CURRICULUM
FOR
MECHANICAL ENGINEERING

SEMESTER – I

Sl. No.	Paper Code	Paper Title	L	T	P	Credits
1	102101	Physics (Electromagnetism)	3	1	3	5.5
2	102102	Mathematics –I (Calculus & Linear Algebra)	3	1	0	4
3	100101	Basic Electrical Engineering	3	1	2	5
4	100102	Engineering Graphics & Design	1	0	4	3

PAPER CODE - 102101

BSC	PHYSICS (ELECTROMAGNETISM)	L:3	T:1	P:3	CREDIT:5.5

INTRODUCTION TO ELECTROMAGNETIC THEORY [L: 3; T: 1; P: 0 (4 CREDITS)]

PRE-REQUISITES (IF ANY) MATHEMATICS COURSE WITH VECTOR CALCULUS

DETAILED CONTENTS:

MODULE 1: ELECTROSTATICS IN VACUUM (8 LECTURES)

CALCULATION OF ELECTRIC FIELD AND ELECTROSTATIC POTENTIAL FOR A CHARGE DISTRIBUTION; DIVERGENCE AND CURL OF ELECTROSTATIC FIELD; LAPLACE'S AND POISSON'S EQUATIONS FOR ELECTROSTATIC POTENTIAL AND UNIQUENESS OF THEIR SOLUTION AND CONNECTION WITH STEADY STATE DIFFUSION AND THERMAL CONDUCTION; PRACTICAL EXAMPLES LIKE FARADY'S CAGE AND COFFEE-RING EFFECT; BOUNDARY CONDITIONS OF ELECTRIC FIELD AND ELECTROSTATIC POTENTIAL; METHOD OF IMAGES; ENERGY OF A CHARGE DISTRIBUTION AND ITS EXPRESSION IN TERMS OF ELECTRIC FIELD.

MODULE 2: ELECTROSTATICS IN A LINEAR DIELECTRIC MEDIUM (4 LECTURES)

ELECTROSTATIC FIELD AND POTENTIAL OF A DIPOLE. BOUND CHARGES DUE TO ELECTRIC POLARIZATION; ELECTRIC DISPLACEMENT; BOUNDARY CONDITIONS ON DISPLACEMENT; SOLVING SIMPLE ELECTROSTATICS PROBLEMS IN PRESENCE OF DIELECTRICS – POINT CHARGE AT THE CENTRE OF A DIELECTRIC SPHERE, CHARGE IN FRONT OF A DIELECTRIC SLAB, DIELECTRIC SLAB AND DIELECTRIC SPHERE IN UNIFORM ELECTRIC FIELD.

MODULE 3: MAGNETOSTATICS (6 LECTURES)

BIO-SAVART LAW, DIVERGENCE AND CURL OF STATIC MAGNETIC FIELD; VECTOR POTENTIAL AND CALCULATING IT FOR A GIVEN MAGNETIC FIELD USING STOKES' THEOREM; THE EQUATION FOR THE VECTOR POTENTIAL AND ITS SOLUTION FOR GIVEN CURRENT DENSITIES.

MODULE 4: MAGNETOSTATICS IN A LINEAR MAGNETIC MEDIUM (3 LECTURES)

MAGNETIZATION AND ASSOCIATED BOUND CURRENTS; AUXILIARY MAGNETIC FIELD; BOUNDARY CONDITIONS ON AND. SOLVING FOR MAGNETIC FIELD DUE TO SIMPLE MAGNETS LIKE A BAR MAGNET; MAGNETIC SUSCEPTIBILITY AND FERROMAGNETIC, PARAMAGNETIC AND DIAMAGNETIC MATERIALS; QUALITATIVE DISCUSSION OF MAGNETIC FIELD IN PRESENCE OF MAGNETIC MATERIALS.

MODULE 5: FARADAY'S LAW (4 LECTURES)

FARADAY'S LAW IN TERMS OF EMF PRODUCED BY CHANGING MAGNETIC FLUX; EQUIVALENCE OF FARADAY'S LAW AND MOTIONAL EMF; LENZ'S LAW; ELECTROMAGNETIC

BREAKING AND ITS APPLICATIONS; DIFFERENTIAL FORM OF FARADAY'S LAW EXPRESSING CURL OF ELECTRIC FIELD IN TERMS OF TIME-DERIVATIVE OF MAGNETIC FIELD AND CALCULATING ELECTRIC FIELD DUE TO CHANGING MAGNETIC FIELDS IN QUASI-STATIC APPROXIMATION; ENERGY STORED IN A MAGNETIC FIELD.

