Fourth Semester(Electrical Engineering)					
Theory					
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	PCC	19EE4PC01T	PCC-3: Electrical Machines-II	3-0-0	3
2	PCC	19EE4PC02T	PCC-4: Electrical Measurement and Instrumentation	3-0-0	3
3	PCC	19EE4PC03T	PCC-5: Electrical Power Transmission and Distribution	3-0-0	3
4	HSMC	19CM4HS01T/ 19CM4HS02T	Organizational Behavior/ Engineering Economics and Costing	3-0-0	3
5	ESC	19EE4ES01T/ 19EE4ES02T	Analog Electronics Circuit/ Digital Electronics Circuit	3-0-0	3
6	PEC	19EE4PE01T/ 19EE4PE02T/ 19EE4PE03T/ 19EE4PE04T	Modeling and Simulation of Dynamical Systems in Electrical Engineering / Electromagnetic Theory / Power Generation Systems/Signals and Systems	3-0-0	3
Total Credit (Theory)					**18**
Practical					
1	PCC	19EE4PC01L	Electrical Machine-II Lab	0-0-2	1
2	PCC	19EE4PC02L	Electrical Measurement and Instrumentation Lab	0-0-2	1
3	PCC	19EE4PC03L	Electrical Power Transmission and Distribution Lab	0-0-2	1
4	ESC	19EE4ES01L/ 19EE4ES02L	Analog Electronics Circuit Lab/ Digital Electronics Circuit Lab	0-0-2	1
Total Credit (Practical)					**4**
Total Semester Credit					**22**

Course Code:	Course Name:	L-T-P	Credit
19EE4PC01T	Electrical Machine-II	3- 0- 0	3

COURSE OBJECTIVES:

1. To understand the operation, characteristics of cylindrical rotor synchronous generator.
2. To understand the basic principle of operation, construction and performance characteristics of salient pole synchronous generator.
3. To analyze the performance characteristics of three-phase synchronous motor.
4. To understand the basic principle of operation, construction and performance characteristics of three phase induction motor.

SYLLABUS

Module-1: Cylindrical Rotor Synchronous Generator (10 Hours)

Three Phase Synchronous Generators: Synchronous Generator Construction (both Cylindrical Rotor and Salient Pole type), the Speed of Rotation of a Synchronous Generator, Induced voltage in A.C Machines, The Internal Generated Voltage of a Synchronous Generator, The Equivalent Circuit of a Synchronous Generator (Armature Reaction Reactance, Synchronous Reactance and Impedance). Cylindrical Rotor type Three Phase Synchronous Generators: The Phasor Diagram of a Synchronous Generator, Power and Torque in Synchronous Generators (Power Angle Equation and Power Angle Characteristic), Measuring Synchronous Generator Model Parameters (Open Circuit and Short Circuit Tests and Determination of Synchronous Impedance and Reactance, The Short Circuit Ratio), Voltage Regulation and Speed Regulation. Voltage Regulation by Synchronous Impedance Method

Module-2: Salient-pole Synchronous Generator (8 Hours)

Salient Pole type Three Phase Synchronous Generators: Two Reaction Concept, Development of the Equivalent Circuit of a Salient Pole type Three Phase Synchronous Generator (Direct axis and Quadrature axis Reactance, Phasor Diagram for various load power factors,), Torque and Power Equations of Salient Pole Synchronous Generator (Power Angle Equation and Power Angle Characteristic with stator resistance neglected). Slip Test for determination of Direct axis and Quadrature axis Reactance.

Parallel operation of Three Phase A.C. Synchronous Generators.The Conditions Required for Paralleling, The General Procedure for Paralleling Generators, Frequency - Real Power and Voltage – Reactive Power Characteristics of a Three Phase Synchronous Generator.

Module-3: Three-phase Synchronous Motor (10 Hours)

Basic Principles of Motor operation, Steady State Synchronous Motor operation, Starting Synchronous Motors, Synchronous Generators and Synchronous Motors, Operation of synchronous motors connected to bus and phasor diagrams for normal, under and over excited conditions, Salient pole synchronous motor phasor diagram under lagging, leading and unity power factor load, Synchronous condenser, V and Λ curves, Synchronous Motor Ratings and Application.

Module-4 Three-phase Induction Motor (8 Hours)

Constructional features and types; 3-phase distributed winding production of rotating magnetic field, Principle of Operation, The Effect of Coil Pitch and distribution factor on A.C. Machines, winding factor, Concept of Slip, Slip Speed; Phasor diagram and Development of equivalent circuit and derivation of torque equation; Typical torque-slip characteristic and influence of different parameters on it, No-Load and Blocked Rotor tests, Determination of Parameters, power flow diagram, Losses and Efficiency, Methods of starting and speed control. Cogging, Crawling.

Module-5 (6Hours)

Single phase induction machines: Double field revolving theory, Methods of starting using auxiliary winding, development of equivalent circuit. No-Load and Blocked Rotor tests, Determination of Parameters Speed Control of Single Phase Induction Motors.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

1. Understand electrical principle, laws, and working of cylindrical rotor synchronous generator.
2. Understand electrical principle, laws, and working of salient pole synchronous generator.
3. To impart the knowledge on constructional details, principle of operation, performance of 3 phases synchronous motor.
4. To impart the knowledge on starting methods and applications of synchronous motor.

