the course, the students will be able to
1. Understand the fundamentals of first and second laws of thermodynamics and their application to a wide range of systems.
2. Familiarize with calculations of the efficiencies of heat engines and other engineering devices.
3. Familiarize the construction and principles governing the form of simple and complex one-component phase diagrams such as pressure-temperature, volume-temperature & and pressure-volume and the steam tables in the analysis of engineering devices and systems.
4. Calculate various fluid flow parameters
5. Determine the optimum working conditions for hydraulic machines
EE 209 DC MACHINES AND TRANSFORMERS LABORATORY

Course Objectives: The main objective of the course is to give the students an insight into the constructional details of the dc machines and transformers with a view of better understanding of their working principles. The course also equips the students to test and evaluate the performance of various dc machines and single phase transformers by conducting appropriate experiments.

Prerequisites: Basic knowledge in electric circuit analysis, constructional details and operational principles of various dc machines and transformers.

List of Experiments

A demonstration of the static and rotational electrical machines (constructional details) is ought to be done in an introductory class.

1. Open circuit and load characteristics of DC shunt/compound generator
2. Swinburne's test and Speed control of DC shunt motor
3. Load test on DC shunt motor
4. Load test on DC series motor
5. Open circuit and short circuit test on single phase transformer
6. Load test on single phase transformer
7. Sumpner's test
8. Parallel operation of single phase transformer
9. Electrical braking in DC shunt motor
10. Three phase transformer connections

Mini-project

COURSE OUTCOMES:
Upon completion of the course, the students will be able to

1. Interpret the constructional details of the DC machines and Transformers and also understand the significance of different connections of three phase transformers
2. Estimate or test the performance of any DC machine (shunt, series or compound) and single phase transformer, by conducting suitable experiments and report the results.
3. Experiment and analyze, the various speed control and braking techniques for dc motors
4. Develop simulation models and prototype modules in view of implementing any control technique upon dc motors and single phase transformers for various applications
EE211 CIRCUITS AND DEVICES LABORATORY

Course Objectives:
- To understand and analyze the basic theorems of Circuit theory
- Understand and analyze series & parallel circuits and measurement of single and three phase power.
- Understand and analyze different applications of diode and characteristics of Transistor.

Prerequisites: Basic electrical and electronics elements (R, L, C, diode, Transistor)

List of Experiments

1. Verification of Thevenin’s and Maximum Power Transfer Theorem.
2. Verification of KCL, KVL and Super Position Theorem.
3. Basic operation of AC R-L-C Series & Parallel Circuit
5. Verification of Resonance in Electrical Circuit.
6. Verification of 3-Phase Star & Delta Connection.
7. Design of full wave Rectifiers (Centre –tapped and Bridge).
8. Design of Clipping and Clamping circuits
9. Volt-ampere characteristics of rectifier diode and Zener diodes as a voltage regulator circuit.
10. Characteristics of CE configuration of BJT

COURSE OUTCOMES:

Upon completion of the course, the students will be able to
1. Verify the network theorems and operation of typical electrical and electronic circuits.
2. Choose the appropriate equipment for measuring electrical quantities and verify the same for different circuits.
3. Prepare the technical report on the experiments carried.
MA202 NUMERICAL METHODS

Course Objectives: To learn numerical methods and apply to engineering problems

Prerequisites: Knowledge of Calculus and Differential Equations

Solution of linear system - Gaussian elimination and Gauss-Jordan methods - LU - decomposition methods - Crout's method - Doolittle method - Cholesky's method - Jacobi and Gauss-Seidel iterative methods - sufficient conditions for convergence - Power method to find the dominant eigenvalue and eigenvector

Solution of nonlinear equation - Bisection method - Secant method - Regula falsi method - Newton-Raphson method - Order of convergence of these methods - Horner's method - Graeffe's method - Birge-Vieta method - Bairstow's method

Curve fitting - Method of least squares and group averages - Least square approximation of functions - solution of linear difference equations with constant coefficients


Numerical solution of Laplace equation and Poisson equation by Liebmann's method - solution of one dimensional heat flow equation - Bender - Schmidt recurrence relation - Crank - Nicolson method - Solution of one dimensional wave equation

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Understand the various methods of solving linear and non-linear equations.
2. Solve ordinary differential equations numerically.
3. Apply the knowledge to real life engineering problems.
Course: This course provides a basic understanding of AC machinery fundamentals, machine parts and helps to gain the skills for operating AC machines. The course also equips students with ability to understand and analyse the phasor diagrams and equivalent circuits of AC Induction and Synchronous Machines.

Prerequisites: DC Machines and Transformers

Alternators – construction, principle and types - armature reaction - load characteristics – voltage regulation - two reaction theory.

Synchronous motors - Synchronous machines on infinite bus bars - phasor diagram - V and inverted V curves - current - Hunting and its suppression - starting methods.

Polyphase induction motors - construction, principle and types - equivalent circuit – circle diagram - starting and speed control - Induction generators.

Single phase induction motors - construction, principle and types - double revolving field theory – equivalent circuit.

Permanent magnet brushless motors – construction, principle and types – principle of operation – phasor diagram - torque equation.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the students will be able to

1. Understand the constructional details and principle of operation of AC Induction and Synchronous Machines.
2. Understand and appraise the principle of operation and performance of PMBLDC machines.
3. Analyze the performance of the AC Induction and Synchronous Machines using the phasor diagrams and equivalent circuits.
4. Select appropriate AC machine for any application and appraise its significance.
EE204 TRANSMISSION AND DISTRIBUTION OF ELECTRICAL ENERGY

Course Objectives:
- Identify major components of power transmission and distribution systems.
- Describe the principle of operation of transmission and distribution equipment.
- Know and appreciate the key factors in equipment specification and network design.

Prerequisites:
Ordinary differential equation, Partial differential equation, Basic of voltage, current, power and elements like R, L & C.

Transmission line parameters – Resistance, Inductance and Capacitance calculations – single phase and three phase lines – double circuit lines – effect of earth on transmission line capacitance

Performance of transmission lines – Regulation and efficiency – Tuned power lines, Power flow through a transmission line – Power circle diagrams, Introduction to Transmission loss and Formation of corona – critical voltages – effect on line performance

Mechanical design of overhead lines – Line supports – Insulators, Voltage distribution in suspension insulators – Testing of insulators – string efficiency – Stress and sag calculation – effects of wind and ice loading

Underground cables – Comparison with overhead line – Types of cables – insulation resistance – potential gradient – capacitance of single core, three core cables


Text Books:

Reference Books:

Useful web links:
1. http://nptel.ac.in/video.php?subjectId=108102047

COURSE OUTCOMES:

Upon completion of this course, students will be able to
1. Understand the major components of Transmission and Distribution Systems (TDS) and its practical significance
2. Good Knowledge of various equipment specifications and design for TDS
3. Awareness of latest technologies in the field of electrical transmission and distribution
To emphasize the relationship between the conceptual understanding and problem-solving approach for (i) analyzing the electric circuit/system excited with non-sinusoidal and non-periodic source,(ii) one-port and two- port networks, (iii) system modeling and simplifications, (iv) transfer function, state- space analysis and z-transform analysis.

Prerequisites: Knowledge on differential and integral calculus, Fourier series, Fourier transform and Laplace transform are essential.


Differential equation for of translational and rotational systems-transfer function modeling for simple electrical and mechanical systems-open loop and closed loop systems - block diagram representation-Block diagram algebra-signal flow graph- Mason's gain formula.

Concepts of state and state variables – state space modeling for simple electrical and mechanical systems – state transition matrix - solution of state equations.


Text Books:

References:

COURSE OUTCOMES:
Upon completion of this course, students will
1. Understand the significance of Fourier series and Fourier Transform and apply them for typical electrical systems.
2. Apply Laplace Transform for typical circuits and be able to determine the two-port network parameters.
3. Model the systems in transfer function and state-space domains and analyze the system using these models.
4. Apply Z-transforms for the analysis of discrete time systems.

Apply Z transforms for the analysis of discrete time system
EE208 MEASUREMENTS AND INSTRUMENTATION

Course: To understand the basic operation of different measuring instruments and thereby able to choose appropriate instruments for measuring different parameters.

Prerequisites: Basics of electrical laws and theorems, basic knowhow about operational amplifiers.


Text Books:

References:

COURSE OUTCOMES:
Upon completion of the course, the students would be able to
1. Describe the working principle of different measuring instruments.
2. Choose appropriate measuring instruments for measuring various parameters in their laboratory courses.
3. Correlate the significance of different measuring instruments, recorders and oscilloscopes.
4. Develop a micro-processor based measuring unit for any practical application.
## EE210 ANALOG ELECTRONIC CIRCUITS

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### Course Objectives:
To give a comprehensive exposure to all types of amplifiers and oscillators constructed with discrete components such as BJTs and FETs. This helps to develop a strong basis for building linear and digital integrated circuits.