MODULE 6: DISPLACEMENT CURRENT, MAGNETIC FIELD DUE TO TIME-DEPENDENT ELECTRIC FIELD AND MAXWELL'S EQUATIONS (5 LECTURES)

CONTINUITY EQUATION FOR CURRENT DENSITIES; MODIFYING EQUATION FOR THE CURL OF MAGNETIC FIELD TO SATISFY CONTINUITY EQUATION; DISPLACE CURRENT AND MAGNETIC FIELD ARISING FROM TIME- DEPENDENT ELECTRIC FIELD; CALCULATING MAGNETIC FIELD DUE TO CHANGING ELECTRIC FIELDS IN QUASI- STATIC APPROXIMATION. MAXWELL'S EQUATION IN VACUUM AND NON-CONDUCTING MEDIUM; ENERGY IN AN ELECTROMAGNETIC FIELD; FLOW OF ENERGY AND POYNTING VECTOR WITH EXAMPLES. QUALITATIVE DISCUSSION OF MOMENTUM IN ELECTROMAGNETIC FIELDS.

MODULE 7: ELECTROMAGNETIC WAVES (8 LECTURES)

THE WAVE EQUATION; PLANE ELECTROMAGNETIC WAVES IN VACUUM, THEIR TRANSVERSE NATURE AND POLARIZATION; RELATION BETWEEN ELECTRIC AND MAGNETIC FIELDS OF AN ELECTROMAGNETIC WAVE; ENERGY CARRIED BY ELECTROMAGNETIC WAVES AND EXAMPLES. MOMENTUM CARRIED BY ELECTROMAGNETIC WAVES AND RESULTANT PRESSURE. REFLECTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES FROM A NON-CONDUCTING MEDIUM-VACUUM INTERFACE FOR NORMAL INCIDENCE.

SUGGESTED TEXT BOOKS

- 🕮 *DAVID GRIFFITHS, INTRODUCTION TO ELECTRODYNAMICS*

SUGGESTED REFERENCE BOOKS:

- 🕮 *HALLIDAY AND RESNICK, PHYSICS*
- 🕮 *W. SASLOW, ELECTRICITY, MAGNETISM AND LIGHT*

LABORATORY - INTRODUCTION TO ELECTROMAGNETIC THEORY [L:0;T:0;P:3 (1.5 CREDITS)]

CHOICE OF EXPERIMENTS FROM THE FOLLOWING:

- ❖ EXPERIMENTS ON ELECTROMAGNETIC INDUCTION AND ELECTROMAGNETIC BREAKING;
- ❖ LC CIRCUIT AND LCR CIRCUIT;
- ❖ RESONANCE PHENOMENA IN LCR CIRCUITS;
- ❖ MAGNETIC FIELD FROM HELMHOLTZ COIL;
- ❖ MEASUREMENT OF LORENTZ FORCE IN A VACUUM TUBE

PAPER CODE – 102102

BSC	MATHEMATICS –I (CALCULUS & LINEAR ALGEBRA)	L:3	T:1	P:0	CREDIT:4

DETAILED CONTENTS

MODULE 1: CALCULUS: (6 LECTURES)

EVOLUTES AND INVOLUTES; EVALUATION OF DEFINITE AND IMPROPER INTEGRALS; BETA AND GAMMA FUNCTIONS AND THEIR PROPERTIES; APPLICATIONS OF DEFINITE INTEGRALS TO EVALUATE SURFACE AREAS AND VOLUMES OF REVOLUTIONS.

MODULE 2: CALCULUS: (6 LECTURES)

ROLLE'S THEOREM, MEAN VALUE THEOREMS, TAYLOR'S AND MACLAURIN THEOREMS WITH REMAINDERS; INDETERMINATE FORMS AND L'HOSPITAL'S RULE; MAXIMA AND MINIMA.