5. To impart the knowledge on fundamental of AC rotating machine.
6. To impart the knowledge on constructional details, principle of operation, performance, starter, speed control and braking of 3 phase induction motor.
7. To impart the knowledge on constructional details, principle of operation, type of 1 phase induction motor and special machine.

TEXT BOOKS:

1. P S Bimbhra – Electrical Machinery –Khanna Publishers.
2. B.S.Guru & H.R.Hiziroglu-'Electric Machinery & Transformers'-3rd Ed-Oxford Press, 2014

REFERENCE BOOKS:

1. P.C.Sen-'Principles of Electric Machines and Power Electronics'-2nd Edition, John Wiley and Sons, Wiley India Reprint, 2014.
2. A.E.Fitgerland, Charles Kingslay Jr. & Stephen D. Umans -Electric machinery – 6th Edition Mc Graw Hill – Reprint 2015.
3. D.P. Kothari & I.J. Nagrath – Electric Machines – 4th Edition Mc Graw Hill – Reprint 2015.
4. Stephen J. Chapman-'Electric Machinery and Fundamentals'- Mc Graw Hill International Edition, (Fourth Edition), 2015.
5. M.G.Say-'Alternating Current Machines', English Language Book Society (ELBS)/ Longman , 5th Edition, Reprinted 1990.

Course Code:	Course Name:	L-T-P	Credit
19EE4PC02T	Electrical Measurement and Instrumentation	3- 0- 0	3

COURSE EDUCATIONAL OBJECTIVE (CEO/COB):

1. Exposure to different types of measurement standards and their gradation.
2. Relevant knowledge in bridge circuits for measuring electrical components.
3. Detail insight of construction, operation and working principle of various electrical and electronics measuring instrument.

SYLLABUS

Module- 1 **(8 Hours)**

Measurement, Error and Standards of Measurement: Definition, Accuracy and Precision, Significant Figures, Types of Errors, Classification of Standards, Electrical Standards, IEEE, **Measurement of Resistance, Inductance and Capacitance**: Resistance: Measurement of Low Resistance by Kelvin's Double Bridge, Measurement of Medium Resistance, Measurement of High Resistance, Measurement of Resistance of Insulating Materials, Measurement of Insulation Resistance when Power is ON. Inductance: Measurement of Self Inductance by Ammeter and Voltmeter, and AC Bridges (Maxwell's, Hay's and Anderson Bridges). Capacitance: Measurement of Capacitance by Ammeter and Voltmeter, and AC Bridges (Owen's, Schering & Wien's Bridge), Screening of Bridge Components and Wagnor Earthing Device.

Module-2 **(6 Hours)**

Galvanometer: Construction, Theory and Principle of operation of D' Arsonval, Vibration (Moving Magnet & Moving Coil types), Influence of Resistance on Damping, Damping, Logarithmic decrement, Calibration of Galvanometers. **Potentiometer:** Principle of operation of DC Potentiometers (Crompton, Vernier, and Deflectional Potentiometer); AC Potentiometers (Drysdale-Tinsley and Gall-Tinsley Potentiometer).

Module-3 **(8 Hours)**

Current Transformer and Potential Transformer: Construction, Theory, Characteristics and Testing of CTs and PTs. **Electronic Instruments for Measuring Basic Parameters:** Amplified DC Meters, AC Voltmeters using Rectifiers, True RMS Voltmeter, Considerations for choosing an Analog Voltmeter, Digital Voltmeters (Block Diagrams only), Q-meter.

Module-4 **(6 Hours)**

Measurement of Power, Energy, Frequency and Power factor: Measurement of single phase and three phase power by wattmeter. Construction, Theory and Principle of operation of (a) Electro-Dynamometer and Induction type Watt meters, (b) Induction Type Watt-hour meters, (c) Frequency Meters, and (d) Power Factor Meters.

Module-5

CRO & DSO: Block Diagrams, Delay Line and Working principle, Oscilloscope Probes, Oscilloscope measurement: Phase, Time and Frequency, DSO and Spectrum Analyzer.

COURSE OUTCOMES:

After completion of this course the students will be able to:

1. To enable students to classify measuring instruments on the basis of performance indices and familiarization with standards of measurement.
2. To measure resistance, inductance and capacitance by different methods based on its rang and type.
3. To analyze the construction and operation of Galvanometers, ammeter, voltmeter, potentiometer and oscilloscope in measuring ac and dc parameters.
4. To analyze the construction and operation of different types of energy, power and frequency measuring instruments.

TEXT / REFERENCES:

1. A Course in Electrical and Electronic Measurements and Instrumentation – A K Sawhney – Dhanpat Rai & Co.
2. Electronic Measurement and Instrumentation – Oliver & Cage – Tata McGraw Hill.
3. Electrical Measurements and Measuring Instruments – Golding & Widdis – 5th Edition, Reem Publication.
4. Modern Electronic Instrumentation and Measurement Techniques – Helfrick & Cooper – Pearson Education.

Course Code:	Course Name:	L-T-P	Credit
19EE4PC03T	Electrical Power Transmission &Distribution	3- 0- 0	3

COURSE EDUCATIONAL OBJECTIVE (CEO/COB):

1. Understanding the concept of per unit system and calculation of line constants in different types of transmission lines.
2. Modeling and performance of transmission line for the analysis of power system.
3. Application of different types of overhead line insulators and Mechanical design of transmission lines.
4. Application of insulated cables, earthing system and different electrical distribution system for the transmission of electrical power.

