Curriculum for Undergraduate Degree (B.Tech.) in Electrical Engineering (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Fifth Semester (Third Year)

Course Name:	**Electric Machine-II**		
Course Code:	PC-EE-501	**Category:**	Professional Core Courses
Semester:	5th	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	Basic Electrical Engineering (ES-EE-101) Electric Circuit Theory (PC-EE-301) Electromagnetic field theory (PC-EE-303) Electric Machine-I (PC-EE-401)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the arrangement of windings of AC machines.
2	To understand the principle of production of pulsating and revolving magnetic fields.
3	To understand the principle of operation and characteristics of three phase Induction machines
4	To understand the principle of operation and characteristics of single phase Induction machines
5	To understand the principle of operation and characteristics of synchronous machine
6	To understand the principle of operation and characteristics of special electromechanical devices.
7	To solve problems of Induction machines, synchronous machines and special eletromechanical devices.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Fundamentals of AC machine windings:** Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch& short pitch coils, concentrated winding, distributed winding, winding axis, Air-gap MMF distribution with fixed current through winding-concentrated and distributed, Sinusoidally distributed winding, winding distribution factor	5L

2	**Pulsating and revolving magnetic fields:** Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.	5L
3	**Induction Machines:** Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.	10L
4	**Single-phase induction motors:** Constructional features double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications	6L
5	**Synchronous machines:** Constructional features, methods of excitation, cylindrical and salient pole rotor synchronous machine - generated EMF, Short circuit ratio, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation (EMF, MMF, ZPF). Operating characteristics of synchronous machines, Salient pole machine - two reaction theory, Parallel operation of alternators - synchronization and load division, Synchronous machine connected to infinite bus, effect of change of excitation and speed of prime mover, Starting of synchronous motor, V-curves. Analysis of phasor diagram, power angle characteristics, Damper winding, hunting, short circuit transients.	9L
6	**Special Electromechanical devices:** Principle and construction of switched Reluctance motor, Permanent magnet machines, Brushless DC machines, Hysteresis motor, Stepper motor, Tacho generators.	5L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe the arrangement of winding of AC machines.
2	Explain the principle of operation of Induction machines, Synchronous machines and special machines.
3	Solve numerical problems of Induction machines, Synchronous machines and Special machines.
4	Estimate the parameters and efficiency of Induction machines and Synchronous machines.
5	Determine the characteristics of Induction machines and Synchronous machines.
6.	Select appropriate methods for starting, braking and speed control of Induction machines.

Learning Resources:	
Recommended Text Books	
1	Electrical Machines -II, P.S. Bimbhra, Khanna Book Publishing House.
2	Theory and Performance of Electrical Machines – J. B. Gupta, Katson Publication
3	Electrical Machines, P.K. Mukherjee and S. Chakravorti, Dhanpat Rai Publications.
Alternative Text Books	
4	Electrical Machines, Nagrath & Kothary, TMH
5	Electrical Machines, Theory & Applications, M.N. Bandyopadhyay, PHI
6	Electric Machinery & Transformes, Irving L. Kosow, PHI
Reference Books	
7	Electric Machinery & Transformer, Bhag S. Guru and H.R. Hiziroglu, 3rd Edition, Oxford University press.
8	Electric Machinery, A.E.Fitzgerald, Charles Kingsley,Jr. & Stephen D. Umans, 6th Edition, Tata McGraw Hill Edition.
9	Electrical Machines, R.K. Srivastava, Cengage Learning
10	Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill Edition
11	The performance and Design of Alternating Current Machines, M.G.Say, CBS publishers & distributors
12	Electric Machines, Charles A. Gross, CRC press
13	Problems in Electrical Engineering, Parker smith, 9th Edition, CBS publishers & distributors.