### Prerequisites:
Basic knowledge on electronic devices and circuit theory

- Small signal amplifiers - biasing circuits of BJT and FET transistors, analysis and design of BJT and FET amplifiers, chopper stabilized amplifiers
- Large signal amplifiers – analysis and design of class A and class B power amplifiers, class C and class D amplifiers, thermal considerations, tuned amplifiers
- Feedback amplifiers – gain with feedback - effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers
- Oscillators – Barkhausen criterion for oscillation - Hartley & Colpitts oscillators - phase shift, Wien bridge and crystal oscillators - 1ap oscillator – oscillator amplitude stabilization
- Pulse circuits – attenuators – RC integrator and differentiator circuits – diode clampers and clippers – multivibrators - Schmitt Trigger- UJT Oscillator

### Text Books:

### Reference Books:

### COURSE OUTCOMES:
Upon completion of this course, students will be able to
1. Understand the working of different types of amplifier, oscillator and multivibrator circuits.
2. Design BJT and FET amplifier and oscillator circuits.
3. Analyze transistorized amplifier and oscillator circuits.
4. Understand the applications of different types of amplifier, oscillator, attenuators and multivibrator circuits.
EE212 SYNCHRONOUS AND INDUCTION MACHINES
LABORATORY

Course Objectives: The main objective of the course is to give the students an insight into the constructional details of the induction and synchronous machines with a view of better understanding of their working principles. The course also equips the students to test and evaluate the performance of induction and synchronous machines by conducting appropriate experiments.

Prerequisites: Basic knowledge in electric circuit analysis, constructional details and operational principles of induction and synchronous machines.

List of Experiments

A demonstration of the static and rotational electrical machines (constructional details) is ought to be done in an introductory class.

1. Load test on 3 phase induction motor
2. No load and blocked rotor test on 3 phase induction motor
3. Load test on grid connected induction generator
4. Load test on self-excited induction generator
5. Load test on single phase induction motor
6. Regulation of three phase alternator by E.M.F and M.M.F methods
7. Load test on three phase alternator
8. Synchronisation of three phase alternator with infinite bus bar
9. V and inverted V-curves of synchronous motor
10. Speed Control on three phase induction motor

Mini project

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

1. Estimate or test the performance of induction and synchronous machines by conducting suitable experiments and report the results.
2. Experiment and analyze the speed control techniques for three phase induction motors.
3. Evaluate the different modes of operating the induction generators and justify their usage in wind power generation.
4. Experiment synchronization of alternators and power exchange with the grid to get convinced with their usage at conventional power generation stations
5. Develop simulation models and prototype modules in view of implementing any control technique upon single phase and three phase induction motors for various applications.
EE214 ELECTRONIC CIRCUITS LABORATORY

Course Objectives:

Course: Design of amplifiers and other electronic systems to satisfy specifications. Gain, Bandwidth, Feedback and Stability are some of the design concepts needed.

Prerequisites: Electron Devices, Electronic Circuits, Circuits and Devices Laboratory.

List of Experiments

1. Frequency analysis of Common emitter amplifier
2. Measurement of input/output impedance of Common collector amplifier
3. Design and verification of characteristics of RC oscillators
4. Design and characterisation of Monostable multivibrator
5. Design and Characterisation of Astable multivibrator
6. Characteristics of UJT and applications of UJT oscillator
7. Frequency analysis of FET Amplifier
8. Frequency response of series voltage negative feedback Amplifier
9. Square waveform generation using transistor based Schmitt trigger
10. Design and characterisation of Bistable Multivibrator

Mini -Project

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

1. Design a complete electronic circuit using a top-down approach which starts from specifications.
2. Design and analyze electronic circuits using BJT and FET.
3. Design and characterization of electronic circuits using UJT.
5. Prepare the technical report and provide solutions to real time problems.
**EE301 POWER SYSTEM ANALYSIS**  

**Course**  
To model various power system components and carry out load flow, short circuit and stability studies

**Objectives:**
Modeling of power system components - single line diagram –per unit quantities – bus impedance and admittance matrix

Power flow analysis methods - Gauss- Seidel, Newton-Raphson and Fast decoupled methods of load flow analysis

Fault studies - Symmetrical fault analysis, Analysis through impedance matrix, Current limiting reactors

Fault analysis - Unsymmetrical short circuit analysis- LG, LL, LLG; Fault parameter calculations – Open circuit faults

Stability studies - Steady state and transient stability – Swing equation - Equal area criterion – multi-machine stability analysis

**Text Books:**

**Reference Books:**

**COURSE OUTCOMES:**
Upon completion of this course, students will be able to
1. Carry out load flow study of a practical system
2. Simulate and analyze fault
3. Study the stability of power systems
Course

To equip the students with the fundamental concepts in control systems

Objectives:

Prerequisites: Laplace Transform, Complex Analysis

Test signals - Response of second order systems — time domain specifications - generalised error series - Frequency domain specifications - polar plots - Bode plots.

Stability Analysis - Routh -Hurwitz criterion - Nyquist criterion - Stability of systems with transportation lag - gain margin and phase margin.


Gain adjustments for the desired $M_p$ – constant M and N loci - Nichols Chart - Compensator design by Bode and Root locus techniques - PID controller design.

Control system components - error detectors - potentiometers and synchro - a.c and d.c servomotors - stepper motors - tacho generators – Proportional, integral and derivative controllers.

Text Books:


Reference Books:


COURSE OUTCOMES:

Upon completion of the course, the students will be able to

1. Understand the concepts of closed loop control systems.
2. Analyse the stability of closed loop systems.
3. Apply the control techniques to any electrical systems.
4. Design the classical controllers such as P, PI etc for electrical systems.
EE305 LINEAR INTEGRATED CIRCUITS  L    T    P    C
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Course: To provide in-depth instructions on the characteristics and applications of operational amplifiers, timers and voltage regulators

Objectives: Basics of analog and digital Electronic

Prerequisites: Block diagram of a typical op-amp - characteristics of ideal and practical op amp - parameters of op-amp – inverting and non-inverting amplifier configurations - frequency response - circuit stability

DC and AC amplifiers - summing amplifier - difference amplifier - voltage follower- differentiator - integrator - clamper - clipper – filters

Oscillators, sine wave, square wave, triangular wave, saw tooth wave generation, Schmitt trigger, window detector

Analog to digital, digital to analog, sample and hold circuits. voltage controlled oscillator, phase locked loop – operating principles , applications of PLL

IC555 Timer, monostable and astable modes of operation ; voltage regulators - fixed voltage regulators, adjustable voltage regulators - switching regulators

Text Books:

Reference Books:

COURSE OUTCOMES:

Upon completion of this course , students will be able to
1. Describe the various ideal and practical characteristics of an OPAMP
2. Develop simple OPAMP based circuits
3. Implement various signal generating circuits.
4. Analyze and design various types of ADCs and DACs
5. Analyze and construct various application circuits using 555 timer
Course Objectives:

To obtain knowledge on data structures and their usage in an algorithmic perspective.

Prerequisites:

Basic knowledge on computers


Linear Data structures and their sequential storage representation – arrays, structures and array of structures, stacks, queues; their storage representation and applications. Strings – storage representation and string manipulation applications.

Linear Data structures and their linked storage representation – pointers, linked allocation- single, double and circular linked list and their applications.

Nonlinear data structures – Trees, storage representation and operation on binary trees, application of trees; Graphs- representations and applications of graphs.


Text Books:


Reference Books:


COURSE OUTCOMES:

Upon completion of this course, students will have

1. Knowledge on algorithmic notations and concepts
2. Clear understanding of the primitive data structures and their applications
3. Familiarity of linked linear and non-linear data structures and operations on such data structures
4. The awareness of various sorting, searching algorithms and file structures
5. The ability to design and develop menu driven application programs.
EC319 COMMUNICATION SYSTEMS

Course Objectives:
- To develop a fundamental understanding on communication systems with emphasis on analog and digital modulation techniques
- To get introduced the basics of error control coding techniques

Prerequisites: Signals and Systems, Digital Electronics

Analog Modulation - Principles of Amplitude Modulation, single and double side band - suppressed carrier system and frequency modulation - varactor diode and reactance modulator - AM detectors - FM discriminators - AM and FM transmitters and receivers

Digital communication - Sampling theorem - pulse modulation techniques - PAM, PWM and PPM concepts - PCM encoder and decoder - Data transmission using analog carriers (FSK, PSK, QPSK, MSK &QAM)

Synchronous & Asynchronous transmission - error control techniques – protocols - data communication, link oriented, asynchronous

Modern Communication Systems – Microwaves - optical communication system - Satellite communication system - Mobile communication system

Principles of television engineering - Requirements and standards - need for scanning - types of camera tubes and picture tubes - B/W and colour systems - PAL - CCTV - Cable TV

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course
1. Students are able to apply the basic knowledge of signals and systems and understand the basics of communication system and analog modulation techniques.
2. Students are able to apply the knowledge of digital electronics and understand the error control coding techniques.
3. Students are able to summarize different types of communication systems and its requirements.
4. Students are able to design and analyse the performance of communication systems.
EE309 INTEGRATED CIRCUITS LABORATORY

Course Objectives:
To enrich the students’ knowledge on practical circuit design using analog and digital ICs.