SYLLABUS

Module-1 **(8 Hours)**

Line Constant Calculations:

Per unit system, Determination of transmission line resistance, Inductors and Inductance, Magnetic field Intensity due to long current carrying conductors, Inductance of two wire transmission line, Flux linkages with one conductor in a group of conductors, Transposition of power lines, Composite Conductors, Inductance of Composite Conductors, Inductance of double circuit three phase line, Concept of GMD, Bundled conductors, Skin and Proximity effect.

Capacitance of Transmission Lines:

Electric Field of a Line of charge, Straight Conductor, Potential Difference between Two Points due to a line Charge, Two infinite lines of charge, Capacitance of a Two Wire Line, Capacitance of a Three Phase Line with Unsymmetrical Spacing, Capacitance of a double circuit line, Effect of Earth on the Capacitance of conductors.

Module-2 **(8 Hours)**

Performance of Lines:

Short Transmission Lines, Medium Transmission Lines, Long Transmission Line, ABCD parameters, Ferranti Effect Hyperbolic Form of The Equations, The Equivalent Circuit of a Long Line, Power Flow Through Transmission Line, Reactive Power Compensation, Series and Shunt compensation of a Transmission Line, Effect of Corona loss in a transmission line.

Module-3 **(6 Hours)**

Overhead Line Insulators:

Insulator Materials, Types of Insulators, Voltage Distribution over Insulator String.

Mechanical Design of Overhead Transmission Lines:

Catenary curve, Sag Tension calculation, supports at different levels, Stringing chart, sag Template, Equivalent span, Stringing of Conductors, Vibration and Vibration Dampers.

Module-4 **(8 Hours)**

Distribution and Symmetrical Components:

Comparison of various Distribution Systems, AC three-phase four-wire Distribution System, Types of Primary Distribution Systems, Types of Secondary Distribution Systems, Voltage Drop in DC Distributors, Voltage Drop in AC Distributors, Kelvin's Law, Symmetrical components and Fault analysis.

Module-5 **(6 Hours)**

Insulated Cables:

The Insulation, Extra High Voltages Cable, Insulation Resistance of Cable, Grading of Cables, Capacitance of Single Core Cables, Heating of cables, Current rating of cables, Overhead lines Vs Underground Cables, Types of cable.

COURSE OUTCOMES:

After completion of this course the students will be able to:

1. Design of power system using per unit reactance diagram and calculation of inductance and capacitance for different types of transmission lines.
2. Design of equivalent circuit and calculation of efficiency and voltage regulation for short, medium and long transmission lines.
3. Measure the potential distribution over a string of suspension insulators and calculation of sag and tension for transmission lines.
4. Grade the insulated cables and calculate the insulation resistance and capacitance of underground cables.
5. Calculate the voltage drop, earth resistance and soil resistivity in different type of electrical distribution line.

TEXT BOOKS:

1. B.M Weedy & B.J Cory, "Electric Power Systems", Wiley India.

2. C. L. Wadhwa, “Electrical Power Systems”, New Age International Publishers.

REFERENCE BOOKS:

1. John J. Grainger & W.D Stevenson, “Power System Analysis” Tata McGraw-Hill.
2. B.R Gupta, “Power System Analysis & Design”, S. Chand Publications.

Course Code:	Course Name:	L-T-P	Credit
19CM4HS01T	Organizational Behavior	3- 0- 0	3

COURSE OBJECTIVES:

Developing an understanding of the behavior of individuals and groups inside organizations by enhancing the skills in appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations is the goal of any organization. Through this course students will develop theoretical and practical insights and problem-solving capabilities for effectively managing the organizational processes.

Module-1: Fundamentals of OB: (6 Hours)

Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Models of OB. Learning; Theories and their applications

Module-2: Foundations of Individual Behavior: (12 Hours)

Personality and values: Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications. Attitude; ABC Model. Perception: Meaning and concept of perception, Factors influencing perception, Selective perception, Perceptual errors.

Motivation: Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy & Herzberg's Two Factor model Theory), The Process Theories (Vroom's expectancy Theory & Porter Lawler model), Contemporary Theories – Equity Theory of Work Motivation.

Module-3: Foundations of Group Behavior: (8 Hours)

Group Dynamics, Types of Groups, The Five – Stage Model of Group Development.

Developing Work Teams, Team Effectiveness & Team Building.

Leadership: Concept, Types & Styles of Leadership, Traditional & Contemporary theories of leadership Success stories of today's Global and Indian leaders.

Module-4: Foundations of Organizational Behavior: (10 Hours)

Organizational Culture; creating and maintenance. Organizational Change; concept and technique and theories of change. Organizational Development; concept and methods of doing development.

COURSE OUTCOMES:

1. Students will understand the essential of maintaining the inter-personal relationships in organizations.
2. Personality factors will be effectively used to understand the communication among groups.
3. The reasons for conflict will be known and prescriptive methods can be devised to enhance higher productivity in organizations.
4. Being an employee in an organization the importance of organizational change and culture can be known to all.

TEXT BOOKS:

1. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.

REFERENCE BOOKS:

1. Organizational Behaviour, K. Awathappa, HPH.
2. Organizational Behaviour, VSP Rao, Excel.
3. Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage.
4. Organizational Behaviour,Hitt, Miller, Colella, Wiley.
5. Organizational Behaviour, Suba Rao,Mishra, Himalaya.
6. Organisational Behaviour – Uma Sekharan.
7. Understanding Organizational Behaviour, Parek, Oxford.

