SEMESTER-III

PHYDSM201T

ELECTRICITY, MAGNETISM AND ELECTRONICS

Contact Hours: 60

Full Marks = 100 [ESE (70) CCA(30)]

Course objective: *The objective of this course is to review the concepts of electrostatics and electromagnetism learnt earlier from a more advanced perspective and to build new concept on their basis. The course also intends to cover the basics of analog and digital electronics and their applications.*

Unit 1: Electrostatics

Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet. Electric potential as line integral of electric field, potential due to a point charge, electric dipole. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. **(12 Lectures)**

Unit 2: Electromagnetism

Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law and its application for Solenoid and toroidal coils.

Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Idea of dia, para and ferro-magnetic materials. **(12 Lectures)**

Unit 3: Electromagnetic Induction and Maxwell's equations

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic Field. Transformer, different losses of transformer,

Maxwell`s equations, Equation of continuity of current, Displacement current, Electromagnetic wave propagation: Poynting vector. **(12 Lectures)**

Unit 4: Analogue electronics

Semiconductor Diodes: P and N type semiconductors. Conductivity and Mobility, Concept of Drift velocity. Characteristics of PN Junction diode. Static and Dynamic Resistance. Application of PN junction as Rectifier; Half-wave and Full-wave Rectifiers (Circuit diagram & working), Zener Diode and Voltage Regulation.

Transistors: NPN and PNP transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β, Relations between α and β. **(13 Lectures)**

Unit 5: Digital electronics

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates. Half adder and full adder. Binary addition and subtraction using 1's complement. **(13 Lectures)**

Expected learning outcomes: *After completing this course, the students will be able to apply Gauss's law of electrostatics to distribution of charges, understand the applications of Biot-Savart's law to calculate magnetic field, understand the classification of magnetic materials and understand the process of electromagnetic induction. The students are also expected to learn the introductory ideas of analog and digital electronics.*

Reference Books:

i. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.

ii. Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.

iii. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.

iv. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

v. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

vi. Digital Principles & Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw.

vii. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.

viii. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.

ix. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India.

x. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.