

ENGINEERING PHYSICS [BS-104]

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[43 Lectures = Tutorials = Approx. 53 Hours duration]

1. Lasers

Concepts of maser and laser, spontaneous and stimulated emission, elementary idea about lasers, basic principles involved in laser, three and four level laser system, coherence, characteristics of laser light; Ruby, He-Ne, CO₂ and semiconductor lasers, application of lasers.

[7 lectures]

2. Fibers Optics

Optical Fiber, physical structure and basic theory, modes in optical fibers, step index and graded index fibers, losses in optical fibers, Sources and sensors for optical fibers, applications of optical fibers in communication.

[7 Lectures]

3. Electrostatics and Electrodynamics

Gauss's law in dielectric medium, Equation of continuity, displacement current, Maxwell's equations, wave equation for electromagnetic radiation, electromagnetic wave propagation in free space and isotropic dielectric medium, Poynting theorem & Poynting vector, vector potential, Lorentz gauge.

[8 Lectures]

4. Mechanics and Theory of Relativity

Displacement, velocity and acceleration in polar and spherical coordinate systems, inertial and non inertial frames, Michelson and Morley experiment, postulates of special theory of relativity, Lorentz's space-time transformations and their consequences, velocity transformations, mass variation with velocity, mass energy equivalence, momentum and energy transformations.

[7 Lectures]

5. Quantum Mechanics

Need of quantum Mechanics, Compton effect, Born's concept of wave function, eigen function and eigen values, operators in quantum mechanics, expectation values, time independent and time dependent Schrödinger's wave equations and its applications viz., particle in one dimensional potential well, particle in three dimensional well, rectangular potential barrier, quantum mechanical tunneling and its applications.

[8 Lectures]

6. Superconductivity

Introduction and discovery of superconductivity, superconducting materials, Meissner effect, critical magnetic field and critical current, type-I and type-II superconductors, Isotope effect, theory of superconductivity, flux quantization, SQUIDS, applications of superconductivity.

[4 Lectures]

7. Ultrasonic

Ultrasonic waves, methods of their generation and detection, properties and application of ultrasonic waves.

[2 Lectures]

TEXT BOOKS

1. A text Book of Engineering Physics; M.N. Avadhanulu and P.G. Kashirsagar, S. Chand & Co. Ltd.
2. Engineering Physics; Satya Prakash and Vibhav Saluja, Pragati Prakashan, Meerut
3. Modern Engineering Physics; A.s. Vasudeva, S. Chand & Co. Ltd.

REFERENCE BOOKS

1. Optical Electronics; AK Ghatak and Thyagarajan, Foundation Books, New Delhi.
2. Electromagnetic Theory and electrodynamics; Satya Prakash, pragati Prakashan, Meerut
3. Introduction to electrodynamics; David J Griffiths, Prentice Hall of India, New Delhi
4. Concepts of modern Physics; Arthur and Beiser, McGraw Hill Publication.
5. Optical Fiber Communication and Technology, D.K. Mynbaev and L.L.Scheiner, Pearson Education.

List of Experiments in Engineering Physics Lab

Experiment No.	Description of Experiment
1	To find the resistance of a given wire using a post office and hence to determine the specific resistance of the material of wire.
2	To find the area of the rectangle by using sextant.
3	To convert a Weston type galvanometer into a voltmeter of a given range 03 volt.
4	To verify inverse square law of magnetism using magnetometer.
5	To study the variation of magnetic field with distance along the area of circular coil carrying current.
6	To find the refractive index of material of given prism using a spectrometer.
7	To determine the wavelength of laser light using transmission grating.
8	To find the wavelength of sodium light by measuring the diameter of Newton ring.
9	To find the value of plank's constant and photo electric work faction of the material of the cathode using a photo electric cell.
10	To find the velocity of ultrasonic velocity in liquid with interferometer.
11	To find numerical aperture of optical fibers.
12	To determine the resolving power of the plane transmission grating.
13	To find the magnifying power of a telescope by linear method.