MODULE 3: SEQUENCES AND SERIES: (10 LECTURES)

CONVERGENCE OF SEQUENCE AND SERIES, TESTS FOR CONVERGENCE; POWER SERIES, TAYLOR'S SERIES, SERIES FOR EXPONENTIAL, TRIGONOMETRIC AND LOGARITHM FUNCTIONS; FOURIER SERIES: HALF RANGE SINE AND COSINE SERIES, PARSEVAL'S THEOREM.

MODULE 4: MULTIVARIABLE CALCULUS (DIFFERENTIATION): (8 LECTURES)

LIMIT, CONTINUITY AND PARTIAL DERIVATIVES, DIRECTIONAL DERIVATIVES, TOTAL DERIVATIVE; TANGENT PLANE AND NORMAL LINE; MAXIMA, MINIMA AND SADDLE POINTS; METHOD OF LAGRANGE MULTIPLIERS; GRADIENT, CURL AND DIVERGENCE.

MODULE 5: MATRICES (10 LECTURES)

INVERSE AND RANK OF A MATRIX, RANK-NULLITY THEOREM; SYSTEM OF LINEAR EQUATIONS; SYMMETRIC, SKEW-SYMMETRIC AND ORTHOGONAL MATRICES; DETERMINANTS; EIGENVALUES AND EIGENVECTORS; DIAGONALIZATION OF MATRICES; CAYLEY-HAMILTON THEOREM, AND ORTHOGONAL TRANSFORMATION.

SUGGESTED TEXT/REFERENCE BOOKS

- 🕮 *G.B. THOMAS AND R.L. FINNEY, CALCULUS AND ANALYTIC GEOMETRY, 9TH EDITION, PEARSON, REPRINT, 2002.*
- 🕮 *ERWIN KREYSZIG, ADVANCED ENGINEERING MATHEMATICS, 9TH EDITION, JOHN WILEY & SONS, 2006.*
- 🕮 *VEERARAJAN T., ENGINEERING MATHEMATICS FOR FIRST YEAR, TATA MCGRAW-HILL, NEW DELHI, 2008.*
- 🕮 *RAMANA B.V., HIGHER ENGINEERING MATHEMATICS, TATA MCGRAW HILL NEW DELHI, 11TH REPRINT, 2010.*

- *D. POOLE, LINEAR ALGEBRA: A MODERN INTRODUCTION, 2ND EDITION, BROOKS/COLE, 2005.*
- *N.P. BALI AND MANISH GOYAL, A TEXT BOOK OF ENGINEERING MATHEMATICS, LAXMI PUBLICATIONS, REPRINT, 2008.*
- *B.S. GREWAL, HIGHER ENGINEERING MATHEMATICS, KHANNA PUBLISHERS, 36TH EDITION, 2010.*

COURSE OUTCOMES

THE OBJECTIVE OF THIS COURSE IS TO FAMILIARIZE THE PROSPECTIVE ENGINEERS WITH TECHNIQUES IN CALCULUS, MULTIVARIATE ANALYSIS AND LINEAR ALGEBRA. IT AIMS TO EQUIP THE STUDENTS WITH STANDARD CONCEPTS AND TOOLS AT AN INTERMEDIATE TO ADVANCED LEVEL THAT WILL SERVE THEM WELL TOWARDS TACKLING MORE ADVANCED LEVEL OF MATHEMATICS AND APPLICATIONS THAT THEY WOULD FIND USEFUL IN THEIR DISCIPLINES.

THE STUDENTS WILL LEARN:

- TO APPLY DIFFERENTIAL AND INTEGRAL CALCULUS TO NOTIONS OF CURVATURE AND TO IMPROPER INTEGRALS. APART FROM SOME OTHER APPLICATIONS THEY WILL HAVE A BASIC UNDERSTANDING OF BETA AND GAMMA FUNCTIONS.
- THE FALLOUTS OF ROLLE'S THEOREM THAT IS FUNDAMENTAL TO APPLICATION OF ANALYSIS TO ENGINEERING PROBLEMS.
- THE TOOL OF POWER SERIES AND FOURIER SERIES FOR LEARNING ADVANCED ENGINEERING MATHEMATICS.
- TO DEAL WITH FUNCTIONS OF SEVERAL VARIABLES THAT ARE ESSENTIAL IN MOST BRANCHES OF ENGINEERING.
- THE ESSENTIAL TOOL OF MATRICES AND LINEAR ALGEBRA IN A COMPREHENSIVE MANNER