Prerequisites: Basics of Electronic Devices and Circuits

List of Experiments

1. Understanding of OPAMP Imperfections
2. Application of OPAMP in closed loop
3. Application of OPAMP in open loop
4. Design of Analog filters using OPAMP
5. Output verification of Analog to Digital Converter
6. Output verification of Digital to Analog converter
7. Design of Multivibrators using 555 Timer
8. Design of combinational logic circuits
9. Design of sequential logic circuits
10. Design of Code converter with seven segment display

   Mini project

COURSE OUTCOMES:
Upon completion of the course, the students will be able to

2. Analyze and prepare the technical report on the experiments carried out.
3. Design application oriented circuits using Op-amp and 555 timer ICs.
4. Create and demonstrate live project using ICs.
EE311 DATA STRUCTURES LABORATORY

Course Objectives: To have a better understanding of the different types of data and data structures; storage structures, representations and operations on these data structures.

Prerequisites: Programming in C/C++/any language

List of Experiments

1. Functions and parameter passing
2. Arrays, Structures and string operations
3. Stack and queue operations
4. Single linked lists: linear and circular
5. Double linked lists: linear, circular and restricted deques
6. Linked list Applications
7. Trees and tree traversals
8. Applications of trees
9. Sorting Searching techniques
10. Mini Project: Developing menu driven program for specific applications

COURSE OUTCOMES:

Upon completion of the course, the students will

1. Have a clear understanding of the various data structures, their storage structures and operations on these data structures
2. Be able to identify the suitable data structure for implementation based on given input data and the required output.
3. Be able to design algorithms to perform operations like insertion, deletion, search and sort on various data structures
4. Be able to develop programs for a specific application
Course Objectives: This course aims to equip the students with a basic understanding of modern power semiconductor devices, various important topologies of power converter circuits for specific types of applications. The course also equips students with an ability to understand and analyze non-linear circuits involving power electronic converters.

Prerequisites: Electron devices, Circuit theory, Electrical machines.

Power Semiconductor Devices – power diodes, power transistors, SCRs, TRIAC, GTO, power MOSFETs, IGBTs-Principles of operation, characteristics, ratings, protection and gate drive circuits.

Controlled rectifiers- single- phase and three-phase- power factor improvement (qualitative treatment)-dual converters.

DC-DC converters- Buck, Boost, Buck-Boost types with circuit configuration and analysis.

DC-AC converters-1-phase/3- phase, VSI, CSI, frequency and voltage control.

AC-AC converters- single/three phase controllers, phase control, PWM AC voltage controller, Principle of ON-OFF control and cyclo-converters. Introduction to Matrix converters

Text Books:

Reference Books:

COURSE OUTCOMES:

Upon completion of the course

1. The student will be able to understand the principle of operation of commonly employed power electronic converters.
2. The student will be capable of analyzing non-linear circuits with several power electronic switches.
3. The student will be equipped to take up advanced courses in Power Electronics and its application areas.
Course: To give a broad coverage on all types of protective relays, circuit breakers and provide a strong background for working in a practical power system protection system.

Prerequisites: Fundamentals in power system analysis and short circuit studies

Relays – General classification, Principle of operation, types, characteristics, Torque equation, Relaying Schemes, Relay Co-ordination.


Protection against over voltages – Causes of over voltage Ground wires, Surge absorbers and diverters. Earthling - types. Insulation coordination.

Theory of arcing and arq quenching circuit breakers types – rating and comparison, RRRV, Resistor switching and capacitor switching.


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course the students would be able to
1. Classify and describe the working of various relaying schemes
2. Identify and implement an appropriate relaying schemes for different power apparatus
3. Illustrate the function of various CBs and related switching issues
4. Describe the causes of overvoltage and protection against overvoltage
EE306 MICROPROCESSORS AND MICROCONTROLLERS

Course: To gain knowledge on the architecture of 8085 microprocessors and 8051 micro controller, their programming and associated peripheral interface devices.

Objectives: Digital Electronics, Electron Devices and Linear Integrated Circuits

Prerequisites: 8-bit microprocessor - 8085 architecture and memory interfacing (RAM & ROM), interfacing I/O devices - instruction set - addressing modes - assembly language programming - interrupts - timing diagram.

8051 Microcontroller - Intel 8051 architecture, memory organization, flags, stack, and special function registers, I/O ports - connecting external memory, counters and timers, serial data I/O, Interrupts.

Microcontroller instructions - addressing modes, moving data, logical operations, arithmetic operations, jump and call instructions - subroutines - Interrupts and returns.

Microcontroller programming - Assembly Language Programming, timer and counter programming, connection to RS 232 and RS 485, Interrupt programming.

Peripherals and interfacing - Serial and parallel I/O (8251 and 8255), Programmable DMA controller, Programmable interrupt controller, ADC/DAC interfacing.

Case Study:(i)Waveform generation (ii)speed control of DC motor(iii)Stepper motor control (iv)seven segment LED display (v)Firing Pulse generation (vi) Traffic Control Systems etc.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course, the students will
1. Have a clear understanding of the architecture and instruction set of 8085 and 8051.
2. Be able to interface peripherals and memories with 8085 and 8051.
3. Be able to understand the application of 8085 and 8051 in waveform generators.
Course: To enrich the student with the concepts of VLSI devices and its fabrication and also to develop different electronic circuits.

Prerequisites: Essentials of Electronic devices, circuits and Digital systems.

MOS characteristics: NMOS characteristics, inverter action – CMOS characteristics, inverter action - models and second order effects of MOS transistors – Current equation – MOSFET Capacitances - MOS as Switch, Diode/ resistor – current source and sink – Current mirror.


Memory design – SRAM cell – 6T SRAM – DRAM – 1T, 3T, 4T cells CMOS Sequential circuits: Static and Dynamic circuits – True single phase clocked registers – Clocking schemes.


Text Books:

Reference Books:

COURSE OUTCOMES:

Upon completion of this course, students will be able to
1. To understand the insights of the MOS devices and its characteristics.
2. To appreciate the different VLSI process technologies.
3. To design the CMOS combinational logic circuits and its layout
4. To develop the sequential circuits and clocking schemes
5. To realize the Design flow of Application specific Integrated circuit
## EE310 POWER ELECTRONICS LABORATORY

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**Course Objectives:** To enable the students to develop hands-on experience in analyzing, designing, and carrying out experiments on various electrical networks by make use of power electronic components. It aims to familiarize the switching devices, power converters and its applications in various systems for power control.

**Prerequisites:** Circuits and Devices Laboratory.

### List of Experiments

1. 1-phase Fully Controlled SCR Converter
2. Buck Converter using MOSFET
3. Boost Converter using MOSFET
4. Buck-Boost Converter using IGBT
5. 1-phase Inverter using IGBT.
6. 1-phase step-down Cyclo-converter
7. Speed Control of 1-phase A.C Motor
8. 1-phase Half Controlled SCR Converter
9. Illumination Control of Lamp
10. Speed Control of 1-phase Capacitor Run Fan Motor
11. Characteristics of SCR, IGBT, MOSFET

   Mini project

### COURSE OUTCOMES:

Upon completion of the course, the students will be able to

1. Understand the characteristics of various switching devices and appreciate its applications in various electrical networks/systems.
2. Analyze and design the operation of power switching converters.
3. Develop practical control circuits for various real-time applications.
4. Analyze and prepare the technical report on the experiments carried out.
EE312 MICRO-COMPUTING AND VLSI DESIGN LABORATORY

Course Objectives: To train the students to use micro-processor, micro-controller and FPGA for computational and logical applications. Also this course prepares the students to provide solutions to real-time problems.

Prerequisites: Basics of Digital logics and programming skills

List of Experiments

1. Arithmetic operations (8/16 bit) using 8085.
2. Waveform generation using 8085.
3. Interfacing with 8085 (ADC, DAC)
4. Arithmetic operations (16 bit) using 8051
5. Firing pulse generation using 8051.
6. Interfacing with 8051 (Stepper motor/ DC Motor control).
7. VHDL programming for PWM pulse generation
8. Design and Simulation of Sequence detector circuit using Verilog HDL.
9. Design and FPGA implementation of 4-bit multiplier unit.
10. Layout and physical design of a Mod-N counter unit.