Course Name:	**Power System-I**		
Course Code:	PC-EE502	**Category:**	Professional Core Courses
Semester:	5th	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	Basic Electrical Engineering (ES-EE-101) Electric Circuit Theory (PC-EE-301) Electromagnetic field theory (PC-EE-303)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the basic principle of generation of Electricity from different sources
2	To find parameters and characteristics of overhead transmission lines and cables.
3	To find different parameters for the construction of overhead transmission line
4	To determine the performance of transmission lines
5	To understand the principle tariff calculation
6	To solve numerical problems on the topics studied.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Basic Concepts: Evolution of Power System and present day Scenario. Structure of power system: Bulk power grid and Micro Grid. Generation of Electric Power: General layout of a typical coal fired power station, Hydro electric power station, Nuclear power station, their components and working principles, comparison of different methods of power generation. Introduction to Solar & Wind energy system. Indian Electricity Rule-1956: General Introduction.	10L
2	Overhead transmission line: Choice of frequency, Choice of voltage, Types of conductors, Inductance and Capacitance of a single phase and three phase symmetrical and unsymmetrical configurations. Bundle conductors. Transposition. Concept of GMD and GMR. Influence of earth on conductor capacitance. Overhead line construction: Line supports, Towers, Poles, Sag, Tension and Clearance, Effect of Wind and Ice on Sag. Dampers. Corona: Principle of Corona formation, Critical disruptive voltage, Visual critical corona discharge potential, Corona loss, advantages & disadvantages of Corona. Methods of reduction of Corona.	12L
3	Insulators: Types, Voltage distribution across a suspension insulator string, String efficiency, Arching shield & rings, Methods of improving voltage distribution across Insulator strings, Electrical tests on line Insulators.	5L
4	Cables: Types of cables, cable components, capacitance of single core & 3 core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle.	4L
5	Performance of lines: Short, medium (nominal, T) and long lines and their representation. A.B.C.D parameters, Voltage regulation, Ferranti effect, Power equations and line compensation, Power Circle diagrams.	6L
6	Tariff: Guiding principle of Tariff, different types of tariff	3L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the principle of generation of Electric power from different sources.
2	Determine parameters of transmission lines and its performance.
3	Explain the principle of formation of corona and methods of its reduction
4	Conduct electrical tests on insulators.
5	Solve numerical problems related to overhead transmission line, cable, insulators and tariff
6	Analyze overhead transmission line based on short medium and long lines.

Learning Resources:	
Recommended Text Books	
1	Electrical Power System, Subir Roy, Prentice Hall
2	Power Systems, A. Ambikapathy, Khanna Publishing House
3	Power System Engineering, Nagrath & Kothery, TMH
4	Elements of power system analysis, C.L. Wodhwa, New Age International.
Alternative Text Books	
5	Electrical Power System, Ashfaq Hussain, CBS Publishers & Distributors
6	A Text book on Power system Engineering, Soni, Gupta, Bhatnagar & Chakrabarti, Dhanpat Rai & Co
Reference Books	
7	Electric Power transmission & Distribution, S.Sivanagaraju, S.Satyanarayana,, Pearson Education.
8	Electric Power distribution system Engineering, 2nd Edition, T. Gonen, CRC Press
9	www.powermin.nic.in/acts_notification/pdf/ier1956.pd

Course Name:	**Control System**		
Course Code:	PC-EE503	**Category:**	Professional Core Courses
Semester:	5th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	1. Basic Electrical Engineering 2. Electric Circuit Theory 3. Electric Machine
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To classify open loop and closed loop control system and the effect of feedback system
2	To describe transfer function of linear dynamic system using linear differential equations
3.	To compare time response and frequency response analysis of linear system.
4	To understand stability analysis of different systems.
5	To explain the improvement of system performance using compensator or controller
6	To develop state space model formation of some linear system.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
	Introduction to control system: Objectives of control system, Concept of feedback and Effects of feedback	4L

1	examples of feedback control systems. Types of control systems, Definition of linear time varying, linear time invariant (LTI) and nonlinear systems, Transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function.	
2.	**Mathematical modeling of dynamic systems:** Translational systems, Rotational systems, Electrical analogy of Spring–Mass-Dashpot system. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula. Block diagram level description of feedback control systems for position control, speed control of DC motors	8L
3.	**Time domain analysis:** Time domain analysis of first and standard second order closed loop system as step and impulse input. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Effects of Pole and Zeros on transient response. Stability by pole location. Routh-Hurwitz criteria and applications. Concepts of system types and error constants. Steady state errors analysis in control systems due to step, ramp and parabolic inputs.	8L
4.	**Stability Analysis:** Root locus techniques, construction of Root Loci for simple linear time invariant systems. Effects of gain on the movement of Pole and Zeros. **Frequency domain analysis of linear system:** Bode plots, Polar plots, Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin. Determination of margins in Bode plot.	10L
5.	**Compensator and controller:** Improvement of system performance through compensation. Lead, Lag and Lead- lag compensation, and P, PI, PD and PID control.	5L
6.	**State variable Analysis:** Concepts of state variables. State space model formation of physical system. Solution of state equations. Eigen values, State transition matrix and its properties. Concept of controllability and observability.	5L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Develop mathematical model and compute transfer of linear system
2	Calculate peak time, rise time, settling time , steady state error of linear system in time response analysis.
3	Compute peak response, bandwidth, gain crossover, phase crossover , gain margin and phase margin of linear system in frequency response analysis
4	Explain stability analysis of linear system in time domain approach and frequency domain approach
5	Describe the effect of using controller and compensator to improve the system