BASIC ELECTRICAL ENGINEERING L:3 T:1 P:2 Credit:5

MODULE 1: DC CIRCUITS (8 LECTURES)

ELECTRICAL CIRCUIT ELEMENTS (R, L AND C), VOLTAGE AND CURRENT SOURCES, KIRCHHOFF CURRENT AND VOLTAGE LAWS, ANALYSIS OF SIMPLE CIRCUITS WITH DC EXCITATION. STAR-DELTA CONVERSION, NETWORK THEOREMS (SUPERPOSITION, THEVENIN, NORTON AND MAXIMUM POWER TRANSFER THEOREMS). TIME-DOMAIN ANALYSIS OF FIRST-ORDER RL AND RC CIRCUITS

MODULE 2: AC CIRCUITS (8 LECTURES)

REPRESENTATION OF SINUSOIDAL WAVEFORMS, PEAK, RMS AND AVERAGE VALUES (FORM FACTOR AND PEAK FACTOR), IMPEDANCE OF SERIES AND PARALLEL CIRCUIT, PHASOR REPRESENTATION, REAL POWER, REACTIVE POWER, APPARENT POWER, POWER FACTOR, POWER TRIANGLE. ANALYSIS OF SINGLE-PHASE AC CIRCUITS CONSISTING OF R, L, C, RL, RC, RLC COMBINATIONS (SERIES AND PARALLEL), RESONANCE. THREE-PHASE BALANCED CIRCUITS, VOLTAGE AND CURRENT RELATIONS IN STAR AND DELTA CONNECTIONS
MODULE 3: MAGNETIC CIRCUITS: (4 LECTURES)

INTRODUCTION, SERIES AND PARALLEL MAGNETIC CIRCUITS, ANALYSIS OF SERIES AND PARALLEL MAGNETIC CIRCUITS.

MODULE 4: TRANSFORMERS (6 LECTURES)

MAGNETIC MATERIALS, BH CHARACTERISTICS, IDEAL AND PRACTICAL TRANSFORMER, EMF EQUATION, EQUIVALENT CIRCUIT, LOSSES IN TRANSFORMERS, REGULATION AND EFFICIENCY. AUTO-TRANSFORMER AND THREE-PHASE TRANSFORMER CONNECTIONS.

MODULE 5: ELECTRICAL MACHINES (10 LECTURES)

CONSTRUCTION, WORKING, TORQUE-SPEED CHARACTERISTIC AND SPEED CONTROL OF SEPARATELY EXCITED DC MOTOR. GENERATION OF ROTATING MAGNETIC FIELDS, CONSTRUCTION AND WORKING OF A THREE-PHASE INDUCTION MOTOR, SIGNIFICANCE OF TORQUE-SLIP CHARACTERISTIC. LOSS COMPONENTS AND EFFICIENCY, STARTING AND SPEED CONTROL OF INDUCTION MOTOR. CONSTRUCTION AND WORKING OF SYNCHRONOUS GENERATORS.MODULE 6: ELECTRICAL INSTALLATIONS (6 LECTURES)

COMPONENTS OF LT SWITCHGEAR: SWITCH FUSE UNIT (SFU), MCB, ELCB, MCCB, TYPES OF WIRES AND CABLES, EARTHING. TYPES OF BATTERIES, IMPORTANT CHARACTERISTICS FOR BATTERIES. ELEMENTARY CALCULATIONS FOR ENERGY CONSUMPTION, POWER FACTOR IMPROVEMENT AND BATTERY BACKUP.

SUGGESTED TEXT/REFERENCE BOOKS

- D. P. KOTHARI AND I. J. NAGRATH, "BASIC ELECTRICAL ENGINEERING", TATA MCGRAW HILL, 2010.

~ D. C. KULSHRESHTHA, "BASIC ELECTRICAL ENGINEERING", MCGRAW HILL, 2009.