Mini – Project

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Accomplish arithmetic and logical operations with micro-processors, micro-controllers and FPGA
2. Generate firing pulses for various control applications related to electrical machines and power electronics.
3. Illustrate various interfacing techniques related to real time applications, using micro-processors and micro-controllers.
4. Analyze and document the experiments carried out.
5. Design and implement control circuitry using micro-processors and micro-controllers for any engineering and real world problems
Course
Objectives:
- To familiarize the students with the concepts of management.
- To facilitate with the basic concepts of marketing.
- To enrich the learners with fundamentals of financial management.
- To select a methodology for technology and production management.
- To impart the importance of Human Resources in the organizational context.

Prerequisites:
Overview of organisation structure and functions, Basic understanding of technology and operation adopted in the industry, Fundamentals of the capital employed and the risks involved.


Core concepts of marketing. Need, want, demand, product, value, satisfaction, marketing mix- product, price, place, promotion.

Financial management, objectives, scope, techniques of investment analysis, payback period, accounting rate of return, working capital, cost of capital. Sources of financing.


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course
1. The learners get equipped with the nuances of management functions
2. The learners understand the framework of a business organization.
3. The learners gain expertise in analyzing the risk and return of an investment.
4. The learners would become better people managers.
EE401 POWER SYSTEM ECONOMICS AND CONTROL
TECHNIQUES

Course: x To understand the economics of power system operation
Objectives:
  x To realize the requirements and methods of real and reactive power control in power system
  x To recognize the recent advancements in power system operation

Prerequisites: Optimization Methods, Operating Principle of Synchronous Machines, Voltage drop and power loss calculation in Transmission lines and Fundamentals of Load flow analysis.

Types of load –components of system loads- load curves – load factor, demand factor, diversity factor, capacity factor, utilization factor, base load and peak load stations- Reserve Capacity and requirements - Load Forecasting-Electrical Tariff-types of tariff

Economic Load Dispatch-characteristics of generation unit, Co-ordination equations with and without transmission loss, General problem formulation and common constraints-Unit Commitment- Constraints in unit commitment- Solution methods

Load frequency control-Generator, Prime mover, Governor & Load models – LFC of a single area and two area systems-Tie line bias control-steady state and transient response- Automatic Voltage Regulator – Exciter and Generator models-steady state and transient response

Reactive power and Voltage control – Load Compensation- power factor correction, voltage regulation, load balancing-Maximum load ability of transmission lines-Line Compensation-Static shunt capacitor/inductor-tap changing transformer, VAR compensators

Recent trends in real time control of power systems - Power system control centers with SCADA/EMS – Restructuring of power system – fundamentals and operational restrictions – Introduction to Smart Grid

Text Books:

Reference Books:

COURSE OUTCOMES:

Upon completion of this course, students will be able to
1. Calculate various factors (such as load factor and demand factor, etc.) and interpret different tariff structures
2. Develop generation dispatching schemes for thermal units
3. Apply frequency control schemes on power system
4. Employ reactive power compensation systems
5. Adopt engineering innovations for improved power system operation
Course: To familiarize the students with basics of solar and wind energy systems and various techniques for the conversion of solar and wind energy into electrical energy.

Prerequisites: Basics on solar systems, Electron devices, Electrical machines and Power electronics


Text Books:

References:

COURSE OUTCOMES:
Upon completion of this course students will be able to
1. Describe the solar radiation, measurements and characteristics of solar PV cell
2. Develop the model of a PV system and its applications
3. Describe the basic types and mechanical characteristics and model of wind turbine
4. Analyze the electrical characteristics and operation of various wind-driven electrical generators
5. Understand various power electronic converters used for hybrid system
Course Objectives: To give an insight to the design of various application based controllers and fundamental operation and control of solar PV and induction generators.

Prerequisites: Fundamentals of control systems, electronics and machines

List of Experiments

1. Stabilization of Inverted pendulum on a cart system using PID controller
2. Closed – loop control of Ball and Beam system
3. Speed control of a BLDC motor drive
4. Water-level controller with data acquisition system
5. Closed-loop temperature control system
6. Identifying and measuring parameters of solar PV module in the field
7. Efficiency measurement of stand-alone PV System
8. I-V characteristics of Solar cell under different illumination and temperature condition
9. Rotor resistance control of WRIG
10. Voltage control of SEIG

COURSE OUTCOMES:
Upon completion of the course, the students will be able

1. To design and implement a suitable controller for a practical system.
2. Estimate or test the performance of a solar PV system and induction generators under different operating conditions.
3. Develop simulation models and prototype modules in view of implementing any control technique upon any renewable energy applications.
4. Analyze and prepare the technical report on the experiments carried out.
Course: To enhance the analyzing and problem solving skills of the students in the area of power system and power electronics through computer programming and simulation.

Prerequisites: Fundamentals of power system, Fundamentals of power electronics

List of Experiments

1. Real and Reactive Power Computation
2. Transmission Line Parameter Calculation
3. Power Circle Diagrams
4. Bus Admittance Matrix Formulation
5. Graph Theory Matrices
6. Load Flow Analysis
7. Z bus Formation
8. Short Circuit Analysis
9. Simulation of AC DC Converters
10. Power Electronic Applications in Power Systems

Mini project

COURSE OUTCOMES:

Upon completion of the course students will be able to

1. Develop computer programs for power system studies
2. Design, simulate and analyze power electronics circuits using simulation packages.
3. Prepare laboratory reports that clearly communicate experimental information in a logical and scientific manner
HM 402 PROFESSIONAL ETHICS AND HUMAN VALUES

Course: Identify the core values that shape the ethical behavior of an engineer
Objectives: To create an awareness on professional ethics and Human Values
To appreciate the rights of others
Prerequisites: Nil


Engineering as experimentation - engineers as responsible experimenters - Research ethics -Codes of ethics - Industrial Standard - Balanced outlook on law - the challenger case study.


Multinational corporations - Business ethics - Environmental ethics - computer ethics - Role in Technological Development - Weapons development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Honesty - leadership - sample code of conduct ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management Institution of electronics and telecommunication engineers (IETE), India, etc..

Text Books:
3. Charles D. Fleddermann, 'Ethics in Engineering', Pearson Education/Prentice Hall, New Jersey, 2004 (Indian Reprint)

Reference Books:
1. Charles E Harris, Michael S. Protchard and Michael J Rabins, ‘Engineering Ethics - Concept and Case’; Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)

COURSE OUTCOMES:
Upon completion of this course, students should have
1. Understood the core values that shape the ethical behaviour of an engineer
2. Exposed awareness on professional ethics and human values.
3. Known their role in technological development
EE001 POWER GENERATION SYSTEMS

Course: To understand the working of different types of power generation systems and to realize the necessity for interconnected operation of different power stations.

Objectives: Basic knowledge about working of alternators and electric power systems

Prerequisites: Hydro-electric power plants – selection of site, elements of power plant, classification, water turbines, governor action, hydro-electric generator, plant layout, pumped storage plants.

Thermal Steam power plants – selection of site, elements and operational circuits of the power plant, turbo-alternators, plant layout, steam turbines, controls and auxiliaries.

Nuclear power plants – selection of site, nuclear reaction – fission process and chain reaction, constituents of power plant and layout, nuclear reactor – working, classification, control, shielding and waste disposal.


Combined operation of power plants – plant selection, choice of size and number of generator units, interconnected systems, real and reactive power exchange among interconnected systems. Major electrical equipment in power plants, DC systems in power plants, station control - switch yard and control room. Economic considerations – types of costs, tariff and consumers.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course the students would be able to:-
1. Appreciate the different types of tariff, consumers and different types of power generation plants
2. Determine the significance of various components of the power generation plants
3. Correlate the importance of interconnected operation of different power generation systems
4. Plan an appropriate scheduling of electric power to satisfy the demand constraint
Course Objectives: This course offers the preliminary instructions and techniques to design the main dimensions and other major part of the transformer and DC and AC rotating machines. The course also provides the students with an ability to understand the step by step procedure for the complete design of electrical machines.

Prerequisites: DC Machines and Transformers, AC Machines

General concepts in the design of rotating machines-output equation-Magnetic and electric loadings-Common design features of all rotating machines-Condecting, insulating and magnetic materials used in electrical apparatus-mmf calculation for the magnetic circuit of rotating machines-Leakage reactance calculation.

Armature winding –output equation-Choice of specific loadings-Choice of poles-design of conductors, winding, slot, air gap, field poles and field coils, commutator and brush-Predetermination of efficiency, temperature rise and open circuit characteristics from design data (qualitative treatment only)

Output equation-Design of core and coils for single phase and three phase transformers-Design of tank and cooling tubes-Predetermination of circuit parameters, magnetising current, losses, efficiency, temperature rise and regulation from design data (qualitative treatment only)

Output equation-Choice of specific loadings-Design of stator-Design of squirrel cage and slip ring rotors-Stator and rotor winding designs-Predetermination of circuit parameters, magnetising current, efficiency and temperature rise from design data (qualitative treatment only).

Constructional features of synchronous machines-SCR-Output equation-specific loadings-Main dimensions-Stator design-Design of salient pole field coil.