Course Code:	Course Name:	L-T-P	Credit
19CM4HS02T	Engineering Economics and Costing	3- 0- 0	3

Module-1: **(8 Hours.)**

Introduction to Economics: Definition, scope and nature of economics, consumption laws, demand & supply analysis, elasticity of demand& supply, indifference curve analysis.

Module-2 **(10 Hours.)**

Production : factors of production, production function, law of variable proportion, laws of return to scale, elasticity of factor-substitution, optimal combination of factor-inputs, production efficiency, economies of scales,Cost of Production: types of costs, economic costs: fixed cost and variable costs, short-run and long-run cost functions.

Module-3 **(10 Hours.)**

Market Structure: pure competition, perfect competition, imperfect market, monopoly andoligopoly.Indian Banking System, Functions and Roles of Commercial Banks and ReserveBank of India.

Module-4 **(12 Hours.)**

Time value of money and interest formulae,Nominal and effective rate of interest, Present, Annual and Future worth analysis, Rate ofReturn Analysis, Cost-Benefit analysis in Public sector projects.

Module-5: (as per choice of faculty) **(8 Hours.)**

Portion covered can be tested through Internal evaluation only not to be included in University examination.

REFERENCE BOOKS:

1. Koutsoyiannis, A., 'Modern Microeconomics', English Language Book Society, Macmillan.
2. Pindyck, R S, Rubinfeld, D L &Mehta , 'Microeconomics', 6 th Edition, Pearson Education India.
3. Varian, H R, 'Intermediate Microeconomics', 7th edition, East West Press India.
4. Samuelson, Paul A, 'Economics', 5th edition, McGraw Hill New York.
5. Basics of Engineering Economy; Leland Blank and Anthony Tarquin, TMH.

6. Contemporary Engineering Economics, Chan. S Park, Pearson.
7. Engineering Economics, Paneerselvam, PHI.
8. Engineering Economics; Sasmita Mishra.

Course Code:	Course Name:	L-T-P	Credit
19EE4ES01T	Analog Electronics Circuits	3- 0- 0	3

COURSE OBJECTIVES:

1. Understand the basics of construction, operation and characteristics of different transistors and its biasing techniques
2. Develop small-signal model to analyze the performance of different amplifier both for low frequency and high frequency operation.
3. Analyze the performance parameters of large signal amplifiers and feedback topologies; extend the concept of feedback in different amplifier and oscillator circuits.

Module – 1 **(8 Hours)**

Biasing of BJTs: Load lines (AC and DC); Operating Points; Different Biasing Techniques; Bias Stabilization; Bias design Examples.

Biasing of FETs and MOSFETs: Operating point, Load line, Biasing techniques of FETs and design, Bias design: Graphical and analytical Method, Complimentary MOS (Principal of oeration).

Module – 2 **(12 Hours)**

Small Signal Analysis of BJTs: Small-Signal Equivalent-Circuit Models; r_e model, Small Signal Analysis of CE, CC, CB amplifiers using r_e model, Hybrid equivalent Model, Graphical determination of hybrid parameter.

Small Signal Analysis of FETs: Small-Signal Equivalent-Circuit Model, Small Signal Analysis of CS, CD, CG Amplifiers.; Source Follower and Cascaded System.

Two port system approach: Effects of R_S and R_L on CE amplifier operation, Effects of R_{SIG} and R_L on CS Amplifier, Small signal analysis of Cascade and Cascode configurations, Darlington Connection and Current Mirror Circuits.

Module – 3 **(6 Hours)**

Frequency Response of BJT and FET Amplifiers: General Frequency Considerations, Low and High Frequency Analysis of Single Stage Amplifiers, Square Wave Testing of amplifier.

Module – 4 **(4 Hours)**

Operational Amplifier: Ideal Op-Amp, Op-Amp Parameters, Open-loop and Closed-loop Gains, OP-AMP application as weighted summer, Differentiator and Integrator, Instrumentationamplifier.

Module – 5 **(6 Hours)**

Feedback amplifier and Oscillators: Concepts of negative and positive feedback, Four Basic Feedback Topologies, Advantage of Negative feedback, Principle of oscillation, OP-AMP based sinusoidal Oscillator Circuits: Wien Bridge oscillator and R-C Phase shift oscillator; CrystalOscillators.

COURSE OUTCOMES

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

1. Analyze and understand the different biasing techniques to have excellent stabilization against internal and external parameter variation.
2. Develop small-signal model to analyze the performance of different amplifier both for low frequency and high frequency operation.
3. Apply the concept of different feedback and feedback topologies in designing various circuits used for amplification and frequency generation.
4. Analyze and design operational amplifier based amplifier and oscillator circuits by understanding its characteristics and configuration details.

TEXT BOOKS:

1. Electronic Devices and Circuits theory, R.L. Boylestad and L. Nashelsky, 10th Edition, Pearson Education.

REFERENCE BOOKS:

1. Microelectronics Circuits, A. Sedra and K.C Smith, Oxford University press
2. Electronic Circuits: Analysis and Design(SIE), Donald Neamen, Mc-Graw Hills

3. Milliman's Electronics Devices and Circuits, J. Milliman, C. Halkias, 2nd Edition, TMH

Course Code:	Course Name:	L-T-P	Credit
19EE4ES02T	Digital Electronics Circuits	3- 0- 0	3

COURSE OBJECTIVES:

1. To provide insight about the requirement of designing low cost and high-speed Digital systems.
2. To gain inclusive knowledge about combinational and sequential logic blocks.
3. To get the idea of designing complex digital circuits.
4. To understand the different types of memory and their working principles.
5. To familiarize with various technologies used for Integrated Circuit design.