	performances with given criterion.
6	Apply the knowledge of state variable techniques for analysis of linear systems.

Learning Resources:	
Recommended Text Books	
1	Modern Control Engineering, K. Ogata, 4th Edition, Pearson Education
2	Control System Engineering, I. J. Nagrath & M. Gopal. New AgeInternational Publication.
Alternative Text Books	
3	Automatic Control Systems, B.C. Kuo & F. Golnaraghi, 8th Edition, PHI
4	Control System Engineering, D. Roy Choudhury, PHI
Reference Books	
5	Control System Engineering, R. Anandanatarajan & R. Ramesh Babu, ,SCITECH
6	Control System Engineering, Norman Nise, 5th Edition, John Wiley & Sons
7	Control Engineering Theory & Practice, Bandyopadhyaya, PH

Course Name:	**Microprocessor and Microcontroller**		
Course Code:	OE-EE 501A	**Category:**	Open Elective Courses
Semester:	5th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Analog Electronics Digital Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the architecture of 8085, 8086 microprocessor.
2	To understand the design aspects of I/O and Memory Interfacing circuits.
3	To interface microprocessors with supporting chips.
4	To understand the architecture of 8051 microcontroller.
5	To design a microcontroller based system

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction to Microprocessor- Architecture and Pin configuration of 8085 Microprocessor, memory interfacing, machine cycle and bus timing, stack and interrupt operation of 8085 Microprocessor. Basic architecture of 8086 Microprocessor	7L

2	Assembly Language Programming- Addressing modes, instruction set, assembly language programming with 8085 Microprocessor, program for multi byte addition/subtraction, multiplication, division, block transfer, counter and time delay operation.	6L
3	Interfacing- Basic principles of interfacing memory and I /O devices, details of interfacing devices 8255 and 8253.	4L
4	Introduction to 8051 Microcontroller- Difference between Microprocessor and Microcontroller, architecture of 8051, Special Function Registers(SFRs), I/O Pins Ports and Circuits, instruction set, addressing modes, assembly language programming.	8L
5	Interfacing Microcontroller- 8051 Timer operation, serial communication, interrupts Programming, ADC, DAC and Keyboard interfacing, Waveform generation, stepper motor interfacing.	8L
6	Introduction to PIC Microcontroller- History and features, Architecture, Memory organization, addressing modes, instruction set and assembler directives, PIC programming, RAM & ROM allocation.	7L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe about the basic architecture and pin configuration of 8085, 8086 microprocessor.
2	Explain about Stack, sub routine and interrupt operation of 8085 microprocessor.
3	Solve different arithmetic and logical operation using Assembly language programming.
4	Explain about Memory and I/O interfacing with microprocessor and Microcontroller.
5	Describe the features of 8051 and PIC Microcontrollers and basic operations.

Learning Resources:	
Recommended Text Books	
1	R.S. Gaonkar, "Microprocessor Architecture, Programming and Applications", Penram International.
2	The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi & J. G. Mazidi, Pearson Education.
3	PIC Microcontroller & Embedded System, Muhammad Ali Mazidi, Danny Causey, Rolin D. McKinlay, Pearson Publication
Alternative Text Books	
4	K.J. Ayala, "8051 Microcontroller", Penram International
5	D.V. Hall, "Advanced Microprocessor", TMH.
Reference Books	
7	Advanced Microprocessors, Y. Rajasree, New Age international Publishers.
8	An introduction to the Intel family of Microprocessors, James L. Antonakos, Pearson Education,
9	The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi & J. G. Mazidi, Pearson Education.