Text Books:

References:

COURSE OUTCOMES:
Upon completion of this course,
1. The student will be able to understand the design of main dimensions and other major part of the transformer and DC and AC rotating machines.
2. The student will be capable of evaluating the procedure for the design of main dimensions and other major part of the transformer and DC and AC rotating machines.
3. The student will be equipped to apply in-depth knowledge related to the design of electrical machines.
**Course**

To emphasize on various type and implementation of relays using solid-state circuits and microprocessors.

**Objectives:**

Fundamentals on Power system protection, Analog electronics, Digital electronics and Microprocessor

Power system protection and its requirements – conventional Vs static relays - steady state and transient performance of signal deriving elements, signal mixing techniques and measuring techniques.

Over current protection - instantaneous over current relay – directional over current relay – applications – differential relays - generator and transmission line protection.

Static relay circuits for generator loss of field, under frequency, distance, impedance, reactance, mho and special characteristics - reverse power relays

Static relay circuits for carrier protection and testing of relays - Static relay circuits - tripping circuits using thyristor.

Microprocessor/Microcontroller based Relays-Hardware and software for the measurements of voltage, current, frequency and phase angle- implementation of over current, directional, impedance and mho relays.

**Text Books:**


**Reference Books:**


**COURSE OUTCOMES:**

Upon completion of the course the students would be able to

1. Distinguish between the conventional electro-mechanical relays and static relays
2. Design various electronic circuits to implement various relaying functions
3. Implement microprocessor based relays
EE004 EHV AC AND DC TRANSMISSION

Course:
- To understand and analyze the HVAC and HVDC transmission systems.
- To plan an appropriate transmission system between two destinations based on the load requirement and anticipated technical performance of power transmission.

Prerequisites:
As a pre-requisite to this course the students should have completed a fundamental course on Transmission and Distribution and Power Electronics.

Design aspects of HVAC – conductor, tower, insulator and substation structure design, mechanical design - sag-tension calculations, design of EHVAC lines based on steady state limits and transient over voltages - design of extra HV cables - XLPE cables and gas insulated cables.


Introduction to HVDC transmission - Bridge converters – rectifier and inverter operation, equivalent circuit representation, power reversal, desired features of control and actual control characteristics.

Basic HVDC controllers, converter faults, commutation failure, bypass action in bridges, protection issues in HVDC - DC reactors, voltage and current oscillations, DC circuit breakers and over voltage protection, HVDC cables

Harmonics in HVDC - characteristics and uncharacteristic harmonics, troubles due to harmonics, harmonic filters – active and passive filters, active and reactive power exchange in converters and recent trend in HVDC transmission – Hybrid HVDC and Off-shore wind power evacuation through HVDC, introduction to Wide Area Monitoring Systems.

Text Books:

Reference Books:

Useful web links:
1. http://nptel.iitb.ac.in/courses/108104013

COURSE OUTCOMES:
Upon completion of the course the students would be able to
1. Distinguish between the usage of EHVAC and HVDC transmission systems.
2. Judge when and where to use EHV / HVDC transmission systems in practice.
3. Design implementation circuitry for various controllers used in HVDC transmission systems
4. Plan an appropriate electric power transmission system between two destinations to satisfy the pre-defined load requirement without compromising the technical performance.
EE005 FUNDAMENTALS OF FACTS  L   T   P   C 
            3   0   0   3

Course: To familiarize the students with the basic concepts, different types, scope and applications of FACTS controllers in power transmission.

Objectives: FACTS controllers in power transmission.

Prerequisites: Power Electronics, Electrical Machines and Power systems.

Fundamentals of ac power transmission, transmission problems and needs, emergence of FACTS-FACTS control considerations, FACTS controllers.

Principles of shunt compensation – Variable Impedance type & switching converter type- Static Synchronous Compensator (STATCOM) configuration, characteristics and control.

Principles of static series compensation using GCSC, TCSC and TSSC, applications, Static Synchronous Series Compensator (SSSC), TJE.

Principles of operation-Steady state model and characteristics of a static voltage regulators and phase shifters-power circuit configurations.

UPFC-Principles of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters.

Text Books:


References:


COURSE OUTCOMES:

Upon completion of the course, the students shall be able to:

1. Understand various control issues, for the purpose of identifying the scope and for selection of specific FACTS controllers.
2. Apply the concepts in solving problems of simple power systems with FACTS controllers.
3. Design simple FACTS controllers.
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<th>To design illumination systems, choose appropriate motors for any drive application, to debug a domestic refrigerator circuit and to design battery charging circuitry for specific applications.</th>
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<td>Prerequisites:</td>
<td>Basics of circuit theory, operational characteristics of various dc and ac motors.</td>
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<td>COURSE OUTCOMES:</td>
<td>Upon completion of the course the students would be able to 1. Develop a clear idea on various Illumination techniques and hence design lighting scheme for specific applications 2. Identify an appropriate method of heating for any particular industrial application 3. Evaluate domestic wiring connection and debug any faults occurred 4. Construct an electric connection for any domestic appliance like refrigerator as well as to design a battery charging circuit for a specific household application. 5. Realize the appropriate type of electric supply system as well as to evaluate the performance of a traction unit.</td>
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EE007 SPECIAL ELECTRICAL MACHINES

Course: To expose the students to the construction, principle of operation and performance of special electrical machines as an extension to the study of basic electrical machines.

Prerequisites: Fundamentals of DC and AC machines


Text Books:

Reference Books:

COURSE OUTCOMES:

Upon completion of the course the students would be able to understand the construction, principle of operation and performance of
1. Synchronous reluctance motors
2. Stepping motors
3. Switched reluctance motors
4. Permanent magnet brushless D.C. motors
5. Permanent magnet synchronous motors.
EE008 ELECTRICAL SAFETY

Course Objectives: To provide a comprehensive exposure to electrical hazards, various grounding techniques, safety procedures and various electrical maintenance techniques.

Prerequisites: Basic science and electrical engineering

Primary and secondary hazards- arc, blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one line diagram- electrician’s safety kit.

General requirements for grounding and bonding- definitions- grounding of electrical equipment- bonding of electrically conducting materials and other equipment- connection of grounding and bonding equipment-system grounding- purpose of system grounding- grounding electrode system- grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage and high voltage systems.

The six step safety methods- pre job briefings- hot work decision tree-safe switching of power system-lockout-tag out- flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment, procedure for low, medium and high voltage systems- the one minute safety audit

Electrical safety programme structure, development- company safety team- safety policy- programme implementation- employee electrical safety teams- safety meetings- safety audit- accident prevention- first aid- rescue techniques-accident investigation

Safety related case for electrical maintenance- reliability centered maintenance (RCM) - eight step maintenance programme- frequency of maintenance- maintenance requirement for specific equipment and location- regulatory bodies- national electrical safety code- standard for electrical safety in work place-occupational safety and health administration standards.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course the students would be able to:-
1. Describe electrical hazards and safety equipment.
2. Analyze and apply various grounding and bonding techniques.
3. Select appropriate safety method for low, medium and high voltage equipment.
4. Participate in a safety team.
5. carry out proper maintenance of electrical equipment by understanding various standards.
EE009 COMPUTER RELAYING AND PHASOR MEASUREMENT
UNIT

Course Objectives:
- To understand and analyze the basic architecture of Digital Relay
- Understand the basics of Phasor Measurement unit (PMU)
- Applications of PMUs in power system

Prerequisites: Fourier series, Fourier Transform, Phasors, ADC

Mathematical background to protection algorithms-Finite difference technique-Numerical differentiation-Least Squares Method-Fourier analysis-Fourier analysis of analogue signals- Fourier analysis of discrete signals-Walsh function analysis.

Basic elements of digital protection-Signal conditioning subsystem-Transducers-Surge protection circuits-Analogue filtering-Analog multiplexers-Conversion subsystem-Sampling theorem-Signal aliasing error-Sample and hold circuit-Digital multiplexing-Digital to Analogue Conversion-Analogue to Digital Conversion-Processor-Data and Program memory-Digital relay hardware unit.


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Understand the operation of computer relay.
2. Understand the basics of phasor measurement unit.
3. Understand the different applications of PMUs on power system.
EE081 SOLID STATE DRIVES  
L  T  P  C  
3  0  0  3

Course:  
- To understand the basic concept of DC and AC Drives.

Objectives:  
- To understand the various control techniques involved with both DC and AC Drives.
- To brief about the working principle of Special Electrical Drives.

Prerequisites:  
- Electrical machines, Power Electronics.

Introduction to solid state drives, various components-power converters, motors, loads, coupling mechanisms, Stability of drive.

Modeling of d.c.motor drives. Transfer function and state-space models. Experimental determination of drive parameters. Speed control using ac to dc converters, Input performance parameters, Speed reversal schemes.


