CURRICULUM
FOR
ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER - III (ELECTRICAL & ELECTRONICS ENGINEERING)

S.No	Paper Code	Paper Title	L	T	P	Credits
1	PCC-EEE01	Electrical Circuit Analysis	3	1	0	4
2	PCC-EEE02	Digital Electronics	3	0	0	3
3	PCC-EEE03	Electrical Machines - I	3	0	0	3
4	PCC-EEE04	Electrical Machines Laboratory - I	0	0	2	1
5	PCC-EEE05	Electromagnetic Fields	3	1	0	4
6	ESC 301	Engineering Mechanics	3	1	0	4
7	MOOC-EEE01	MOOCs / SWAYAM / NPTEL Courses - 1	2	0	0	2
8	INT-EEE011	Internship	4 weeks			4
9	MC 401	Human Values & Ethics	3	0	0	0
10	MC 402	Capstone Design Project	3	0	0	0
11	MC 403	NCC / NSS / other clubs & society activity / Sports	3	0	0	0

PAPER CODE - PCC EEE 01

PCC-EEE01	Electrical Circuit Analysis	L:3	T:1	P:0	CREDIT:4

Detailed contents:

Module 1

Network Theorems: Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

Module 2

Solution of First and Second order networks: Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Module 3

Sinusoidal steady state analysis: Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Module 4

Electrical Circuit Analysis Using Laplace Transforms: Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

Module 5

Two Port Network and Network Functions: Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Module 6

Network Topology and Graph Theory: Introductory concepts of network graphs, cut sets, loops, cut set and loop analysis.

Text / References:

- M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
- D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.

- W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
- C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
- K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

Course Outcomes:

- At the end of this course, students will demonstrate the ability to ➔ Apply network theorems for the analysis of electrical circuits.
- Obtain the transient and steady-state response of electrical circuits.
- Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
- Analyse two port circuit behavior.

PAPER CODE - PCC EEE 02

PCC-EEE02	Digital Electronics	L:3	T:0	P:0	CREDIT:3

Detailed contents:

Module 1

Fundamentals of Digital Systems and logic families: Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Module 2

Combinational Digital Circuits: Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De- Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial ladder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3

Sequential circuits and systems: A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- KT and DTypes flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Module 4:

A/D and D/AConverters: Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

Module 5

Semiconductor Memories and Programmable logic devices: Memory organization and operation, expanding memory size, classificationn and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Text/References:

- ➔ R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
- ➔ M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
- ➔ A. Kumar, "Fundamentals ofDigitalCircuits", Prentice HallIndia, 2016.

Course Outcomes:

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

- ➔ Understand the working of logic families and logic gates.
- ➔ Design and implement Combinational and Sequential logic circuits.
- ➔ Understand the process of Analog to Digital conversion and Digital to Analog conversion.
- ➔ Be able to use PLDs to implement the given logical problem.

PAPER CODE - PCC EEE 03

PCC-EEE03	Electrical Machines - I	L:3	T:0	P:0	CREDIT:3

Detailed contents:

Module 1

Magnetic fields and magnetic circuits: Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

Module 2

Electromagnetic force and torque: B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency.

Module 3

DC machines: Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Module 4

DC machine - motoring and generation: Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series.
Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines.

Module 5

Transformers: Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers construction, principle, applications and comparison with two winding transformer,
Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

Text /References:

- A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
- A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.
- M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
- P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
- I J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.

Course Outcomes:

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

- ➔ Understand the concepts of magnetic circuits.
- ➔ Understand the operation of dc machines.
- ➔ Analyse the differences in operation of different dc machine configurations.
- ➔ Analyse single phase and three phase transformers circuits.

PAPER CODE - PCC EEE 04

PCC-EEE04	Electrical Machines Lab - I	L:0	T:0	P:2	CREDIT:1

Hands-on experiments related to the course contents of PCC-EEE03.

PAPER CODE - PCC EEE 05

PCC-EEE05	Electromagnetic Fields	L:3	T:1	P:0	CREDIT:4

Detailed contents:

Module 1

Review of Vector Calculus: Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus-differentiation, partial differentiation, integration, vector operator del, gradient, divergence a n d curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Module 2

Static Electric Field: Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Module 3

Conductors, Dielectrics and Capacitance: Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Module 4

Static Magnetic Fields: Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Module 5

Magnetic Forces, Materials and Inductance: Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Module 6

Time Varying Fields and Maxwell's Equations: Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions

Module 7

Electromagnetic Waves: Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Module 8

Transmission line: Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Text/References:

- M. N. O. Sadiku, “Elements of Electromagnetics”, Oxford UniversityPublication, 2014.
- A. Pramanik, “Electromagnetism - Theory and applications”, PHI Learning Pvt. Ltd, New Delhi, 2009.
- A. Pramanik, “Electromagnetism-Problems with solution”, Prentice Hall India, 2012.
- G.W. Carter, “The electromagnetic field in its engineering aspects”, Longmans, 1954.
- W.J. Duffin, “Electricity and Magnetism”, McGraw Hill Publication, 1980.
- W.J. Duffin, “Advanced Electricity and Magnetism”, McGraw Hill, 1968.
- E.G. Cullwick, “The Fundamentals of Electromagnetism”, Cambridge University Press, 1966.
- B. D. Popovic, “Introductory Engineering Electromagnetics”, Addison-Wesley Educational Publishers, InternationalEdition, 1971.
- W. Hayt, “Engineering Electromagnetics”, McGraw Hill Education, 2012

Course Outcomes:

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

- To understand the basic laws of electromagnetism.
- To obtain the electric and magnetic fields for simple configurations under static conditions.
- To analyse time varying electric and magnetic fields.
- To understand Maxwell’s equation in different forms and different media.
- To understand the propagation of EM waves.

This course shall have Lectures and Tutorials. Most of the students find it difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.

PAPER CODE - PCC EEE 05

ESC 301	Engineering Mechanics	L:3	T:1	P:0	CREDIT:3

Detailed contents:

Module 1

Introduction to vectors and tensors and coordinate systems: Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indicial notation; Symmetric and antisymmetric tensors; Eigenvalues and Principal axes.

Module 2

Three-dimensional Rotation: Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.

Module 3

Kinematics of Rigid Body: Kinematics of rigid bodies: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two-and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.

Module 4

Kinetics of Rigid Bodies: Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.

Module 5

Free Body Diagram: Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.

Module 6

General Motion: Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin.

Module 7

Bending Moment: Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.

Module 8

Torsional Motion: Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

Module 9

Friction: Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

Text / References:

- ➔ J. L. Meriam and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley, 2011.
- ➔ M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & Business Media, 1986.

Course Outcomes:

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

- ➔ Understand the concepts of coordinate systems.
- ➔ Analyse the three-dimensional motion. Understand the concepts of rigid bodies.
- ➔ Analyse the free-body diagrams of different arrangements.
- ➔ Analyse torsional motion and bending moment.

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