Course No.	Course Name	L-T-P-Credits	Year of Introduction
EE 302	ELECTROMAGNETICS	2-1-0-3	2015

Course Objectives

Objective of the course is to develop a conceptual basis of electrostatics, magnetostatics, electromagnetic waves and to equip students with a thorough understanding of their various engineering applications

Syllabus: Introduction to vector calculus, Electrostatics, Electrical potential, energy density and their applications. Magneto statics, magnetic flux density, scalar and vector potential and its applications, Time varying electric and magnetic fields, Electromagnetic waves.

Expected outcome.

After the successful completion of these course student will be able to:

- Analyze fields and potentials due to static charges
- Explain the physical meaning of the differential equations for electrostatic and magnetic fields
- Understand how materials are affected by electric and magnetic fields
- Understand the relation between the fields under time varying situations
- Understand principles of propagation of uniform plane waves.
- Awareness of electromagnetic interference and compatibility

Text Book:

1. Sadiku M. N. O, *Elements of Electromagnetics*, Oxford university Press, 2010
2. Nannapeni Narayana Rao, "Elements of Engineering Electromagnetics", Prentice Hall India.

Data Book (Approved for use in the examination): Nil

References:

1) Hayt W. H. and J. A. Buck , Engineering Electromagnetics, 8/e, McGraw-Hill, 2012.
2) Inan U. S. and A. S. Inan, Engineering Electromagnetics, Pearson Education, 2010.
3) Murthy T. V. S. A, Electromagnetic field, S. Chand Ltd, 2008.
4) Gangadhar K. A. and P. M. Ramanathan , Electromagnetic field theory , Khanna Publishers, 2009.
5) Edminister J. A., Electromagnetics, Schaum Outline Series , Tata McGraw-Hill, 2006.
6) Premlet B., Electromagnetic theory with applications, Phasor Books, 2000.
7) S.C.Mahapatra and Sudipta Mahapatra ,Principles of Electromagnetics,McGraw-Hill, 2015
8) Cheng D. K., Field and Wave Electromagnetic, Pearson Education, 2013.
9) John Krauss and Daniel A. Fleisch, Electromagnetics with Applications, McGraw-Hill, 5th edition

Course Plan

Module	Contents	Hours	Sem.Exam Marks
I	**STATIC ELECTRIC FIELDS:** Introduction to Co-ordinate System – Rectangular – Cylindrical and Spherical Co- ordinate System – Gradient of a Scalar field, Divergence of a Vector field and Curl of a Vector field- Their Physical interpretation. Divergence Theorem, Stokes' Theorem. Numerical problems	6 hrs	15%
II	Coulomb's Law, Electric field intensity. Field due to a line charge, Sheet Charge and Continuous Volume Charge distribution. Electric Flux and Flux Density; Gauss's law and its application. Electric Potential-The Potential Gradient. The Electric dipole. The Equipotential surfaces. Capacitance - capacitance of co-axial cable, two wire line. Poisson's and Laplace's equations	8 hrs	15%
FIRST INTERNAL EXAMINATION			

III	STATIC MAGNETIC FIELD: Biot-Savart Law,Amperes Force Law.– Magnetic Field intensity due to a finite and infinite wire carrying a current– Magnetic field intensity on the axis of a circular and rectangular loop carrying a current –Magnetic vector potential,Magnetic flux Density and Ampere's circuital law and simple applications.	6 hrs	15%
IV	ELECTRIC AND MAGNETIC FIELDS IN MATERIALS–Electric Polarization-Nature of dielectric materials-Electrostatic energy and energy density–Boundary conditions for electric fields and magnetic fields– Conduction current and displacement current densities–continuity equation for current. Maxwell's Equation in Differential and integral form from Modified form of Ampere's circuital law,Faraday's Law and Gauss Law.	8 hrs	15%
SECOND INTERNAL EXAMINATION			
V	TIME VARYING ELECTRIC AND MAGNETIC FIELDS:. Poynting Vector and Poynting Theorem – Power flow in a co-axial cable – Complex Average Poynting Vector. ELECTROMAGNETIC WAVES: Wave Equation from Maxwell's Equation – Uniform Plane Waves –Wave equation in Phasor form	7 hrs	20%
VI	Plane waves propagation in loss less and lossy dielectric medium and conducting medium. Plane wave in good conductor, surface resistance, Skin depth, Intrinsic Impedance and Propagation Constant in all medium. Phase and group velocity. Transmission lines: waves in transmission line –solution for loss less lines – characteristic impedance – VSWR – impedance matching. Introduction to Electromagnetic interference and compatibility.	7 hrs	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY :20