Module – 1 **(6 Hours)**

Digital Fundamentals and Binary Codes: Introduction to Digital System, Binary Data Representation, Codes: BCD, Excess-3, Gray Code, One-Hot Code, ASCII Code, Logic Levels, Logic gates, Boolean Operators and Expressions.

Simplification of Boolean Functions: Representation of min-terms and max-terms, Simplification of Boolean Functions using K-Map up to 5 variables, K-Map with don't care inputs.

Function Implementations: AND-OR, OR-AND, NAND-NAND, NOR-NOR, AOI, OAI.

Module – 2 **(8 Hours)**

Arithmetic Circuits: Introduction to Combinational Circuit, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Adder-Subtractor, Binary Parallel Adder, BCD Adder, CLA Adder, Multiplier, Square circuit, Magnitude Comparator.

Combinational Circuits: Gray –to- Binary and Binary –to- Gray Code Converter, Encoder, Priority encoder, Decoder, Cascading of Decoders, Multiplexer, Cascading of Multiplexer, Function Implementations using Multiplexer, De-Multiplexer, Decoder.

Module – 3 **(6 Hours)**

Sequential Components: Latches, Flip-Flops, Analysis of Flip-Flops: Functional Table, Characteristic Table, Characteristic Equation, State Diagram, Excitation Table, Timing Diagram, Positive-Edge-Triggered D Flip-Flop, Master-Slave JK-FF, Flip-Flop conversions.

Module – 4 **(10 Hours)**

Sequential Circuits: Design Procedure, Counter: Asynchronous and Synchronous Counter, Shift Registers: Shift of Binary Bits, SISO, SIPO, PISO, PIPO, Ring Counter, Johnson Counter, Design and Analysis of Clocked Sequential Circuits, FSM Fundamentals: Melay and Moore Machines.

Module – 5 **(6 Hours)**

Memory Blocks: Types of Memory, Memory Decoding, Read-Only Memory (ROM), Random Access Memory (RAM). Logic Families: Characteristics of DTL, RTL, TTL and CMOS Logic.

TEXT BOOKS:

1. Digital Design, 3rd Edition, M. Morris Mano, Pearson Education.

REFERENCE BOOKS:

1. Digital Principles And Applications, Seventh Edition , Donald P Leach, Albert Paul Malvino, Goutam Saha, ,Tata McGraw Hill Education Private limited
2. Fundamentals of digital circuits, 8th edition, A. Anand Kumar, PHI
3. Digital Fundamentals, 5th Edition, T.L. Floyd and R.P. Jain, Pearson Education, New Delhi.
4. Digital Logic Design Principles, 2nd edition, Norman Balabanian & Bradley Carlson, Wiley 2004.

COURSE OUTCOMES:

1. Acquire basic knowledge about binary codes and the simplification of logic function using Boolean laws and mapping methods.
2. Understand the behavior of combinational and sequential circuits and use them for development of complex digital systems.

3. Acquire fundamental knowledge about the operation of memory and their application towards synchronous circuits.
4. Illustrate the operation of different logic families and their application in designing integrated circuits for serving the mankind in day to day life.

Course Code:	Course Name:	L-T-P	Credit
19EE4PE01T	Modeling and Simulation ofDynamicalSystems in Electrical Engineering	3- 0- 0	3

COURSE OBJECTIVES:

1. Recognize the main principles of dynamic systems modeling and simulation.
2. Familiarize with various numerical methods for solving differential equations.
3. Convey the analytical and practical details of a range of modelling techniques for non-linear systems.
4. Gain basic knowledge using different tools and methods in a unified approach to perform dynamic simulations dynamical systems.

SYLLABUS

Module- I **(6 Hours)**

Introduction: Overview of dynamical system and classification; dynamic modeling approaches; state-space modeling of dynamic system; selection of variables in state vector; development of state-space model of series RL, RC and RLC circuit; derivation of Swing equation: dynamics of synchronous machine.

Module-2 **(9 Hours)**.

Numerical integration of ordinary differential equations: Classification of numerical integration algorithms: Taylor series-based methods, single-step and multi-step methods, self-starting and non-self-starting methods; accuracy and stability of numerical integration methods: accuracy comparison, stability through Eigen value analysis, significance of Eigen values.

Module-3 **(8 Hours.)**

Fixed-Step Numerical Integration Methods and Applications: Demonstration of fixed-step numerical integration methods: Forward Euler method, Backward Euler method, Trapezoidal method, Runge-Kutta fourth order method: clarification about order of the method;

application of above methods to linear (series RL, RC and RLC circuit excited by (i) DC and (ii) AC) and non-linear electrical systems (Swing equation).

Module -4 (8 Hours)

Variable-Step Numerical Integration Method and Applications: Demonstration of variable-step numerical integration methods; features of variable-step methods; algorithm of Dormand-Prince method; application of Dormand-Prince method to linear (series RL, RC and RLC circuit excited by (i) DC and (ii) AC) and non-linear electrical systems (Swing equation).

Module -5(9 Hours)

Dynamic Modeling of Some Electrical Machines: Induction motor model: fifth order induction motor model, per-unit representation of the induction motor model; reduced order model for induction machine; modeling of DC motor-driven synchronous generator: DC motor modeling, DC motor driving a synchronous generator, synchronous generator supplying a pure resistive load/ series RL load.