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course,
1. The student learns the fundamental concepts of power electronic converter fed DC and AC machines.
2. The student can analyze the converter fed motor under different torque/speed conditions.
3. The student will be able to design converter fed drives with existing/new control techniques.
EE082 POWER SYSTEM DYNAMICS

Course

- To explain the power system stability problem

Objectives:

- To understand the behavior of synchronous and induction machines during disturbance
- To employ mathematical tools for power system stability analysis

Prerequisites:

Mathematical Transformations, Fundamentals of Synchronous and asynchronous machines, Principle of load flow and short circuit analysis

Stability considerations – Dynamic modeling requirements- angle stability – equal area criterion-
Critical fault clearing time and angle-numerical integration techniques.

Synchronous machines - Park’s transformation – flux linkage equations – formulation of normalized
equations – state space current model – simplified models of the synchronous machine – turbine,
Generator – steady state equations and phasor diagrams.

Dynamics of Synchronous machines - Mechanical relationships – electrical transient relationships
– adjustment of machine models – Park’s equation in the operational form.

Induction motor equivalent circuits and parameters - free acceleration characteristics – dynamic
performance – effect of three phase short circuit and unbalanced faults.

Transient and dynamic stability distinction – linear model of unregulated synchronous machine
and its oscillation modes – distribution of power impacts – effects of excitation on stability –
supplementary stabilization signals.

Text Books:


Reference Books:


COURSE OUTCOMES:

Upon completion of the course, the students will have acquired

1. Understanding of the dynamic phenomena of the power system operation
2. Knowledge to employ modeling techniques for investigating the response of system during
disturbance.
3. Ability to interpret results coming from the simulation of differential -algebraic systems
EE083 POWER SYSTEM RESTRUCTURING

Course: To understand the electricity power business and technical issues in a restructured power system in both Indian and world scenario.

Objectives: Knowledge in power system analysis & Power system generation, transmission and distribution.

Prerequisites: Introduction – Market Models – Entities – Key issues in regulated and deregulated power markets; Market equilibrium- Market clearing price- Electricity markets around the world

Operational and planning activities of a Genco - Electricity Pricing and Forecasting -Price Based Unit Commitment Design - Security Constrained Unit Commitment design. – Ancillary Services - Automatic Generation Control (AGC).

Introduction-Components of restructured system-Transmission pricing in Open- access system - Open transmission system operation; Congestion management in Open-access transmission systems- FACTS in congestion management - Open-access Coordination Strategies; Power Wheeling- Transmission Cost Allocation Methods

Open Access Distribution - Changes in Distribution Operations- The Development of Competition – Maintaining Distribution Planning

Power Market Development – Electricity Act, 2003 - Key issues and solution; Developing power exchanges suited to the Indian market - Challenges and synergies in the use of IT in power- Competition- Indian power market- Indian energy exchange- Indian power exchange- Infrastructure model for power exchanges- Congestion Management-Day Ahead Market- Online power trading.

Text Books:

Reference Books:

Useful web links
1. Indian energy exchange: http://www.iexindia.com/
2. Indian power India limited: http://www.powerexindia.com/
3. Indian Electricity Regulations: http://www.cercind.gov.in/

COURSE OUTCOMES: 
Upon completion of the course the students would be able to
1. Explain and differentiate the key issues involved in the regulator and de-regulated power markets.
2. Describe the operational activities in Generation, Transmission and Distribution system in the restructured environment.
3. Illustrate and Solve problems in the de-regulated power System.
4. Explain and analyze the restructuring activities in Indian Power System.
**Course**
This course aims at modelling, analysis and control of various power converter circuits.

**Objectives:**
- Basic converter topologies: Buck, Boost, Buck-Boost converter; steady state converter analysis
- Equivalent circuit modelling
- State space averaging of converters
- Transfer function of converters
- Design of feedback compensators-voltage and current loop
- Isolated converters: forward converter, push-pull converter, fly back converter, half bridge and full bridge converter-operating principles
- Soft-switching DC - DC Converters: zero-voltage-switching converters, zero-current switching converters, Multi-resonant converters and Load resonant converters-operating principles

**Text Books:**

**Reference Books:**

**COURSE OUTCOMES:**
Upon completion of this course the students will be able to
1. Understand the classification and operation of different types of DC-DC converters.
2. Analyze the Steady-state operation of DC-DC converter circuits
3. Develop the transfer function of DC-DC converter circuits
4. Design the compensator and reactive elements of DC-DC converter circuits
5. Illustrate different soft switching techniques in DC-DC converter circuits
Course: To learn the concepts and techniques of evolutionary and optimization techniques in power system applications.

Objectives: Fundamentals of electrical power system

Prerequisites: Definition-Classification of optimization problems-Unconstrained and Constrained optimization-Optimality conditions-Classical Optimization techniques (Linear and nonlinear programming, Quadratic programming, Mixed integer programming)-Intelligent Search methods (Optimization neural network, Evolutionary algorithms, Tabu search, Particle swarm optimization, Application of fuzzy set theory).


Fundamental principle-Velocity Updating-Advanced operators-Parameter selection- Hybrid approaches (Hybrid of GA and PSO, Hybrid of EP and PSO) -Binary, discrete and combinatorial PSO-Implementation issues-Convergence issues- PSO based OPF problem and unit commitment-PSO for reactive power and voltage control-PSO for power system reliability and security.

Simulated annealing algorithm-Tabu search algorithm-SA and TS for unit commitment-Ant colony optimization- Bacteria Foraging optimization.

Concept of pareto optimality-Conventional approaches for MOOP-Multi objective GA-Fitness assignment-Sharing function-Economic Emission dispatch using MOGA-Multiobjective PSO (Dynamic neighbourhood PSO, Vector evaluated PSO) –Multiobjective OPF problem.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course the students will be able to
1. Understand the concept of optimization techniques.
2. Apply evolutionary algorithms for unit commitment and economic dispatch problems.
3. Interpret hybrid approach for power system reliability and security.
EE086 VEHICULAR ELECTRIC POWER SYSTEM

L  T  P  C
3  0  0  3

Course Objectives: This course introduces the fundamental concepts, principles and analysis of hybrid and electric vehicles.
Prerequisites: Power Conversion Techniques, Electrical Machines

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Basics of vehicle performance, vehicle power source characterization, transmission characteristics

Introduction to electric components used in hybrid and electric vehicles- Configuration and control of DC Motor drives Induction Motor drives, Permanent Magnet Motor drives, and Switched Reluctance Motor drives- drive system efficiency.

Energy storage technologies in hybrid vehicles-flywheel, hydraulic, fuel cell and hybrid fuel cell energy storage system-ultra capacitors- comparison- - battery charging control

Introduction to energy management strategies used in hybrid and electric vehicle, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy strategies.

Electrical power system in air craft, sea and undersea vehicles, space vehicles-hybrid vehicle control strategies-supporting subsystem

Text Books:

Reference Books:
2. Sandeep Dhameja, ‘Electric Vehicle Battery Systems’;
3. Chris Mi, M. Abul Masrur, David Wenzhong Gao,

COURSE OUTCOMES:

On completion of the course, the student would be able to

1. Understand the various aspects of hybrid and electric vehicles
2. Plan the selection of electrical machines for hybrid and electric vehicles
3. Select various energy storage technologies for hybrid and electric vehicles
4. Implement energy management techniques for hybrid and electric vehicles
5. Demonstrate the power system of various vehicular system
EE07 DISTRIBUTION SYSTEM AUTOMATION

Course

Objectives: To understand and appreciate the basic control techniques involved in distribution automation and also get introduced to the various communication systems involved in distribution automation. Also the objective of the course is to enable the students capable of analyzing the economics behind the automation of distribution system automation.

Prerequisites: Basic knowledge on control systems, communication systems and electric power distribution systems

Introduction to Distribution Automation, Control System Interfaces, Control and Data requirements, Centralized (Vs) Decentralized Control, Distribution Automation System, DAS Hardware, DAS Software, DA Capabilities, Automation system computer facilities.


DA Communication Requirements, Communication Reliability, Cost Effectiveness, Data Rate Requirements, Two Way Capability, Ability to communicate during outages and faults, Ease of operation and maintenance, Conforming to the architecture of data flow. Communication Systems used - Distribution line carrier (Power line carrier), Telephone, Cable TV, Radio, AM Broadcast, FM SCA, VHF Radio, UHF Radio, Microwave, Satellite, Fibre Optics, Hybrid Communication Systems.


Text Books:

Reference Books:
2. IEEE Working Group on ‘Distribution Automation’

COURSE OUTCOMES:
Upon completion of the course the students would be able to
1. Understand the Distribution Automation Systems and the Control techniques involved.
2. Develop a clear idea on the layout of the substations and feeders and also on the various management techniques viz., load management and voltage management.
3. Identify an appropriate method of communication for any particular distribution system with a view of automation.
4. Evaluate the economic aspects of any distribution system with automation.
EE021 COMPUTER ARCHITECTURE

L T P C

3 0 0 3

Course:
This Course will render the basic structure of computers their control design, memory organizations and an introduction to parallel processing

Objectives:

Prerequisites:
Fundamental of digital systems, Basic programming skills

Computer – Functional units, Addressing modes, Instruction formats, Stacks and Subroutines. Processing Unit - Execution of instructions - Control step sequence.