MARKS FOR TESTS :30

- **EXTERNAL EVALUATION:**

Maximum Marks: 100 Exam Duration: 3 Hrs

QUESTION PAPER PATTERN:

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x 5) = 40

Part B: 8 questions

3 questions from each 2 module set; at least one question from each module.
Student has to answer any 2 from 3 questions: (2 x 10) x 3 = 60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE304	**Advanced Control Theory**	**3-1-0-4**	**2015**

Course Objectives: To provide a strong concept on the compensator design and on advanced control system analysis and design techniques. Also this course help the students to analyse the behaviour of discrete time systems and nonlinear control systems.

Syllabus: Compensator design-Frequency domain approach-root locus method-Tuning of P, PI and PID controller-State space analysis of systems-state feedback controller design-sampled data control systems-Nonlinear systems-describing function-phase plane-Lyapunov method.

Expected outcome.

On successful completion, students will have the

1. Ability to design compensators using classical techniques.
2. Ability to analyse both linear and nonlinear system using state space methods.
3. Ability to analyse the stability of discrete system and nonlinear system.

Text Book:

1) Ogata K., Modern Control Engineering, Prentice Hall of India, New Delhi, 2010.
2) Nise N. S., Control Systems Engineering, 6/e, Wiley Eastern, 2010.
3) Kuo B.C, Analysis and Synthesis of Sampled Data Systems, Prentice Hall Publications.
4) Nagarath I. J. and Gopal M., Control System Engineering, Wiley Eastern, 2008.
5) Hassan K Khalil, Nonlinear Systems, Prentice - Hall International (UK), 2002.

Data Book (Approved for use in the examination):

References:

1) Jean-Jacques E. Slotine & Weiping Li, Applied Nonlinear Control, Prentice-Hall., NJ, 1991.
2) Gibson J. E., F.B. Tuteur and J. R. Ragazzini, Control System Components, Tata McGraw Hill, 2013
3) Gopal M., Control Systems Principles and Design, Tata McGraw Hill, 2008.
4) Alberto Isidori, Nonlinear Control Systems, Springer Verlag, 1995.

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Types of controller- Feedforward-feedback-cascade-P, PI and PID. Compensator design: Realization of compensators – lag, lead and lag-lead -Design of compensator using bode plot.	7 hrs	15%
II	Compensator design: Realization of compensators – lag, lead and lag-lead. Design of compensator using rootlocus. Design of P, PI and PID controller using Ziegler-Nichols tuning method.	7 hrs	15%
FIRST INTERNAL EXAMINATION			
III	State space analysis of systems: Introduction to state concept - state equation of linear continuous time systems, matrix representation of state equations. Phase variable and canonical forms of state representation-controllable, observable, diagonal and Jordan canonical forms- solution of time invariant autonomous systems, forced system-state transition matrix- relationship between state equations and transfer function. Properties of state transition matrix-Computation of state transition matrix using Laplace	7 hrs	15%

	transform-Cayley-Hamilton method.Conversion from canonical form to phase variable form.		
IV	State feedback controller design: Controllability & observability. State feed-back design via pole placement technique. Sampled data control system: Pulse Transfer function-Stability of sampled data system -Routh Hurwitz criterion and Jury's test. Introduction to state-space representation of sampled data systems.	7 hrs	15%
SECOND INTERNAL EXAMINATION			
V	Nonlinear systems: Introduction - characteristics of nonlinear systems. Types of nonlinearities. Analysis through harmonic linearisation - Determination of describing function of nonlinearities (relay, dead zone and saturation only) - application of describing function for stability analysis of autonomous system with single nonlinearity.	7 hrs	20%
VI	Phase Plane Analysis: Concepts- Construction of phase trajectories for nonlinear systems and linear systems with static nonlinearities - Singular points – Classification of singular points. Definition of stability- asymptotic stability and instability Liapunov methods to stability of linear and nonlinear, continuous time systems.	7 hrs	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P	Credits	Year of Introduction
EE 306	**POWER SYSTEM ANALYSIS**	**3-0-0-3**	**3**	**2015**

Course Objectives

1. To enable the students to analyse power systems under normal and abnormal conditions.
2. To understand how load can be economically dispatched in a power system.
3. To understand the need for load flow analysis and different methods.
4. To understand how power system modeling can be done.
5. To understand the need for stability studies and their analysis.