-L. S. BOBROW, "FUNDAMENTALS OF ELECTRICAL ENGINEERING", OXFORD UNIVERSITY PRESS, 2011.

- E. HUGHES, "ELECTRICAL AND ELECTRONICS TECHNOLOGY", PEARSON, 2010.

- V. D. TORO, "ELECTRICAL ENGINEERING FUNDAMENTALS", PRENTICE HALL INDIA, 1989.

- BASIC ELECTRICAL ENGINEERING BY FITZERALD, ET AL, TATA MCGRAW HILL
FUNDAMENTALS OF ELECTRICAL ENGG. BY R. PRASAD, PHI PUBLICATION

- BASIC ELECTRICAL ENGINEERING BY V.K. MEHTA AND ROHIT MEHTA, S.CHAND PUBLICATION

Engineering Graphics and Design L:1 T:0 P:4 Credit:3

Traditional engineering graphics: principles of engineering graphics;

Orthographic projection; descriptive geometry; drawing principles; isometric

Projection; surface development; perspective; reading a drawing; sectional views; dimensioning and tolerances; true length, angle;

Intersection, shortest distance.

Computer graphics:

Engineering graphics software; -spatial transformations; orthographic projections; model viewing; co-ordinate systems; multi-view projection; exploded assembly; model viewing; animation; spatial manipulation; surface modelling; solid modelling, introduction to building information modelling (bim).

(except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

Module 1: introduction to engineering drawing

Principles of engineering graphics and their significance, usage of drawing instruments, lettering, conic sections including the rectangular hyperbola (general method only); cycloid, epicycloid, hypocycloid and involute; scales - plain, diagonal and vernier scales

Module 2: orthographic projections

Principles of orthographic projections-conventions -projections of points and lines inclined to both planes; projections of planes inclined planes -auxiliary planes

Module 3: projections of regular solids

Those inclined to both the planes- auxiliary views; draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as wc, bath, sink, shower, etc.

Module 4: sections and sectional views of right angular solids

Covering, prism, cylinder, pyramid, cone - auxiliary views; development of surfaces of right regular solids- prism, pyramid, cylinder and cone; draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

Module 5: isometric projections

Principles of isometric projection - isometric scale, isometric views, conventions; isometric views of lines, planes, simple and compound solids; conversion of isometric views to orthographic views and vice-versa, conventions

Module 6: overview of computer graphics

Listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of cad software [such as: the menu system, toolbars (standard, object properties, draw, modify and dimension), drawing area (background, crosshairs, coordinate system), dialog boxes and windows, shortcut menus (button bars), the command line (where applicable), the status bar, different methods of zoom as used in cad. Selectand erase objects.; isometric views of lines, planes, simple and compound solids]

Module 7: customisation and cad drawing

Consisting of set up of the drawing page and the printer, including scale settings, setting up of units and drawing limits; iso and ansi standards for coordinate dimensioning and tolerancing; orthographic constraints, snap to objects manually and automatically; producing drawings by using

various coordinate input entry methods to draw straight lines, applying various ways of drawing circles.

Module 8: annotations, layering and other functions

Covering applying dimensions to objects, applying annotations to drawings; setting up and use of layers, layers to create drawings, create, edit and use customized layers; changing line lengths through modifying existing lines (extend/lengthen); printing documents to paper using the print command; orthographic projection techniques; drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; drawing annotation computer-aided design Cad) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling.

Module 9: demonstration of a simple team design project that illustrates

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2d blueprint form and as 3d wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; use of solid-modeling software for creating associative models at the component and assembly levels. Floor plans that include: windows, doors, and fixtures such as wc, bath, sink, shower, etc. Applying colour coding according to building drawing practice; drawing sectional elevation showing foundation to ceiling; introduction to building information modelling (bim).

Suggested text/reference books:

Bhatt n.d., panchal v.m. and ingle p.r., (2014), engineering drawing, charotar publishing house Shah, m.b. and rana b.c. (2008), Engineering drawing and computer graphics, pearson education 2 agrawal b. And agrawal c. M. (2012), engineering graphics, tmh publication Narayana, k.l. and p kannaiah (2008), text book on engineering drawing, Scitechpublishers~ (corresponding set of) cad software Theory