Open Elective for B. Tech. 3rd Year Students

Nuclear Physics AP-360C

Contents:

Nuclear Structure

8

Introduction to the Nucleus and theories of Nuclear Composition, Classifications of Nuclei, Properties of Nucleus, Wave Mechanical Properties of Nucleus, Binding Energy & Nuclear Stability, Nuclear Forces & their Properties, Non-existence of Electron in Nucleus

Models of Nuclear Structure

5

Liquid Drop Model, Semi-Empirical Mass Formula, Experimental Evidence of Nuclear Magic Numbers, Nuclear Shell Model

Radioactivity and Radiation Hazards

8

Introduction to Radioactivity, Radioactive Series, Successive Transformation and Radioactive Equilibrium, Neutron Sources and types of Neutrons, Mass & Wavelength of Neutrons, Neutron Detection, Induced Radioactivity, Radio Isotopes, Applications of Radioisotopes, Radioactive Dating, Biological Effects of Nuclear Radiations, Radiation Hazards, Radiation Levels for safety, Radiation Protection Methods, Nuclear Disasters, Nuclear Waste Disposal

Theories of Alpha, Beta and Gamma Decays

8

Velocity and Range of Alpha Particles, Experimental Measurement of Range of α -particles: Geiger's Law, Range-Energy Relation, Geiger-Nuttall Law, α -particle Spectra, Gamow's Theory of α -Decay, Beta Decay, β -particle Spectra, Neutrino Theory of β -Decay, Origin of Gamma Rays, Nuclear Isomerism, Internal Conversion & Mossbauer Effect, Internal Pair Creation

Detectors of Nuclear Radiation

7

Introduction, Interaction Between Energetic Particles and Matter, Ionization Chamber, Solid-State Detectors, Proportional Counter, Gieger-Muller Counter, The Wilson Cloud Chamber, Bubble Chamber, Nuclear Emulsions

Nuclear Reactors

8

Theory of Nuclear Fission & Fusion, Source of Stellar Energy, Thermonuclear Reactions, Transuranic Elements, Nuclear Reactor Engineering, Pressurized Water Reactor (PWR), Boiling Water Reactor (BWR), Fast Breeder Reactor, Neutron Cycle in thermal Nuclear Reactor, Fusion Reactors, Plasma Confinement

Text Books:

1. Atomic and Nuclear Physics, T a Littlefield and N Thorley, English Language Book Society
2. Nuclear Physics, S. N. Ghoshal, S. Chand & Company LTD
3. Nuclear Physics: Principles and Applications, John Lilley, Wiley / Wiley India Pvt Ltd
4. Introductory Nuclear Physics, Kenneth S. Krane, Wiley / Wiley India Pvt Ltd
5. Modern Physics, R. Murugesan and Kiruthiga Sivaprasath, S. Chand & Company LTD.
6. Nuclear Physics, Tayal D C, Himalaya Publishing House
7. Basic Nuclear Physics, Srivastava B.N., Pragati Prakashan, Meerut
8. Fundamentals of Nuclear Physics, N. A. Jelley, Nicholas Alfred Jelley, Cambridge University Press
9. Nuclear Physics Theory & Experiment, R R Nigam and B. P. Roy, New Age International Limited
10. Introductory Nuclear Physics, Semual S M Wong, Willey VCH Verlag GmbH and Co.

Physics of Semiconductor Devices

1. REVIEW OF ATOMIC STRUCTURE

Idea of atomic structure, crystalline structure, Bonding in semiconductors, crystal structure of semiconductors, Miller indices, Crystal structure X-Ray diffraction, Bragg's law, identification and lattice parameter determination by X-ray diffraction

2. SEMICONDUCTOR PROCESSING

Doping mechanism, ion implantation, doping by diffusion, Fick's law of diffusion, diffusion profiles, diffusion constant and diffusion length, Ohmic and Schottky contact fabrication.

3. SEMICONDUCTOR MATERIALS AND PROPERTIES

Semiconductor materials, Elemental and compound semiconductors, Band model of semiconductors, Carrier concentration in energy bands, Fermi level and energy distribution of carriers inside band, extrinsic semiconductors, concept of effective mass, heavily doped semiconductors.

4. VACUUM SCIENCE AND PLASMAS

Kinetic theory of gases, Pressure ranges and vacuum pumps, Vacuum seals and measurements, deposition techniques, etching and ion milling, sputtering, thermal evaporation, electron beam evaporation, flash evaporation, laser ablation, chemical vapour deposition (CVD), molecular beam epitaxy (MBE), metal oxide chemical vapour deposition (MOCVD).

5. CARRIER TRANSPORT IN SEMICONDUCTORS

Drift and diffusion of charge carriers in semiconductors, Variation of mobility with temperature and doping level, conductivity, Hall effect, Einsteins relations, Temperature dependence of carrier concentration and resistivity in semiconductors,.