Syllabus

Per unit quantities - modeling of power system components - methods of analyzing faults in symmetrical and unsymmetrical case - load flow studies - Automatic Generation Control - Automatic voltage control – Economic load dispatch - Unit commitment - Power system stability - Solution of swing equation - Methods of improving stability limits.

Expected Outcome

Upon successful completion of this course, students will be able to:

1. Analyse power systems under normal and abnormal conditions.
2. Carry out load flow studies under normal and abnormal conditions

References

1. Stevenson W. D., *Elements of Power System Analysis*, 4/e, McGraw Hill, 1982.
2. Wadhwa C. L., *Electrical Power Systems*, 33/e, New Age International, 2004.
3. Weedy B. M., B. J. Cory, N. Jenkins, J. B. Ekanayake and G. Strbac, *Electric Power System*, John Wiley & Sons, 2012.
4. Kothari D. P. and I. J. Nagrath, *Modern Power System Analysis*, 2/e, TMH, 2009.
5. Gupta B. R., *Power System Analysis and Design*, S. Chand, New Delhi, 2006.
6. Uppal S. L. and S. Rao, *Electrical Power Systems*, Khanna Publishers, 2009.
7. Cotton H. and H. Barber, Transmission & Distribution of Electrical Energy, 3/e, Hodder and Stoughton, 1978.
8. Soni, M.L., P. V. Gupta and U. S. Bhatnagar, *A Course in Electrical Power*, Dhanpat Rai & Sons, New Delhi, 1984.
9. Gupta J.B., Transmission *& Distribution of Electrical Power*, S.K. Kataria & Sons, 2009.
10. Hadi Saadat, *Power System Analysis*, 2/e, McGraw Hill, 2002.
11. Kundur P., *Power system Stability and Control*, McGraw Hill, 1994.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Per unit quantities-single phase and three phase-selection of base quantities -advantages of per unit system –changing the base of per unit quantities-Simple problems.	2	15
	Modelling of power system components - single line diagram – per unit quantities. Symmetrical components- sequence impedances and sequence networks of generators, transformers and transmission lines.	3	
II	Methods of analyzing faults in symmetrical and unsymmetrical case- effects of faults - Power system faults - symmetrical faults - short circuit MVA - current limiting reactors-Unsymmetrical faults - single line to ground, line to line, double line to ground faults -consideration of prefault current- problems.	8	15
FIRST INTERNAL EXAM			
III	Load flow studies – Introduction-types-network model formulation - formation of bus impedance and admittance matrix, Gauss-Siedel (two iterations), Newton-Raphson (Qualitative analysis only) and Fast Decoupled method (two iterations) - principle of DC load flow.	8	15
IV	Automatic Generation Control: Load frequency control: single area and two area systems - Automatic voltage control.	6	15
SECOND INTERNAL EXAM			
V	Economic Operation - Distribution of load between units within a plant - transmission loss as a function of plant generation - distribution of load between plants - Method of computing penalty factors and loss coefficients.	5	20
	Unit commitment: Introduction — Constraints on unit commitments: Spinning reserve, Thermal unit constraints-Hydro constraints. -	2	
VI	Power system stability - steady state, dynamic and transient stability-power angle curve-steady state stability limit	3	20
	Mechanics of angular motion-Swing equation – Solution of swing equation - Point by Point method - RK method - Equal area criterion application - Methods of improving stability limits.	5	
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P-Credits	Year of Introduction
EE 308	Electric Drives	3-0-0-3	2015

Course Objectives

- To provide fundamental knowledge in dynamics and control of Electric Drives.
- To justify the selection of Drives for various applications.
- To familiarize the various semiconductor controlled drives employing various motors.

Syllabus : Fundamentals of dynamics and control of electric drives– separately excited dc motor drives using controlled rectifiers — chopper controlled dc drives – ac voltage controllers – three phase induction motor speed control – VSI and CSI fed induction motor drives – synchronous motor drives

Expected outcome.

The students will be able to select a drive for a particular application. They will familiarize with the various control techniques employed for controlling drives with ac and dc motors.