Course Name:	**Digital Signal Processing (DSP)**		
Course Code:	OE-EE 501B	**Category:**	Open Elective Courses
Semester:	5th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Analog Electronics Digital Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand sampling and reconstruction of signal
2	To understand the method of Z-transform and inverse Z- transform of signal and its properties
3	To understand Discrete Fourier Transform
4	To understand methods of design of Digital filters
5	To understand applications of Digital signal processing
6	To solve numerical problems on the topics studied

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction of DSP and its Application in EE:** Definition, representation, impulse response, derivation for the output sequence, Concept of convolution, graphical and analytical methods to compute convolution supported with examples and exercises, properties of convolution, stability and causality conditions.	10L
2	**Z-transform:** Definition, convergence and ROC, properties of z-transform, z-transform on sequences with examples and exercises, Inverse z-transform by partial-fraction expansions with examples and exercises.	6L
3	**Discrete Fourier Transform:** Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT / IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method	5L
4	**Fast Fourier Transform:** Radix-2 algorithm, decimation –in time and decimation-in-frequency algorithms, signal flow graphs, Butterflies, computation in one place, bit reversal, examples and exercises	5L
5	**Filter Design:** Basic concepts behind IIR and FIR filters, Butterworth IIR analog filter, Impulse Invariant and Bilinear transforms, design of IIR digital filter, Design of linear phase FIR filter with rectangular and Hamming window, Kaiser window and Blackman window.	6L

6	**Digital Signal Processor:** Elementary idea about the architecture and important instruction sets of TMS320C 5416/6713	3L
Total		**35L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Represent signals mathematically in continuous and discrete-time and in the frequency domain.
2	Analyze discrete-time systems using z-transform.
3	Explain the Discrete-Fourier Transform (DFT) and the FFT algorithms.
4	Design digital filters for various applications.
5	Apply digital signal processing for the analysis of real-life signals

Learning Resources:	
Recommended Text Books	
1	Digital Signal Processing – Principles, Algorithms and Applications -J.G.Proakis & D.G.Manolakis, Pearson Education/ PHI.
2	Digital Signal Processing – P. Rameshbabu, Scitech Publications (India)
Alternative Text Books	
3	Digital Signal Processing - S. Salivahanan, A. Vallavaraj & C. Gnanapriya, TMH Publishing Co
4	Digital Signal Processing A Hands on Approach – C. Schuler & M. Chugani TMH Publishing Co.
Reference Books	
5	Digital Signal Processing – A Computer Based Approach – S.K.Mitra, TMH Publishing Co,

Course Name:	**Economics for Engineers**		
Course Code:	HM-HU 501	**Category:**	Management Science & Humanities
Semester:	5th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic economic ideas
Full Marks:	100		
Examination Scheme:	**Semester Examination: 70**	**Continuous Assessment: 25**	**Attendance: 5**

Course Objectives:	
1	Understand the role and scope of Engineering Economics and the process of economic decision making along with the different concepts of cost and cost estimation techniques.
2	Familiarization with the concepts of cash flow, time value of money and different interest formulas
3	Appreciation of the role of uncertainty in future events and using different concepts from probability to deal with uncertainty
4	Understand the concepts of Depreciation and Replacement analysis along with their

	methods of calculation and familiarization with the phenomenon of inflation and the use of price indices in engineering Economics
5	Introduction to basic concepts of Accounting and Financial Management

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Economic Decisions Making: Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models – Per Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.	9L
2	Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal& Effective Interest. Cash Flow & Rate of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing an Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity and Breakeven Analysis. Economic Analysis In The Public Sector -Quantifying And Valuing Benefits & drawbacks.	9L
3	Inflation and Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. Uncertainty In Future Events - Estimates and Their Use in Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Riskvs Return, Simulation, Real Options.	9L
4	Depreciation: Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems. Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	9L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Discuss fundamentals of economic analysis.
2	Describe rate of return and profitability analysis, Present, Future, Annuity, Risk and return, BEP and Sensitivity Analysis, Bayesian joint probability and quantitative decision making, basic accounting system and balance sheet and P & L accounts etc.
3	Apply decision making skills in terms of Economic, financial considerations in practice.
4	Apply knowledge to take right financial decision at the right point in time in real world situation.

