IDC- 1- ELECTRICITY AND MAGNETISM

THEORY

Total Lectures : 30 **Credits: 2**

Max. Marks: 50

Objective *: This course focuses on essentials of electrostatics and magnetostatics along with Maxwell's mathematical formulation of electric and magnetic fields.*

Vector Analysis: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

(5 Lectures)

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- suggestive examples: Electric field due to point charge, uniformly charged spherical shell and solid sphere, ,etc. Electric potential as line integral of electric field, potential due to a point charge, electric dipole. Capacitance of an isolated spherical conductor. Parallel plate,. Dielectric medium, Polarisation, Displacement vector. Parallel plate capacitor completely filled with dielectric.

(10 Lectures)

Magnetism: Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field.
Magnetic properties of materials: eg. permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferro-magnetic materials. **(5 Lectures)**

Electromagnetic Induction: 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.

(5 Lectures)

Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization. **(5 Lectures)**

Suggested Reading

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
2. Electricity & Magnetism, J.H. Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. D.J.Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

PRACTICAL Credits :2 , Marks : 25

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (b)DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer: (a) Measurement of charge and current sensitivity (b) Measurement of CDR, (c) Determine a high resistance by Leakage Method, (d) To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8. To calibrate the wire of Carey Foster bridge and hence determine Low Resistance of two turns of a tangent galvanometer.
9. To verify the Thevenin and Norton theorems
10. To verify the Superposition, and Maximum Power Transfer Theorems
11. Self-inductance by Anderson's bridge.
12. Verification of laws of electromagnetic induction.
13. Verification of maximum power theorem.
14. To study the concentration dependence of the resistance electrolyte
15. To study dependence of magnetic field in a solenoid on various parameters and hence to evaluate μ_0.
16. To study the variation of the resistance of filament of bulb with its temperature.
17. Study of B-H curves of various materials using C.R.O, and determination of various parameters.

IDC – II - ELEMENTS OF MODERN PHYSICS

THEORY

Total Lectures: 30 **Credits: 2**

Max. Marks: 50

Objective*: The aim of the course is to provide students with insight of the exciting results and reasoning of the physical phenomena on the basis of modern physcs.*

Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves, Wave-particle duality, Heisenberg uncertainty principle, Estimating minimum energy of a confined particle using uncertainty principle. (9 lectures)

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; physical interpretation of wavefunction, probabilities and normalization. (6 lectures)

Rutherford model; Bohr's quantization rule and atomic stability Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy. (9 lectures)

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life and half-life; α decay; β and gamma decay.Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions. (6 lectures)

Suggested Reading

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson,2009, PHI Learning
3. Six Ideas that Shaped Physics:Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
4. Quantum Physics, Berkeley Physics,Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
5. Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Cengage Learning
6. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

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Practical --- Credits: 1 Marks-25

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine the ionization potential of mercury.
4. To determine value of Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser and measure its intensity variation using Photosensor & compare with incoherent source – Na.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
9. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
10. To setup the Millikan oil drop apparatus and determine the charge of an electron.
11. Determination of Eg in Si and Ge.
12. Determination of Planck's constant using photocell.
13. Dependence of scattering angle on kinetic energy and impact parameter in Rutherford scattering (mechanical analogue).
14. Verification of Rutherford- Soddy nuclear decay formula - mechanical analogue.
15. To find half-life period of a given radio-active substance using GM counter/ Charterctisitcs of GM Counter.

Suggested reading

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed.2011, Kitab Mahal
4. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
5. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.
6. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

IDC - 3

WAVES AND OPTICS

THEORY

Total Lectures : 30 **Credits: 2**

Max. Marks : 50

Objective *: The course covers Harmonic oscillations and coupled oscillations, wave motion in damped, driven media. It also covers the Interference, diffraction and polarisation of light and their applications.*

Superposition of oscillations: Linearity & Superposition Principle, Oscillations having equal and unequal frequencies(Beats), Lissajous Figures and their uses. **(3 lectures)**

Waves Motion: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. (**3 Lectures)**

Sound: Simple harmonic motion - forced vibrations and resonance, Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - measurement of reverberation time - Acoustic aspects of halls and auditoria. **(5 lectures)**

Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle. **(3 lectures)**

Interference & Diffraction: Interference concept. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Interference in Thin Films. Newton's Rings: measurement of wavelength and refractive index, Michelson's Interferometer**,** Fraunhofer diffraction- Single slit; Double Slit. Multiple slits and Diffraction grating. Fresnel Diffraction. (**10 lectures)**

Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization. **(6 lectures)**

Reference Books:

1. Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publications
4. University Physics. F.W. Sears, M.W. Zemansky and H.D. Young. 13/e, 1986. Addison-Wesley

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PRACTICAL - WAVES AND OPTICS , Marks -25

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2 – T Law.

3. To study Lissajous Figures
4. Familiarization with Schuster`s focussing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a Prism using Mercury Light
8. Determination of refractive index of prism for different wave-lengths using Spectrometer and deterrmine the value of Cauchy Constants.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium and (2) Spectral lines of the Mercury light using plane diffraction Grating
14. To determine the Resolving Power of a Plane Diffraction Grating.
15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.
16. Determination of focal length of convex mirror by beam compass method.
17. Determination of magnifying power of a telescope by slit method.
18. Determination of resolving power of a telescope.
19. To determine the wave-length of laser light using a plane diffraction grating.
20. Determination of wave-length of sodium light by Newton's rings method.
21. Determination of specific rotation of sugar using a Polarimeter.
22. Determination of frequency of A.C. mains by using electrical vibrator.
23. Determination of velocity of ultrasonic waves in a given liquid

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.