Text book

1. Dubey G. K. "Power semiconductor control drives" Printice Hall, Englewood Cliffs, New Jersy, 1989
2. Bimal K. Bose "Modern power electronics and AC drives" Pearson Education Asia 2003

References:

1. N. K. De, P. K. Sen "Electric drives" Prentice Hall of India 2002
2. J. M. D. Murphy "Thyristor control of AC drives"
3. Dr. P. S. Bimbra "Power electronics", Khanna publishers
4. Ned Mohan, Tore m Undeland, William P Robbins, "Power electronics converters applications and design", John Wiley and Sons.
5. Vedam Subrahmanyam, "Electric Drives", MC Graw Hill Education, New Delhi
6. Pillai S. K. "A first course on electric drives", Wieley Eastern Ltd, New Delhi
7. Dewan S.B. , G. R. Slemon, A. Strauvhen, "Power semiconductor drives", John Wiley and sons
8. W. Shepherd, L. N. Hulley and D. T. Liang, "Power Electronocs and motor control", Second Edition, Cambridge University Press, 1995.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to electric drives – Block diagram – advantages of electric drives – Dynamics of motor load system, fundamental equations, and types of load – classification of load torque, four quadrant operation of drives. Steady state stability. Introduction to closed loop control of drives.	7 hrs	15%
II	DC motor drives- constant torque and constant power operation, separately excited dc motor drives using controlled rectifiers, single phase semi converter and single phase fully controlled converter drives. Three phase semi converter and fully controlled converter drives. Dual converters, applications of dual converter for speed control of DC motor. Closed loop control of separately excited dc motor drive. DC series motor drive for traction application.	7 hrs	15%
FIRST INTERNAL EXAMINATION			

III	Chopper controlled DC drives. Analysis of single quadrant chopper drives. Regenerative braking control. Two quadrant chopper drives. Four quadrant chopper drives. Cycloconverters for drive applications – different types – basic principle.	7 hrs	15%
IV	Three phase induction motor speed control. Using semiconductor devices. Stator voltage control – stator frequency control - Stator voltage and frequency control (v/f). Rotor chopper speed control - slip power recovery control schemes – sub synchronous and super synchronous speed variations.	7 hrs	15%
SECOND INTERNAL EXAMINATION			
V	Voltage source inverter fed induction motor drives, Current source inverter fed induction motor drives. Concept of space vector – Basic transformation in reference frame theory – field orientation principle.	7 hrs	20%
VI	Synchronous motor drives – introduction to v/f control. Permanent Magnet synchronous motor drives – different types – control requirements, converter circuits, modes of operation. Microcontroller based permanent magnet synchronous motor drives (schematic only).	7 hrs	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE 322	**Systems and Control laboratory**	**0-0-3-1**	**2016**

Course Objectives

This course will enable the students to develop mathematical models for electrical systems, analyse the systems and implement compensators for systems based on system performance.

List of Experiments:

1. Predetermination and verification of frequency response characteristics of Lag and Lead networks.
2. Transfer Function of AC and DC servomotors
3. Step and frequency response of R-L-C circuit
4. Study of P,PI and PID controllers. Response analysis of a typical system with different controllers, using process control simulator.
5. Study of performance characteristics and response analysis of a typical temperature/ Flow/ Level control system.
6. MATLAB: Use of control system Tool box for the Time domain and frequency domain methods of system analysis and design
7. SIMULINK: Simulation and control of real time systems using SIMULINK
8. Compensator design using Bode plot with MATLAB control system Tool box
9. Simple experiments using Programmable Logic Controller- Realization of AND, OR logic, concept of latching, experiments with timers and counters- using ladder diagrams
10. Study of various types of synchros (TX, TR & TDX). Characteristics of transmitter, data transmission using TX-T R pair. Effect of TDX in data transmission.
11. Realization of Lag & lead compensator using active components

Final evaluation will be based on design of a controller for the given system

Course Outcome:

After successful completion of this course, students will be able to:

1. Develop mathematical models for servomotors and other electrical systems
2. Performance analysis of different process control systems
3. Performance analysis of different types of controllers
4. Use MATLAB and SIMULINK to design and analyze simple systems and compensators

Course No.	Course Name	L-T-P - Credits	Year of Introduction
EE 324	Power Electronics and Drives Lab	0-0-3-1	2015

Course Objectives

- Impart practical knowledge for the design and setup of different power electronic converters and its application for motor control
- Simulate the various power electronics converters, AC drives and DC drives.