Learning Resources:	
1	James L.Riggs, David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e, Tata McGraw-Hill
2	Donald Newnan, Ted Eschembach, Jerome Lavelle: Engineering Economics Analysis, OUP
3	R.PaneerSeelvan: Engineering Economics, PHI
4	Sullivan and Wicks: Engineering Economy, Pearson
5	John A. White, Kenneth E. Case, David B. Pratt : Principle of Engineering Economic Analysis, John Wiley

Laboratory

Course Name:	**Electric Machine II Lab**		
Course Code:	PC EE 591	**Category:**	Professional core courses
Semester:	5th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Electrical Machine I Electrical Machine II
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Realization of the arrangement of windings of AC machines.
2	Demonstration of characteristics of three phase Induction machines
3	Demonstration of characteristics of single phase Induction machines
4	Demonstration of characteristics of synchronous machine
5	To understand problem solving of Induction machines and synchronous machines.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Different methods of starting of a 3 phase Cage Induction Motor & their comparison [DOL, Auto transformer &Star-Delta]	3P

2	Study of equivalent circuit of three phase Induction motor by no load and blocked rotor test.	3P
3	Study of performance of wound rotor Induction motor under load.	3P
4	Study of performance of three phase squirrel- cage Induction motor – determination of iron-loss, friction & windage loss	3P
5	Speed control of 3 phase squirrel cage induction motor by different methods & their comparison [voltage control & frequency control].	3P
6	Speed control of 3 phase slip ring Induction motor by rotor resistance control	3P
7	Determination of regulation of Synchronous machine by a. Potier reactance method. b. Synchronous Impedance method.	3P
8	Determination of equivalent circuit parameters of a single phase Induction motor.	3P
9	Load test on single phase Induction motor to obtain the performance characteristics.	3P
10	To determine the direct axis resistance [X_d] & quadrature reactance [X_q] of a 3 phase synchronous machine by slip test.	3P
11	To make connection diagram to full pitch & fractional slot winding of 18 slot squirrel cage Induction motor for6 poles & 4 pole operation	3P
12	Parallel operation of 3 phase Synchronous generators	3P
13	V-curve of Synchronous motor	3P
Total		**39P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify appropriate equipment and instruments for the experiment.
2	Test the instrument for application to the experiment.
3	Construct circuits with appropriate instruments and safety precautions.
4	Validate different characteristics of single phase Induction motor, three phase Induction motor, Induction generator and synchronous motor , methods of speed control of Induction motors and parallel operation of the 3 phase Synchronous generator.
5	Work effectively in a team

Course Name:	**Power System-I Lab**		
Course Code:	PC-EE 592	**Category:**	Professional Core Courses
Semester:	5th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Electrical Engineering (ES-EE-101) Electric Circuit Theory (PC-EE-301) Electromagnetic field theory (PC-EE-303)

Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To understand the basic principle of generation of Electricity from different sources
2	To find parameters and characteristics of overhead transmission lines and cables.
3	To find different parameters for the construction of overhead transmission line
4	To determine the performance of transmission lines

Course Contents:

Exp. No.	Description of Experiment	Contact Hrs.
1.	Determination of the generalized parameters A.B, C, D of long transmission line and regulation of a 3-Φ transmission line model.	3P
2.	Study of distribution system by DC network analysis.	3P
3.	Measurement of earth resistance by earth tester.	3P
4.	Determination of dielectric strength of insulating oil.	3P
5.	Determination of breakdown strength of solid insulating material.	3P
6.	Determination of parameter of 3-Φ transmission line model by power circle diagram.	3P
7.	Study of different types of insulator	3P
8.	Study of active and reactive power control of alternator	3P
9.	Study and analysis of an electrical transmission line circuit with the help of software.	3P
10.	Determination of dielectric constant, tan delta, resistivity of transformer oil.	3P
Total		**30P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify appropriate equipment and instruments for the experiment.
2	Test the instrument for application to the experiment.
3	Construct circuits with appropriate instruments and safety precautions.
4	Validate different characteristics of transmission line.
5	Determine earth resistance, dielectric strength of insulating oil, breakdown strength of solid insulating material and dielectric constant of transformer oil.
6	Analyze an electrical transmission line circuit with the help of software.
7	Work effectively in a team

Course Name:	**Control System Lab**		
Course Code:	PC-EE593	**Category:**	Practical Courses
Semester:	5th	**Credit:**	1

L-T-P:	0-0-2	**Pre-Requisites:**	1. Control system
Full Marks:	100		
Examination Scheme:	Semester Examination : 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To familiarize with the control system toolbox and Simulink in MATLAB.
2	To acquire knowledge of time response analysis of RLC circuit using Pspice.
3	To study and analyze the state variable modeling of given system in MATLAB.