COURSE OUTCOMES:

1. Construct dynamical models of electrical engineering systems and shall master different engineering tools for dynamic modeling and simulation including basic programming skills.
2. Demonstrate a basic understanding of differential equations and their role in engineering simulation.
3. Carry out independent modeling and simulation of dynamic systems, from physical description to mathematical models described by a set of differential equations, and further to solve the equations in a simulation (integration) process.
4. Explain the fundamental practical limitations of numerical simulation of dynamical systems and know how to recognize them.

TEXT BOOKS:

1. Power System Analysis: A dynamic perspective, K. N. Shubhanga, Pearson India Education Services Pvt. Ltd., 2018 Edition.
2. Dynamic Simulation of Electric Machinery: Using MATLAB/Simulink, Chee-MunOng, Prentice Hall, 1998.

REFERENCE BOOKS:

1. Dynamic systems: Modeling, Analysis and Simulation, Finn Haugen, Tapir Academic, 2004 Edition.
2. Linear Systems Theory and Design, Chi-Tsong Chen, Oxford University Press, NY, 1999.

Course Code:	Course Name:	L-T-P	Credit
19EE4PE02T	Electromagnetic Theory	3- 0- 0	3

COURSE OBJECTIVE:

1. To impart knowledge on Diasporas of Maxwell's equations in both static and time varying field.
2. Introduce wave propagation in different medium and its governing law.
3. To impart knowledge on response of EM field during interaction with different boundary along with different polarization.
4. To elucidate Telegraph equations to solve impedance mismatching by smith chart as well as solution of waveguide through the knowledge of Maxwell's equations.

Module-1 **(7+6 Hours)**

Review of Maxwell's equations for static field:

Maxwell's equations for static field in differential and integral form, Boundary conditions for electrostatics and magnetostatics.

Maxwell's equations for time varying field:

Faraday's Law, Transformer and Motional EMFs, Displacement Current, Maxwell's Equations in Final Forms, Time-Varying Potentials, Time-Harmonic Fields

Module-2 **(6Hour)**

Electromagnetic Wave Propagation:

Waves in General, Wave Propagation in Lossy Dielectrics, Plane Waves in Lossless Dielectrics, Plane Waves in Free Space, plane Waves in Good Conductors, Power and the Poynting Vector.

Module-3

EM Wave: Reflection and Refraction(6hours)

Polarization of Electromagnetic waves (Linear, Elliptical and Circular), Reflection of a plane wave at Normal incidence and Oblique incidence, Brewster's Angle.

Module-4

Transmission line & Analysis: (6hours)

The lumped-element circuit model for transmission line, Telegraph equation, Lossless line and distortion less line, Terminated lossless transmission line, Smith chart, Quarter-wave transformer.

Module-5 **(7hour)**

Wave Guide:

Transverse Electric wave propagation in Rectangular Waveguide, Transverse Magnetic wave propagation in Rectangular Waveguide, Impossibility of TEM mode in rectangular waveguide, Rectangular Cavity Resonator.

COURSE OUTCOMES:

1. Able to state several laws related to EM fields and apply the vector calculates to describe electromagnetic phenomena.
2. Ableto visualize and evaluate wave in spacio domain as well as formulate and solve realistic problems on wave propagation in different medium.
3. Able to apply the knowledge of reflection and the refraction of EM waves to understand the utilization of waves in medical application as well as wireless connection under shading.
4. Able to apply the Telegraph Equations to design simple distributed circuit components and calculate transmission line parameters withimpedance measurement using smith chart as well as understand the concept of EM energy transportation through guided device.

TEXT BOOKS:

1. Matthew. N.O. Sadiku&Kulkarani "Elements of Electromagnetics", sixth Edition, Oxford University Press, First Indian Edition 2015.
2. D.M Pozar, Microwave Engineering ,Fourth Edition,JohnWiley& Sons, Inc.

3. William H.Hayt Jr. and John A Buck "Engineering electromagnetics", Tata McGraw Hill 8th Revised Edition, 2011.

REFERENCE BOOKSs

1. Lifshitz, Evgeny; Landau, Lev (1980). The Classical Theory of Fields (4th ed.). Butterworth-Heinemann. ISBN 0-7506-2768-9
2. Taflove, Allen; Hagness, Susan C. (2005). Computational Electrodynamics: The Finite-Difference Time-Domain Method (3rd ed.). Artech House. ISBN 1-58053-832-0.
3. J.A.Edminister, "Schaum's Outlines of Electromagnetics", Third Edition, (Schaum'sOutlineseries), Tata McGraw hill 2010.
4. Kraus and Fleisch "Electromagenetics with Applications", McGraw Hill International Editions, 5th Edition 2010.
5. Bhag Singh Guru and Huseyin R. Hiziroglu, "Electromagnetic Field Theory Fundamentals" Cambridge University Press, 4th Revised Edition, 2014.
6. **Cui**, Tie Jun, **Smith**, David, **Liu**, Ruopeng,(2010) Metamaterials Theory, Design, and Applications, Springer, ISBN 978-1-4419-0573-4
7. Constantine A. Balanis, Antenna Theory: Analysis and Design, 3rd Edition, ISBN: 978-1-118-58573-3
8. MatteoPastorino, Microwave Imaging, ISBN: 978-0-470-27800-0
9. Smith, A. Mark (1996). Ptolemy's Theory of Visual Perception– An English translation of the Optics. The American Philosophical Society. ISBN 0-87169-862-5.