List of Exercises/Experiments: (List at least 18 experiments out of which 12 experiments are mandatory**)**

HARDWARE EXPERIMENTS:

1. Static characteristics of SCR
   Aim: Determine latching current, holding current and static characteristics of SCR
2. R and RC firing circuits
   Aim: Design and set up R and RC firing circuits and observe waveforms across load resistance and SCR
3. UJT Trigger circuit with Single phase controlled Rectifier
   Aim: Design & Set up UJT Triggering Circuit and observe waveforms across load resistance, SCR, capacitance and pulse transformer output.
4. Line Synchronised Triggering Circuits
   Aim: Design and set-up line synchronized Ramp Trigger and Digital Trigger circuits and observe the waveforms
5. Static characteristics of MOSFET
   Aim: Plot the characteristics of a Power MOSFET
6. AC Voltage Controller using TRIAC
   Aim: Set a 1-phase AC voltage controller & observe waveforms across load resistance, TRIAC and capacitor for different firing angles
7. Single Phase fully Controlled SCR Bridge circuit
   Aim: Set up a 1-phase full converter with RL load & with and without freewheeling diode
8. Single-phase half bridge/full bridge inverter using power MOSFET/IGBT
   Aim: Design and set up a single phase half-bridge/full-bridge inverter and observe the waveforms across load and firing pulses.
9. Single-phase sine PWM inverter with LC filter
   Aim: Design and set up a single phase sine PWM inverter with LC filter using microcontroller
10. Chopper controlled DC motor
    Aim: Control the speed of a DC motor using a step-down chopper
11. Speed control of 3-phase induction motor
    Aim: Control the speed of 3-phase induction motor using V/f control
12. IGBT based three phase PWM Inverter
    Aim: Set up a 3-phase PWM Inverter with RL load and observe the waveforms
13. Closed Loop Control of Single Phase Fully Controlled Rectifier
    Aim: Design and set-up a closed loop control circuit for a 1ph Fully Controlled Rectifier such that it keeps the load voltage constant irrespective of the load variations (use R load)

SIMULATION EXPERIMENTS:

14. Simulation of 1-phase fully-controlled and half-controlled rectifier fed separately excited DC motor

Aim: Simulate 1-phase fully-controlled and half-controlled rectifier fed SEDC motor and observe the speed, torque, armature current, armature voltage, source current waveforms and find the THD in source current and input power factor.

15. Simulation of closed loop speed control of DC motor with different control schemes (PID, hysteresis current control, Fuzzy, ANFIS etc)
16. Simulation of open loop or closed loop speed control of 3-phase induction motor using V/f control and using sine PWM
17. Design and simulation of buck, boost and buck-boost converters
18. Simulation of Dual Converter – 4 quadrant operation – separately excited DC motor
19. Simulation of Regenerative Braking – Bidirectional Power Transfer
20. Simulation of Switched Mode Rectifiers – keeping load voltage constant irrespective of line and load variations – closed loop circuit simulation

Minimum of EIGHT hardware experiments and FOUR simulation experiments from the above list are to be done

Expected outcome.

Students are expected to design, setup and analyse various power electronic converters and apply these converters for the implementation of various motor control applications.

Text Book:

1) Mohan, Undeland, Robbins, *Power Electronics, Converters, Applications & Design*, Wiley-India

2) Muhammad H. Rashid, *Power Electronics Circuits, Devices and Applications*, Pearson Education

3) L. Umanand, *Power Electronics – Essentials & Applications*, Wiley-India

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE 362	Data Structures and Algorithms	3-0-0-3	2015

Course Objectives

To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms

To impart knowledge about algorithm specification

Syllabus

Linear Structures , Tree Structures , Applications of trees , Balanced Search Trees and Indexing ,

Graphs , Shortest-path algorithms , Applications of graphs , Algorithm Design , Algorithm Analysis , Dynamic programming

Expected outcome.

After completing this course satisfactorily, a student will be able to:

Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms

Describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs Demonstrate different methods for traversing trees

Compare alternative implementations of data structures with respect to performance

Compare and contrast the benefits of dynamic and static data structures implementations

Describe the concept of recursion, give examples of its use, describe how it can be implemented using a stack

Text Book:

1. Classic Data Structures: Samanta, PHI

2. Data Structures and program design in C: Robert Kruse, Pearson Education Asia

3. An introduction to Data Structures with applications: Trembley & Sorenson, McGraw Hill

Data Book (Approved for use in the examination):

References:

1. Fundamentals of Data Structures in C++: Horowitz, Sahni & Mehta, Galgottia Pub.

2. Data Structures using C & C++: Langsam, Augenstein & Tanenbaum

3. Fundamental Algorithms: Knuth.

4. Algorithms + Data Structures & Programs: N.Wirth, PHI

5. Data structures in Java: Thomas Standish, Pearson Education Asia

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Linear Structures : Abstract data types(ADT), List ADT, Array based implementation, Linked list implementation, Curser based linked lists, Doubly linked lists, Applications of lists, Stack ADT, Queue ADT, Circular queue implementation, Applications of stacks and queues		15%
II	Tree Structures : Need for nonlinear structures, Tree ADT, Tree traversals, Left child right sibling data structures for general trees, Binary tree ADT, Expression trees, Applications of trees, Binary search tree ADT		15%
FIRST INTERNAL EXAMINATION			
III	Balanced Search Trees and Indexing : AVL trees, Binary heaps, B-trees, Hashing, Separate chaining, Open addressing, Linear probing		15%
IV	Graphs : Definitions, Topological sort, Breadth-first traversal, Shortest-path algorithms, Minimum spanning tree, Prim's and Kruskal's algorithms, Depth-first traversal, Bio connectivity, Euler circuits, Applications of graphs		15%
SECOND INTERNAL EXAMINATION			
V	Algorithm Design: Greedy algorithm, Divide and conquer, Dynamic programming, Backtracking, Branch and bound, Randomized algorithms		20%

VI	Algorithm Analysis : Asymptotic notations, Recurrences, NP complete problems		20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE 364	Switched Mode Power Converters	3-0-0-3	2015

Course Objectives

To study and analyze various types of switched mode dc- dc converters, inverters and resonant converters and its switching techniques.

Syllabus

DC-DC convertors without isolation – switched mode power supply – DC-DC converters with isolation – switched mode DC-AC converter – sine PWM and space vector PWM - resonant converter

Expected outcome.

Students who successfully complete this course have ability to analyze and design switched mode power converters, proper understanding about soft switching and its applications, deep knowledge on pulse width modulated techniques

Text Book:

1. Mohan, Undeland, Robbins, *Power Electronics – Converters Application and Design*, Wiley-India
2. Muhammad H. Rashid, *Power Electronics – Circuits, Devices and Applications*, Pearson Education

Data Book (Approved for use in the examination): Nil

References:

1. Abraham Pressman, *Switching Power supply Design*, McGraw Hill

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Switched Mode DC-to-DC Converter - buck converters – boost Converter – buck-boost converter - Continuous Conduction mode – design of filter inductance & capacitance - boundary between continuous and discontinuous conduction – critical values of inductance/load resistance - discontinuous conduction mode with constant output voltage - Output voltage ripple	7 hrs	15%
II	Cuk converter – Full-ridge dc-dc Converter – PWM with bipolar voltage and unipolar voltage switching – comparison of dc-dc converters - Linear Power Supply – disadvantages of linear power supply – switched mode power supply – dc-dc converters with electrical isolation – unidirectional core excitation & bidirectional core excitation	7 hrs	15%
FIRST INTERNAL EXAMINATION			
III	Fly back converter – continuous & discontinuous conduction mode - double ended fly back converter – forward converters – basic forward converter – practical forward converter – continuous conduction mode only - double ended forward converter – push pull converter – half bridge converter – full bridge converter – continuous conduction mode – current source dc-dc converter	7 hrs	15%
IV	Switched Mode DC to AC converter – 1-phase square wave full-bridge inverter – square wave switching scheme - sine	8 hrs	15%

	PWM switching scheme – PWM with bipolar & unipolar voltage switching - harmonic analysis of output voltage – output control by voltage cancellation - 3-phase voltage source inverter – 3-phase sine PWM inverter – RMS line to line voltage & RMS fundamental line-to-line voltage – square wave operation - Switching utilisation ratio of 1-phase & 3-phase full-bridge inverters		
SECOND INTERNAL EXAMINATION			
V	Concept of space vector – space vector modulation – reference vector & switching times – space vector sequence – comparison of sine PWM & space vector PWM - programmed (selective) harmonic elimination switching – current controlled voltage source inverter - hysteresis current control	6 hrs	20%
VI	Resonant Converters - Basic resonant circuit concepts – series resonant circuit – parallel resonant circuit – load resonant converter - ZCS resonant converter - L type & M type - ZVS resonant converter – comparison of ZCS & ZVS Resonant Converters	7 hrs	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION: 50**
  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30
- **EXTERNAL EVALUATION:**
  Maximum Marks: 100 Exam Duration: 3 hrs

QUESTION PAPER PATTERN:

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x 5) = 40

Part B: 8 questions

3 questions from each 2 module set; at least one question from each module.
Student has to answer any 2 from 3 questions: (2 x 10) x 3 = 60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE 366	Illumination Engineering	3-0-0-3	2015

Course Objectives

Illumination Engineering provides an introduction to the fundamentals of illuminating engineering and architectural lighting design. Students are introduced to lighting

fundamentals, measurement, and technology and to their application in the analysis

and design of architectural lighting systems

Syllabus

Introduction of Light , Types of illumination , Lighting systems , Lighting Scheme , Measurement of Light , Laws of illumination , Design of Interior Lighting, Determination of Lamp Lumen output taking into account voltage and temperature variations , Indian standard recommendation and standard practices for illumination levels in various areas, Special feature for entrance, staircase, Corridor lighting and industrial building , Design of Outdoor Lighting ,

Special Features of Aesthetic Lighting

Expected outcome.