6. P-N JUNCTION

P-n junction formation, constancy of Fermi level across junction, abrupt junctions, graded junctions and diffused junctions, current conduction across p-n junction, temperature dependence of I-V characteristic of junction, breakdown in p-n junctions

7. SEMICONDUCTOR JUNCTIONS WITH METAL AND INSULATORS

Schottky junction, criteria for formation of Ohmic and Schottky junction, current conduction mechanism across Schottky junction, comparison of Schottky junction and p-n junction, current-voltage characteristics of Schottky junctions, applications of Schottky junctions in devices.

8. OPTOELECTRONIC DEVICES

Solar cells, photodectors, light emitting diodes, p-n junction lasers diodes, semiconductor requirements for laser diodes, Hetrojunction and quantum well lasers,

TEXT BOOKS

1. Introduction to Semiconductor Materials and Devices: by M.S.Tyagi, John Wiley & Sons.
2. Physics of Semiconductor Devices: by S. M. Sze, Wiley Eastern Limited.

Reference Books

1. The Science and Engineering of Microelectronics fabrication: by Stephen A Campbell, Oxford Univ Press.
2. Electronic Materials Science: by James W Mayer & S S Lau, Macmillan publishing Co.
3. Semiconductor Devices An Introduction: by Jasprit Singh, McGraw Hill.

Vibrations and Waves

1. **Simple and Damped Simple Harmonic Motion:**

S.H.M. of mechanical and electrical systems, Damped S.H.M., Logarithmic decrement, Relaxation time, Quality Factor, Q value of a simple harmonic oscillator.

2. **The Forced Oscillator:**

Transient and steady state behaviour of a forced oscillator, Displacement and velocity, variation with driving force frequency, variation of phase with frequency, power supplied to an oscillator and its variation with frequency. Q value and band width, Q-value as an amplification factor.

3. **Coupled Oscillators:**

Stiffness coupled pendulums, normal coordinates and normal modes of vibration, inductance coupling of electrical oscillators.

4. **Wave Motions:**

Types of waves, wave equation and its solution, characteristic impedance of a string, impedance matching, reflection and transmission of waves at boundary, Reflection and transmission of energy, Reflected and transmitted energy coefficients, Standing waves on a string of fixed length, Energy of a vibrating string, waves and group velocity.

5. **Electromagnetic waves:**

Maxwell's equations, em waves in a medium having finite permeability and permittivity but with conductivity $\sigma = 0$, wave equation for em wave, skin depth, em wave velocity in a conductor and anomalous dispersion, response of a conducting medium to em waves, reflection and transmission of em waves at a boundary for normal incidence.

Reference books:

1. Fundamentals of vibrations and waves, S.P. Puri, Tata Mc Graw-Hill Publishing company Ltd.
2. Vibrations and waves, A.P. French, CBS Publishers
3. The Physics of vibrations and waves, H.J. Pain, John Wiley & Sons, Ltd.
4. Vibrations and Waves, W. Gough, J.P.G. Richards, John Wiley & Sons, Ltd.
5. Vibrations and waves in physics, Iain G. Main, Cambridge University Press.

Microwave Physics

Generation: Klystrons and Magnetrons. Solid-state microwave generators. Tunnel diode and bulk semiconductor devices. Gunn and IMPATT.

Microwave propagation: in rectangular cylindrical and coaxial lines. Boundary conditions. Different modes. Field and current distributions.

Wave guide components: Attenuators, phase shifter, crystal and bolometer detectors. Isolators, Slide screw tuners. Matched termination, directional coupler. Magic Tee. Ferrite and YIG components. Horns.

Microwave Measurements: Impedance and standing wave ratio measurements. The von Hippel method. Measurement of complex permittivity. Phase shift and attenuation measurement.

Microwave materials: Ferrites. Garnets. Ceramic titanates. Copper clad PTFE. Dielectric Resonators.

References

1. A.J. Badenfuller, Mirowaves, Pergamon Press (1969).
2. G.J. Wheeler, Introduction to Microwaves, Prentice-Hall of India (1963).
3. S.Y. Liao, Microwave Devices and Circuits, 2nd Edition, Prentice-Hall of India (1987).
4. K.C. Gupta, Microwaves, 8th Edition, Wiley Eastern (1989).
5. M.I. Sisodia and G.S. Raghuvanshi, Microwave Circuits and Passive Devices, Wiley Eastern (1987).