Course Contents:

Expt. No.	Description of Experiments	Contact Hrs.
1	Familiarization with control system tool box, Simulink tool box in MATLAB	3P
2	Determination of time response analysis of first order system, Second order system with unity feedback Using MATLAB/Octave programming.	3P
3	Simulation of Step response & Impulse response for Type-0, Type-1 & Type-2 system using MATLAB/Octave programming.	3P
4	Design of Root locus plot, Bode plot, Nyquist plot for given system using MATLAB & determination of stability from the plot.	3P
5	Performance analysis of PI, PD and PID controller action of a given system using MATLAB Simulink / Scilab.	3P
6	Performance analysis of lead, lag and lead-lag compensator of given system using MATLAB Simulink/ Scilab.	3P
7	Analysis of performance of a physical system using State variable technique by simulation and testing of controllability and observability of the given system using MATLAB.	3P
8	Determination of time response analysis of RL, RC and RLC Using PSPICE	3P
9.	Step and impulse response analysis of Type-0, Type-1 & Type-2 system using PSPICE	3P
Total		**27P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Use control system tool box, Simulink tool box in MATLAB for simulation of systems.
2	validate step response & impulse response analysis for Type-0, Type-1 & Type-2 system Using MATLAB & PSPICE.
3	Design lead, lag and lead-lag compensator for given system using MATLAB Simulink
4	Design PI, PD and PID controller for given system using MATLAB Simulink
5	Analyze state space model of given system using MATLAB

Course Name:	**Microprocessor and Microcontroller Lab**		
Course Code:	OE-EE 591A	**Category:**	Open Elective Courses
Semester:	5th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Analog Electronics Digital Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To be familiar with 8085 microprocessor and 8051microcontroller kit.
2	To write and execute different assembly language program with 8085 microprocessor kit.
3	To interface microprocessors with difference supporting devices.
4	To write and execute different arithmetic and logical program with 8051 microcontroller.
5	To design different microcontroller based system.

Course Contents:

Exp. No	**Description of Experiment**	**Contact Hrs.**
1	Familiarization of 8085 Microprocessor Kit and execute prewritten program on data transfer and arithmetic instructions.	3P
2	Programming with 8085 Kit/ Simulator for: a) Copying a block of memory b) shifting a block of memory c) series addition d) Multiplication and division e) Packing and Unpacking of BCD numbers f) BCD addition g) PUSH and POP operation	3P
3	Program for arranging in ascending/ descending order of a set of numbers using 8085 Microprocessor.	3P
4	Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly.	3P
5	Interfacing of 8085 Microprocessor with ADC, Keyboard and Multi digit display with multiplexing using 8255.	3P
6	Familiarization of 8051 Microcontroller Kit and execute different prewritten program on data transfer and arithmetic instructions	3P
7	Programming with 8051 Kit/ Simulator for: a) addition of 1st 10 natural number b) 16 bit addition c) Look up table d) XOR operation without XRL e) 2's complement of a number f) Factorial of a number	3P
8	Design Microprocessor/ Microcontroller based Traffic light control operation circuit.	3P
9	Generate a square wave of given frequency and 50% duty cycle using 8051 Microcontroller Kit.	3P

10	Program and verify interrupt handling in 8051 Microcontroller.	3P
11	Interfacing of stepper motor and run clock wise and anti clockwise direction using 8051 Microcontroller.	3P
Total		**33P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain 8085 register level architecture and components of trainer kit.
2	Solve numerical problems by programming in 8085 trainer kit or simulator.
3	Use 8255 PPI on the trainer kit for IN/ OUT operation.
4	Interface ADC, Keyboard and Multi digit display with 8085 trainer kit.
5	Solve arithmetic and logical problems using 8051 microcontroller trainer kit.
6	Demonstrate the interfacing of stepper motor with 8051 microcontroller.

Course Name:	**Digital Signal Processing (DSP) Lab**		
Course Code:	OE-EE591B	**Category:**	**Open Elective-I Lab**
Semester:	5th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Analog Electronics Digital Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To generate the elementary signals/ waveforms.
2	To Calculate and Plot DFT of given DT signal and prove it theoretical
3	To Implement DFT using FFT algorithm of a given sequence.
4	To Plot Magnitude and Phase response of FIR and IIR filter for any given sequence.