Control Design - Hardwired control- design - multiplier control unit - CPU control unit and Micro programmed control - micro instructions - Sequencing - prefacting.

Arithmetic and Logic Unit-Fixed point and floatingpoint numbers and operations. Design of arithmetic units.

Memories - cache memories - virtual memories. Input-Output Organization - Data transfer-synchronization- Interrupt handling-I/O interfaces.

Introduction to parallel processing- Generation of computer systems – Parallelism in uniprocessor system – Parallel computer structures- architectural classification schemes.

Text Books:

Reference Books:

COURSE OUTCOMES:

Upon completion of this course, students will

1. Describe the general architecture of computers.
2. Be familiar with the history and development of modern computers, the Von Neumann architecture and functional units of the processor such as the register file and arithmetic- logical unit,
3. Understand the major components of a computer including CPU, memory, I/O and storage, how computer hardware has evolved to meet the needs of multi-processing systems, the uses for cache memory, parallelism both in terms of a single processor and multiple processors.
4. Design principles in instruction set design including RISC architectures.
5. Analyze and design computer hardware components.
### EE022 COMPUTER NETWORKS

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**Course**
To know about different network architectures and network protocols, data communications and different IEEE standards.

**Objectives:**
Basics of Programming, Digital Electronics

Introduction - Architecture, Network hardware and software. Physical layer - Guided transmission media - Cable television.

Data Link Layer - Design issues – Channel allocation problem - Multiple access protocols - Ethernet - Wireless LAN - 802.11 architecture.

Network Layer - Design issues – Routing algorithms - Congestion control algorithms - Quality of Service - Internetworking.


**Text Books:**

**Reference Books:**

**COURSE OUTCOMES:**

Upon completion of this course, students will be able to

1. Understand of the fundamental network issues
2. Analyze the significance of the network layers and their functions.
3. Gain knowledge about the basic network protocols.
4. Have a basic understanding of TCP / IP
EE023 OPERATING SYSTEMS  L T P C
3 0 0 3

Course Objectives: To learn the various aspects of operating systems such as process management, memory management, and I/O management. This course will outline the importance of operating system components, different views and principles of design and implementation.

Prerequisites: Fundamental of computer systems, Basic programming skills


Text Books:

Reference Books:

COURSE OUTCOMES:

Upon completion of this course, students will be able to
1. Describe functions, structures and history of operating systems, various process management concepts including scheduling, synchronization, Deadlocks, concepts of memory management including virtual memory, related to file system interface and implementation, disk management,
2. Be familiar with protection and security mechanisms
3. Be familiar with various types of operating systems including WINDOWS and UNIX.
4. Analyze theory and implementation of processes, resource control (concurrency etc.), physical and virtual memory, scheduling, I/O and file.
EE024 DESIGN WITH PIC MICROCONTROLLERS

Course Objectives: To understand the internal structure and operation of PIC16F876 microcontroller, assembly language programming with MPLAB and PICSTART plus and design methodology for software and hardware applications.

Prerequisites: Knowledge on any microprocessor and power electronics may be desirable.

Introduction to PIC microcontrollers-PIC 16F876 microcontroller –device overview-pin diagrams-memory organisation.


Introduction to MPLABIDE and PICSTART plus–Device Programming using MPLAB and PICSTART plus.

Assembly language programming for –Zero crossing detectors-square wave generation–firing pulse generation for typical single-phase converters and inverters- ADC program –hardware demonstration.

Text Books:

References:

COURSE OUTCOMES:
Upon completion of this course, students will
2. Be able to develop assembly language program.
3. Be able to develop the program using MPLAB and download it to the microcontroller chip using suitable developer.
4. Be able to design and generate the firing pulses for typical power electronic circuits.
EE025 EMBEDDED SYSTEM DESIGN

Course: To enable the learner to design a system with combination of hardware and Software for specific application.

Prerequisites: Basics of processors and controllers


Sensor and Actuator I/O – ADC, DAC, timers, Servos, Relays, stepper motors, H-Bridge, C O D E C s, F P G A, ASIC, diagnostic port.

Real time operating systems (RTOS) – real time kernel – OS tasks – task states – task scheduling – interrupt processing – clocking communication and synchronization – control blocks – memory requirements and control – kernel services.

Embedded Networks – Distributed Embedded Architecture – Hardware and Software Architectures, Networks for embedded systems– I2C, CAN Bus, Ethernet, Internet, Network–Based design– Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design Example: Elevator Controller.


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course, students will be able to
1. Remember the concepts of process and controllers
2. Apply the concepts for real time applications
3. Create a real time system for particular applications
Course: To explore the basic concepts of digital signal processing in a simple and easy-to-understand manner.

Objectives:

Prerequisites: Signals and systems

Linearity shift - invariance - Unit sample response characterization – Convolution summation, causality, linear difference equations with constant coefficients and their solution using Z-transform – System function concept.


Architecture and features of signal processor and motion controller.

Text Books:


Reference Books:


COURSE OUTCOMES:

Upon completion of the course, the student will be able to

1. Understand the operations on digital signals.
2. Analyze the signal processing concepts.
3. Design the systems required for digital signal processing.
**Course**: To impart the concepts of Digital systems and hardware description languages.

**Objectives:**

**Prerequisites**: Essentials of Digital Electronics

Finite State machines - Mealy and Moore, state assignments, design and examples – Asynchronous finite state machines – design and examples – multi-input system controller design.

*Programmable Devices*: Simple and Complex Programmable logic devices (SPLD and CPLDs), Field Programmable Gate Arrays (FPGAs), Internal components of FPGA, Case study: A CPLD and a 10 million gates type of FPGA.


Fault classes and models – Stuck at faults, Bridging faults - Transition and Intermittent faults. Fault Diagnosis of combination circuits by conventional methods - Path sensitization technique - Boolean different method and Kohavi algorithm

**Text Books:**

**Reference Books:**

**COURSE OUTCOMES:**

On completion of the course the students would be able to:-
1. To understand the insights of the finite state machines.
2. To appreciate and classify the programmable logic devices and FPGA.
3. To design the logic circuits using VHDL.
4. To develop the systems using Verilog HDL.
5. To test the circuits for different faults.
EE028 LOW POWER MICROCONTROLLER

Course

To enrich the student with the concepts of low power microcontroller, its architecture, peripherals and applications.

Objectives:

Prerequisites: Essentials of Electronic devices, circuits, Digital systems, Microprocessor basics.

Introduction - Motivation for MSP430 microcontrollers – Low Power embedded systems, Main characteristics of a MSP430 microcontroller, Main features of the MSP430X RISC CPU architecture, Address space, Interrupt vector table, Flash/ROM, Information memory (Flash devices only), Boot memory (Flash devices only), RAM, Peripheral Modules, Special Function Registers (SFRs), Central Processing Unit (MSP430 CPU), Arithmetic Logic Unit (ALU), MSP430, CPU registers, Central Processing Unit (MSP430X CPU), MSP430X CPU registers.

Addressing modes & Instruction set- Double operand instructions, Single operand instructions, Program flow control – Jumps, Emulated instructions and programming.

Device Systems and Operating Modes- system reset, system clock, interrupt management, WDT, WDT+, Basic Timer, Capture/Compare blocks, Timer_A Interrupts, Timer_B special features, Real Time Clock (RTC).

On-Chip Peripherals and General Purpose I/O- Hardware multiplier, ADC, DAC, SD16, LCD, DMA, Registers, Interruptible ports, Flashing LED, Blinking the LED, toggle the LED state by pressing the push button, Enable / disable LED blinking by push button.

Communications: Communications system model, Transmission mode, Synchronous and asynchronous serial communications, Serial Peripheral Interface (SPI) communication protocol, MSP430 communications interfaces, Case Studies of applications of MSP430.

Text Books:

Reference Books:
Teaching MSP430, Manual from Texas Instruments.

COURSE OUTCOMES:

Upon completion of the course the students would be able to

1. Understand the architecture of MSP 430 Microcontroller.
2. Appreciate the different Addressing modes and Instruction set.
3. Identify the device systems and operating modes of MSP 430.
4. Utilize the on-chip peripherals and I/O pins of MSP 430.
5. Construct the applications of MSP 430 and understand the communication interfaces.
EE088 AIRCRAFT ELECTRONIC SYSTEMS

Course
To inculcate the habit of applying theory in practical electronic systems.