Course Code:	Course Name:	L-T-P	Credit
19EE4PE04T	Signals and Systems	3- 0- 0	3

COURSE OBJECTIVE:

1. Basic knowledge about CT and DT signal and system,modeling concept, and analysis of LTI system
2. To develop expertise in time-domain and frequency domain analysis of CT and DT signals and systems.

Module-1: Introduction to Signals and Systems: Continuous and Discrete Time Signals and Systems (10 Hours)

Continuous time and Discrete signal, Classification of CT and DT signals: energy, power, periodic, aperiodic, even, odd, random, causal, anti-causal, standard signals, CT and DT system Classification : linear, non linear, time varying, time invariant, causal, non causal, stable, unstable, static, dynamic, Mathematical operations on CT and DT signals : amplitude scaling, time scaling, time shifting, folding, addition, multiplication, Convolution and Correlation of CT and DT signals: Convolution properties, correlation of energy and power signals, properties of correlation.

Module-2 Continuous Time Fourier Series and Fourier Transform (6 Hours)

Introduction, Fourier Series (FS) : Trigonometric, exponential , Gibb's phenomena, properties of Fourier series, Fourier Transform (FT) for CT signals: Introduction, FT of aperiodic signals, Convergence of FT, and Fourier Transform (FT) and its properties,FT of periodic signals, Analysis of CT systems using FT, energy spectral density and power spectral density.

Module-3 Laplace Transform (7 Hours)

Concept of complex frequency "S" Definition of Laplace transform and inverse Laplace transform, condition for existence, Laplace transform theorems, Differentiation and

Integration, Concept of initial condition, Laplace transform of commonly used functions (sine, cos, unit step function etc.), Initial value theorem, Final value Theorem

Module-4Discrete Time Fourier Series & Discrete Time Fourier Transform (6Hours)

Introduction, Discrete time Fourier Series (DTFS): Evaluation of DTFS coefficients and Fourier Spectra,properties of DTFS,DTFT of aperiodic DT signals, periodicity, convergence, and properties.

Module-5Z transform (7 Hours)

Z transform: Introduction, One sided and Two sided Z transform, Relationship with other transform, ROC, Properties, Inverse Z transform by long division , residue method and partial fraction method, Analysis of Linear Time Invariant (LTI) DT system using Z transform.

COURSE OUTCOMES:

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

1. Be able to describe continuous time signals and analyze the response of continuous time LTI system using different types of time domain analysis.
2. Able to analyze continuous time signal in frequency domain by using different properties of Fourier series and Fourier transform.
3. Be able to describe discrete time signals and analyze the response of discrete time LTI system using different types of time domain analysis.
4. Able to understand frequency domain analysis of Discrete time signal and system using various transform and its properties.

TEXT BOOKS:

1. Signals and Systems by Tarun Kumar Rawat , Oxford University Press
2. Signals and Systems by A. Nagoorkani, TMH

REFERENCE BOOKS:

1. Signals and Systems by A. V. Oppenheim, A.S. Wilsky, S. H. Nawab, Pearson 2nd Edition.
2. Signals and Systems by I.J. Nagrath, S. N. Sharan, R. RanjanTMH ,2nd Edition.
3. Signals and systems by Ramesh Babu, Scitech Publication.

Course Code:	Course Name:	L-T-P	Credit
19EE4PC01L	Electrical Machine-II Laboratory	0- 0- 2	1

COURSE OBJECTIVES:

1. To study the performance characteristic of cylindrical rotor synchronous generator.
2. To study the performance characteristic of salient pole synchronous generator.
3. To study the performance characteristic of three-phase synchronous Motor.
4. To study the performance characteristics of three-phase induction motor.

SYLLABUS

Select any 8 experiments from the list of 10 experiments [Using Hardware]

LIST OF EXPERIMENT:

1. Determination of the voltage regulation of an alternator by synchronous impedance method and zero power factor (zpf) method
2. Determination of the V and inverted V curves of a synchronous motor
3. Determination of parameters of synchronous machine Positive sequence reactance, Negative sequence reactance and Zero sequence reactance
4. Determination of power angle characteristics of an alternator
5. Study of parallel operation of two alternators
6. Measurement of direct and quadrature axis reactance of a salient pole synchronous machine
7. Measurement of transient and sub transient reactance of a salient pole alternator.
8. Determination of parameters of three phase induction motor from No load Test and Blocked Rotor Test.
9. Determination of Efficiency, Plotting of Torque-Slip Characteristics of Three Phase Induction motor by Brake Test.
10. Determination of parameter of a single phase induction motor and study of

a) Capacitor start induction motor

b) Capacitor start and capacitor run induction motor

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

1. Acquire hands on experience of conducting various tests on alternator and obtaining their performance indices using standard analytical method.
2. Acquire hands on experience of conducting various tests on 3-phase induction motor and obtaining their performance indices using standard analytical method

Course Code:	Course Name:	L-T-P	Credit
19EE4PC02L	Electrical Measurement and Instrumentation Lab	0- 0- 2	1

COURSE EDUCATIONAL OBJECTIVE (CEO/COB):

1. Exposure to different types of measuring equipment.
2. Exposure to different types of Bridge circuit and its measurement techniques.
3. Measurement of various electrical quantities and calibration of electrical instruments.