Upon completion of this course, students will be able to:

Provide an introduction to the fundamentals of illuminating engineering

and architectural lighting design ; Identify the criteria for the selection of lamps and lighting systems for an indoor or outdoor space ; Perform calculations on photometric performance of light sources and luminaires for lighting design; Evaluate different types of lighting designs and applications

Text Book:

1. Applied Illumination Engineering by Jack L. Lindsey
2. Lighting by D.C. Pritchard
3. Lamps and Lighting by M.A. Cayless
4. Introduction to the Design and Analysis of Building Electrical Systems By John Matthews

Data Book (Approved for use in the examination):

References:

1. IS CODE 3646
2. IS CODE 6665

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Introduction of Light : Types of illumination, Day lighting, Supplementary artificial lighting and total lighting, Quality of good lighting, Factors affecting the lighting-shadow, glare, reflection, Colour rendering and stroboscopic effect, Methods of artificial lighting, Lighting systems-direct, indirect, semi direct, semi indirect, Lighting scheme, General and localised		15%
II	Measurement of Light : Definition of luminous flux, Luminous intensity, Lumen, Candle power, Illumination, M.H.C.P, M.S.C.P, M.H.S.C.P, Lamp efficiency, Brightness or luminance, Laws of illumination, Inverse square law and Lambert's Cosine law, Illumination at horizontal and vertical plane from point source, Concept of polar curve, Calculation of luminance and illumination in case of linear source, round source and flat source		15%
FIRST INTERNAL EXAMINATION			
III	Design of Interior Lighting : Definitions of maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilisation and factors affecting it, Illumination required for various work planes, Space to mounting height ratio, Types of fixtures and relative terms used for interior illumination such as DLOR and ULOR, Selection of lamp and luminance, Selection of utilisation factor, reflection factor and maintenance factor Determination of Lamp Lumen output taking into account voltage and temperature variations, Calculation of wattage of each lamp and no of lamps needed, Layout of lamp luminaire, Calculation of space to mounting height ratio, Indian standard recommendation and		15%

	standard practices for illumination levels in various areas, Special feature for entrance, staircase, Corridor lighting and industrial building		
IV	Design of Outdoor Lighting : Street Lighting : Types of street and their level of illumination required, Terms related to street and street lighting, Types of fixtures used and their suitable application, Various arrangements in street lighting, Requirements of good street lighting, Selection of lamp and luminaire, Calculation of their wattage, Number and arrangement, Calculation of space to mounting height ratio, Calculation of illumination level available on road		15%
SECOND INTERNAL EXAMINATION			
V	Design of Outdoor Lighting : Flood Lighting : Terms related to flood lighting, Types of fixtures and their suitable applications, Selection of lamp and projector, Calculation of their wattage and number and their arrangement, Calculation of space to mounting height ratio, Recommended method for aiming of lamp		20%
VI	Special Features of Aesthetic Lighting : Monument and statue lighting, Sports lighting, Hospital lighting, Auditorium lighting		20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE 368	SOFT COMPUTING	3-0-0-3	2015

Course Objectives

To provide the students with the concepts of soft computing techniques such as neural networks, fuzzy systems, genetic algorithms

Syllabus

Introduction To Soft Computing And Neural Networks , Fuzzy Sets And Fuzzy Logic: Fuzzy Sets, Neuro-Fuzzy Modelling , Machine Learning , Machine Learning Approach to Knowledge Acquisition

Expected outcome.

Upon completion of this course, the student should be able to get an idea on :

1. Artificial Intelligence, Various types of production systems, characteristics of production systems.

2. Neural Networks, architecture, functions and various algorithms involved.

3. Fuzzy Logic, Various fuzzy systems and their functions.

4. Genetic algorithms, its applications and advances

5. Learn the unified and exact mathematical basis as well as the general principles of various soft computing techniques.