Objectives:

Prerequisites: Essentials of Digital Electronics and system design

Basic flight instruments – Electronic flight instrument systems – primary flight display – navigation display – Display processor unit - Electronic attitude and direction indicator (EADI) – Electronic Horizontal situation indicator (EHSI) – Multi-function processor unit.

Electronic centralized aircraft Monitor - Engine indicating and crew alerting system - Flight management system – cockpit layouts.


Airframe control and indicating systems - Landing gear - Trailing edge flaps - Control surfaces - Electronic indicating systems – Terrain awareness warning systems

Flight data and cockpit voice recorders - Health and usage monitoring system (HUMS) - Aircraft Communication Addressing and Reporting System - Fly-by-wire (FBW).

Text Books:

Reference Books:

COURSE OUTCOMES:

On completion of the course the students would be able to:-
1. To understand the insights of the flight instruments.
2. To appreciate and classify the monitoring and management systems.
3. To differentiate electrostatic and electromagnetic effects.
4. To list the control and indicating systems in aircraft.
5. To enrich about recording and reporting systems in aircraft.
Course Objectives: To inculcate the habit of applying theory in practical signal processing in real time systems.

Prerequisites: Essentials of signals and systems, signal processing

Speech processing in a cell phone conversation - Linear predictive processing of speech – LP model of speech - LP estimation algorithm - LP processing in practice - Linear predictive coders.

Bits played back in an Audio CD - Delta–sigma modulation - Uniform quantization: Bits vs. SNR - Conventional DACs - Oversampling DACs – Noise shaping - Delta–sigma DACs.

Sound processed in a MP3 player - Sub-band and transform coding - Perfect reconstruction filters- Filter banks and lapped transforms - masking properties of the human ear - Audio coders.

Compression of Digital TV programs for broadcasting - Motion estimation - Motion estimation: The block matching algorithm - specificities of video coding standards.

Acoustic echo cancellation - internet phone – guidance and navigation systems – case studies on other real time systems.

Text Books:

Reference Books:

COURSE OUTCOMES:

Upon completion of the course, the students will be able to
1. To appreciate the speech processing technique in cell phones.
2. To understand the bits processed in audio CD.
3. To identify the concepts of sound processed in MP3 player.
4. To determine the compression technique used in Digital TV programs.
5. To enrich about different real time signal processing systems.
Course

Objectives: To learn the fundamentals of ANN and its application to electrical system.

Prerequisites: Engineering Mathematics, Introduction to EEE.


Text Books:

Reference books:

COURSE OUTCOMES:
Upon completion of the course students will be able to
1. Describe the development of artificial neural networks (ANN) and classify various ANN models.
2. Solve and design various ANN models.
3. Apply and construct ANN models to various applications of electrical systems.
Course Objectives:

- This course is designed to expose students to fuzzy methods of analyzing problems which involve incomplete or vague criteria rather than crisp values. The course investigates requirements analysis, logical design, and technical design of components for fuzzy systems development.
- The subject is primarily concerned with the definitions and concepts associated with a fuzzy set, Fuzzy reasoning, Fuzzy design and Fuzzy logic applications. The course also introduces Neuro-Fuzzy systems, Fuzzy Genetic Algorithms.

Prerequisites:

Fundamentals of control systems.

Different faces of imprecision – inexactness, ambiguity, undecidability, Fuzziness and certainty, Fuzzy sets and crisp sets.

Intersections of Fuzzy sets, Union of Fuzzy sets the complement of Fuzzy sets-Fuzzy reasoning..

Linguistic variables, Fuzzy propositions, Fuzzy compositional rules of inference- Methods of decompositions and defuzzification.

Methodology of fuzzy design - Direct & Indirect methods with single and multiple experts, Applications -Fuzzy controllers – Control and Estimation.

Genetic Algorithms- basic structure-coding steps of GA, convergence characteristics, applications.

Text Books:


References:


COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

1. Understand the fundamentals of Fuzzy logic theory.
2. Apply and analyse the concept to existing systems.
3. Design Fuzzy logic Systems for engineering applications.
The contents aim to develop the knowledge of the student in the field of automation in industries. This will be compromising knowledge of PLC, DCS and SCADA Systems. They will also get familiar with different industrial standard protocols.

Prerequisites: Basic knowledge of Control systems and Electrical and electronics measurement


Programmable Logic Controller: Evaluation of PLC, PLC Architecture, Basic Structure. PLC Programming: Ladder Diagram – Ladder diagram symbols, Ladder diagram circuits. PLC Communications and Networking, PLC Selection: I/O quantity and Type, Memory size and type, Programmer Units. PLC Installation, Advantages of using PLCs.

Distributed Control System: Introduction, Overview of Distributed Control System, DCS Software configuration, DCS Communication, DCS Supervisory Computer Tasks, DCS Integration with PLCs and Computers, Features of DCS, Advantages of DCS.

Text Books:

Reference books:

COURSE OUTCOMES:
Upon completion of the subject, students will be able to:

1. Implement low cost automation systems using pneumatic and electrical means.
2. Learn about the modern techniques and devices used for the monitoring and control of manufacturing systems including programming of programmable logic controllers and their interfacing with various sensors and actuators.
3. Design automated assembly system for industrial applications.
Course Objectives:

To equip students to identify and formulate real life problems using mathematical modeling; devise a solution procedure; analyze and interpret the results; revise for the process based on the actual results

Prerequisites:

Knowledge of differential and integral calculus, matrix analysis, differential equations and algebraic system of equations


Dual Theory Transportation and Assignment problems: Dual formulation of primal L.P.P and its solution – Transportation problem – Assignment problem – Travelling salesman problem

Integer programming and CPM-PERT: Gomory’s method – Branch and bound technique – Critical path in networks – CPM – Time and Cost aspects in networks - PERT

Queueing Theory and Inventory models: Classification of queues – Poisson arrivals – Exponential service time – M/M/1 and M/M/c models – Inventory control – E.O.Q. with uniform demand, with finite rate of replenishment and with shortage – Buffer stock – Inventory with price breaks – Basic probabilistic models

Dynamic programming: Recursive equation approach – applications to shortest path network, Inventory and production control – solution of LPP by dynamic programming

Text Books:


References:


COURSE OUTCOMES:

Upon completing the course, the student will be able to

1. Increase the analytical skill of identifying and solving engineering problems.
2. Optimizing the resources and input-output process.
3. Devising new techniques for the better understanding of real life situation.
Course: 
Objectives: Apply modern control techniques to electrical systems.

Prerequisites: Basic control systems, Linear algebra

Review of state space analysis - state variable systems - controllability and observability - State variable feedback and its effect on controllability and observability-elements of observer theory.


Pole placement technique by state feedback for linear SISO time invariant system–Design of state observers and servo system.

Optimal control, adaptive control, robust control and intelligent control methods-Introduction to distributed control systems.

Text Books:

Reference books:

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Understand the concepts of modern control theory using state- space approach.
2. Compare and analyse the classical control system with modern control system.
3. Develop advanced controllers to the existing system using modern control design techniques.
Course: To learn the digital control design techniques.

Objectives:

Prerequisites: Classical Control Systems, Modern Control systems


ADC model- DAC model- Transfer function of zero order hold- DAC, Analog Subsystem, and ADC Combination Transfer Function-Closed loop transfer function- Steady state error and its constants (MATLAB commands).

Definitions of stability (Asymptotic stability, exponential stability etc)-stable z-domain pole placement locations- stability conditions-Stability determination (roth array)-Nyquist criterion.

Root locus- root locus design (p-control, PI-control, pd)- Z-domain root locus- z-domain root locus design-digital implementation of analog controller design (differencing methods forward and backward)- bilinear transformation-direct z-domain controller design-frequency response design-Finite time response settling time.

Concept of state space method-state space representations of discrete time systems- solving discrete time state space equations- Pulse transfer function matrix- Discretization of continuous state space equations- Liapunov stability analysis( discrete time) Controllability-observability-design Via pole placement-state observers.

Text Books:

Reference books:

COURSE OUTCOMES:
Upon completion of this course, the students can
1. Understand the fundamental differences between continuous time control and digital control.
2. Analyse the advantages of digital control over the continuous time control.
3. Develop digital controllers explicitly compared to continuous time controller.
EE092 NON-LINEAR CONTROL SYSTEMS

Course Objectives: The aim of this course is to introduce the concept of non-linear controller design to the undergraduate student.

Prerequisites: Linear Electrical Control systems

Open and closed sets, compact set, dense set, Continuity of functions, Lipschitz condition, smooth functions, Vector space, norm of a vector, normed linear space, inner product space.

Mathematical modeling of simple mechanical and electrical systems, concept of equilibrium points, isolated equilibrium points and limit cycles.


Feedback linearization- dynamic feedback linearization, flatness and back stepping controllers design

Sliding mode controller design, Lyapunov redesign and energy based controller design

Text Books:

Reference Books:

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

1. Understand the concept of non-linear control system
2. Analyze the stability of non-linear system
3. Design non-linear controller for electrical system