SYLLABUS

1. Measurement of Low Resistance by Kelvin‟s Double Bridge & Wheatstone Bridge.
2. Measurement of Self Inductance and Capacitance using Bridges.
3. Study of Galvanometer and Determination of Sensitivity and Galvanometer Constants.
4. Calibration of Voltmeters and Ammeters using Potentiometers.
5. Testing of Energy meters (Single phase type).
6. Measurement of Iron Loss from B-H Curve by using CRO.
7. Measurement of R, L, and C using Q-meter.
8. Measurement of Power in a single-phase circuit by using CTs and PTs.
9. Measurement of Power and Power Factor in a three phase AC circuit by two wattmeter method.
10. Study of Spectrum Analyzers.

COURSE OUTCOME:

After completion of this course the students will be able to:

1. Measure components value by different AC and DC bridge techniques.
2. Calibrate different electrical instrument.
3. Measure power, energy and frequency of single and three phase circuits.

Course Code:	Course Name:	L-T-P	Credit
19EE4PC03L	Electrical Power Transmission and Distribution Lab	0- 0- 2	1

COURSE EDUCATIONAL OBJECTIVE (CEO/COB):

1. To enhance understanding of electrical power system parameters including: Ferranti Effect, ABCD parameters, string efficiency.
2. To get the knowledge of reactive power and reactive power compensation in an electrical circuit.
3. To know the concept of corona discharge and different types of lighting arrester in a transmission line unit.

SYLLABUS

1. Study of Ferranti Effect.
2. Determination of ABCD parameters of a transmission line.
3. Determination of string efficiency.
4. Earth resistance measurement.
5. Series and shunt capacitance computation in transmission line.
6. Transformer oil test.
7. Study of various lightning arresters.
8. Distribution system power factor improvement using switched capacitor.
9. Study of corona discharge.

COURSE OUTCOME

After completion of this course the students will be able to:

1. Determine the different parameters like ABCD parameters, Ferranti effect and string efficiency in a transmission line.

2. Know the fundamentals concept of reactive power and its components in an actual transmission line.
3. Understand the concept of corona discharge and the application of lightning arrestor in a power system line.

Course Code:	Course Name:	L-T-P	Credit
19EE4ES01L	Analog Electronics Circuit Lab	0- 0- 2	1

COURSE OBJECTIVE:

1. To illustrate the students different electronic circuit and their application in practice.
2. To impart knowledge on assessing performance of electronic circuit through monitoring of sensitive design and modeling parameters.

List of Experiments:

(At least 10 out of 13 experiments should be done)

1. Determination of cut- off and saturation voltage of a BJT and its application as a switch.
2. Assemble and test of BJT bias circuits: Fixed bias and feedback bias.
3. Design, assemble and test of BJT bias circuits: Voltage divider bias
4. Design, assemble and test of JEET bias circuits: fixed bias and self bias.
5. Design, assemble and test of BJT common-emitter circuit – D.C and A.C performance: Voltage gain, input impedance and output impedance with bypassed and un-bypassed emitterresistor.
6. Design, assemble and test of BJT emitter-follower – D.C and A.C performance: A.C. voltage gain, input impedance and outputimpedance.
7. Design, assemble and Test of JFET/MOSFET common-source amplifiers – D.C and A.C performance: Voltage gain, input impedance and outputimpedance.
8. Determination of Bandwidth of a common-emitter amplifier from its frequency response.
9. Determination of Bandwidth of a BJT CE amplifier using Square wave testing.

10. Design and test of Differential amplifier circuits with its DC and AC performance.
11. Design and test of Darlington connection/ current mirrorcircuits.
12. Graphical determination of h-parameters of a CE amplifier.
13. Design Wien Bridge/R-C phase shift oscillator.

COURSE OUTCOME

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

1. Test and experiment different types of BJT/JFET based electronic circuit and analyze their operation under different operating conditions.
2. Evaluate possible causes of discrepancy in experimental observations in comparison to theoretical outcome.
3. Practice different types of wiring and instruments connections keeping in mind technical, Economical, safety issues.
4. Prepare professional quality textual and graphical presentations of laboratory data and Computational results.

Course Code:	Course Name:	L-T-P	Credit
19EE4ES02L	Digital Electronics Circuit Lab	0- 0- 2	1

COURSE OBJECTIVES:

1. To understand the procedure for designing fundamental building blocks and observes their outputs.

LIST OF EXPERIMENTS:

2. Digital Logic Gates: Investigate logic behavior of AND, OR, NAND, NOR, EX-OR, and Inverter gates.
3. Gate-level minimization: Two level and multi-level implementation of Boolean functions.
4. Design and Testing of combinational circuits: Half-Adder, Half-Subtraction, and Full Adder.
5. Design of binary to Gray, Gray to Binary Code Converter, and Seven Segment Display Decoder.
6. Design and implementation of 2-bit Binary Multiplier
7. Testing of Multiplexer and function implementation using suitable Multiplexer.
8. Testing of Decoder and function implementation using suitable Decoder.
9. Testing of basic SR Latch and FFs: D-FF, JK-FF
10. Design and Testing of SISO, SIPO Shift Registers
11. Design and testing of 3-bit binary Asynchronous UP-Counter and Modulo-6 counter.

COURSE OUTCOMES:

1. Test the different digital ICs and use them for designing different combinational and sequential circuits.
2. Verify and debug the outputs for developing an error free circuit.