Course Contents:

Exp. No	Description of Experiment	Contact Hrs.
1	Simulation of sampled Sinusoidal signal, various sequences and different arithmetic operations.	3P
2	Simulation of convolution of two sequences using graphical methods and using commands-verification of the properties of convolution.	3P
3	Simulation of z-transform of various sequences - verification of the properties of z- transform.	3P
4	Simulation of Twiddle factors – verification of the properties	3P
5	Simulation of DFTs/IDFTs using matrix multiplication and also using commands	3P

6	Simulation of circular convolution of two sequences using graphical methods and using commands differentiation between linear and circular convolutions.	3P
7	Simulation of DIT & DIF Radix-2 FFT algorithms	3P
8	Simulation of Butterworth Filter design with different set of design parameters,	3P
9	Simulation of FIR Filters using Rectangular and Hamming, windows and comparisons of these designs	3P
Total		**27P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand elementary signals/ waveforms and perform arithmetic operations on signals.
2	Analyze frequency response of a given system and verify the properties using simulation.
3	Implement FFT of given sequence and identify the reduction of computations using FFT.
4	Design and Implement FIR and IIR filter for a given sequence

Course Name:	**Aptitude Skill Development-I**		
Course Code:	MC571	**Category:**	Mandatory Courses
Semester:	5th	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	Basic knowledge of Mathematics and English Language
Full Marks:	100		
Examination Scheme:	Semester Examination: NA	Continuous Assessment: 100	Attendance: NA

Course Objectives:	
1	To be familiar with the basic concepts of QUANTITATIVE ABILITY.
2	To be familiar with the basic concepts of LOGICAL REASONING Skills.
3	To be familiar with the basic concepts of PROBABILITY.
4	Acquire knowledge in VERBAL REASONING and VOCABULARY

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Basics of Quantitative Abilities: Number System, HCF and LCM, Average, Ratio, Proportion and Variations, Problems on Percentage.	4L
2	Arithmetic Quantitative Abilities: Problems on Ages, Profit and Loss, Time and Work, Problems on Simple and Compound Interest, Problems on Time, Speed and Distance.	6L
3	Permutation and Combination, Set theory, Venn Diagram, Probability	5L
4	Logical Reasoning: Number Series, Alpha Numerical, Letter & Symbol Series, Syllogisms	7L

	Numerical and Alphabet Puzzles, Seating Arrangement, Blood Relation and Calendars.	
5	Data Interpretation	2L
6	Verbal: Analogies, Antonym, Synonym, Sentence Correction, Fill in the Blanks	3L
Total		27L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the basic concepts of QUANTITATIVE ABILITY.
2	Understand the basic concepts of LOGICAL REASONING Skills.
3	Understand the basic concepts of PROBABILITY.
4	Acquire satisfactory competency in use of VERBAL REASONING

Learning Resources:	
1	Arun Sharma, "Quantitative abilities", McGraw-Hill
2	R.S.Agrawal, "Quantitative Aptitude for Competitive Examinations", S. Chand
3	R.S.Agarwal,"A Modern Approach to Verbal & Non-Verbal Reasoning ",S. Chand

Course Name:	**Technical Seminar**		
Course Code:	PW-EE581	**Category:**	Mandatory Courses
Semester:	5th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic knowledge Electrical Engineering
Full Marks:	100		
Examination Scheme:	Semester Examination: NA	Continuous Assessment: 100	Attendance: NA

Course Objectives:	
1	To know the process of preparing technical presentation.
2	Get knowledge of advanced engineering techniques
3	Communicate with the audience during the technical presentation.

Guide Line:		
Module No.	**Description of Topic**	**Contact Hrs.**
	The objective of Technical Seminar is to familiar the students with advanced technical topics and acquires knowledge about the broad field of Electrical Engineering. Students are preparing technical presentation for deliver the contain individually. The guidelines preparing the presentation: 1. Prepare presentation based on any topic related to Electrical Engineering. 2. After completion of the presentation, prepare a written report on the presentation topic.	

Course Outcomes:	
After completion of the course, students will be able to:	
1	Prepare presentation on the any advance topic of Electrical Engineering.
2	Describe use of advanced tools and techniques encountered during the presentation.
3	Interact with audience during the presentation.
4	Prepare professional work reports and presentations.