Text Book:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India,

2. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Edn.,

3.Digital Neural Network -S.Y Kung , Prentice-Hall of India

Data Book (Approved for use in the examination):

References:

1. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall,

2. Amit Konar, "Artificial Intelligence and Soft Computing", First Edition,CRC Press, 2000.

3. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Prentice Hall,

4. Mitchell Melanie, "An Introduction to Genetic Algorithm", Prentice Hall, 1998. 5. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Introduction To Soft Computing And Neural Networks : Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Adaptive Networks – Feed forward Networks – Supervised Learning		15%
II	Neural Networks – Radia Basis Function Networks - Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance architectures. Fuzzy Sets And Fuzzy Logic: Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations - Fuzzy Rules and Fuzzy Reasoning		15%
FIRST INTERNAL EXAMINATION			
III	Fuzzy Inference Systems – Fuzzy Logic – Fuzzy Expert Systems – Fuzzy Decision Making Neuro-Fuzzy Modeling : Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees		15%
IV	Data Clustering Algorithms – Rulebase Structure Identification Neuro-Fuzzy Control.		15%
SECOND INTERNAL EXAMINATION			
V	Machine Learning : Machine Learning Techniques – Machine Learning Using Neural Nets – Genetic Algorithms (GA)		20%
VI	Applications of GA in Machine Learning - Machine Learning Approach to Knowledge Acquisition. Support Vector Machines for Learning – Linear Learning Machines		20%

	– Support Vector Classification – Support Vector Regression - Applications.		
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE 372	**Biomedical Instrumentation**	**3-0-0**	**2015**

Course Objectives

This course gives a brief introduction to human physiology and presents various instrumentations system for measurement and analysis of physiological parameters.

Syllabus:

Development of biomedical instrumentation, Sources of bioelectric potentials, Bio potential electrodes, Electro-conduction system of the heart, Measurement of blood pressure, Measurement of heart sounds, Cardiac pacemakers, defibrillators, Electro encephalogram, Muscle response, Respiratory parameters, Therapeutic Equipments, Imaging Techniques, Instruments for clinical laboratory, Electrical safety, tele- medicine

Expected outcome.

Text Book:

1. L. Cromwell, F. J. Weibell and L. A. Pfeiffer, Biomedical Instrumentation Measurements, Pearson education, Delhi, 1990.

2. J. G. Webster, Medical Instrumentation, Application and Design, John Wiley and Sons

Data Book (Approved for use in the examination):Nil

References:

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata Mc Graw Hill

2. J. J. Carr and J. M. Brown, Introduction to Biomedical Equipment Technology,

Pearson Education

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Development of biomedical instrumentation, biometrics, man instrument systemcomponents block diagram, physiological systems of the body (brief discussion on Heartand cardio vascular system, Anatomy of nervous	7	15%

	system, Physiology of respiratorysystems) problems encountered in biomedical measurements. Sources of bioelectric potentials – resting and action potentials - propagation of actionpotentials – bio electric potentials example (ECG, EEG, EMG, ERG, EOG,EGG etc.)		
II	Bio potential electrodes – theory – microelectrodes – skin surface electrodes – needleelectrodes – biochemical transducers – transducers for biomedical applications. Electro-conduction system of the heart. Electro cardiography – electrodes and leads – Einthoven triangle, ECG read out devices, ECG machine – block diagram.	7	15%
FIRST INTERNAL EXAMINATION			
III	Measurementof blood pressure – direct and indirect measurement – oscillometric measurement –ultrasonic method, measurement of blood flow and cardiac output, plethysmography –photo electric and impedance plethysmographs Measurement of heart sounds –phonocardiography.	7	15%
IV	Cardiac pacemakers – internal and external pacemakers, defibrillators. Electro encephalogram –neuronal communication – EEG measurement. Muscle response– Electromyogram (EMG) – Nerve Conduction velocity measurements-Electromyogram Measurements. Respiratory parameters – Spiro meter, pneumograph	7	15%
SECOND INTERNAL EXAMINATION			
V	Ventilators, heart lung machine, hemodialysis, lithotripsy, infantincubators	8	20%

	X-rays- principles of generation, uses of X-rays- diagnostic still picture, fluoroscopy, angiography, endoscopy, diathermy. Basic principle of computed tomography, magneticresonance imaging system and nuclear medicine system – radiation therapy. Ultrasonicimaging system - introduction and basic principle.		
VI	Instruments for clinical laboratory – test on blood cells – chemical tests - Electrical safety– physiological effects of electric current – shock hazards from electrical equipment – method of accident prevention, introduction to tele-medicine.	6	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60