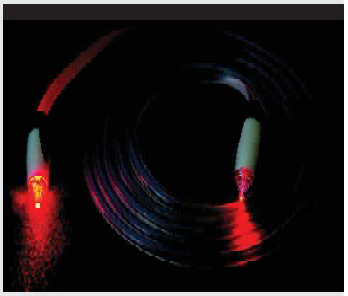
21HS114 ENGINEERING PHYSICS (B)

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30



SOURCE:
https://en.wikipedia.org/wiki/Optical_fiber_cable

COURSE DESCRIPTION AND OBJECTIVES:

This course emphasizes on the wave phenomenon including ultrasonic waves and their applications. It promotes the understanding of mechanical properties of solids and the non-destructive testing of the materials. This enables thorough understanding of fundamentals and applications of Lasers, Optical fiber along with Quantum Mechanics and free electron theory of metals. It also focuses on Nano-materials and experimental techniques for characterizing the materials.

COURSE OUTCOMES:

Upon completion of the course, student will able to achieve the following outcomes:

COs	Course Outcomes
1	Acquire knowledge on mechanical and sound waves in the perspective of engineering applications.
2	Analyze the mechanical properties of materials by the study of stress – strain curve and to adjudge materials from NDT methods.
3	Analyze the wavelengths of Laser for suitable applications in the field of industry, medicine and communication and to foster the knowledge on optical fibers to realize fiber optic communication and fiber optic sensors.
4	Apply the principles of quantum mechanics to learn the dynamics of free electrons in metals.
5	Compute the dimensions of nanoparticles to consolidate the physical aspects of nanomaterials.

SKILLS:

- ✓ *Apply the concepts of waves to unravel the functioning of various physical systems.*
- ✓ *Enunciate the importance of ultrasonics in non-destructive testing of materials.*
- ✓ *Understand the concepts of Lasers and optical fibers in science and engineering.*
- ✓ *Mathematical interpretation of quantum mechanical waves and hence the determination of electrical conductivity of metals.*
- ✓ *Production and characterization of nanomaterials aiming at their applications.*

ACTIVITIES:

- *Determination of Ultrasonic impedance of materials.*
- *Estimate ultimate strength of a given material. (Ductile/brittle)*
- *Evaluate hardness of a material with respect to ambient temperature.*
- *Measurement of height of a room using Laser instrument.*
- *Study the Numerical Aperture of Optical fiber prepared from different materials.*
- *Identification of materials from the determination of acceptance angle of a given fiber.*
- *Measurement of electrical conductivity / resistivity of a given conductor.*

UNIT - I **L-7**

WAVES & OSCILLATIONS: Simple Harmonic Motion; Free oscillations; Damped oscillations; Forced oscillations; Resonance.

ULTRASONICS: Introduction, properties of ultrasonic waves, Types of ultrasonic waves; Production of ultrasonic waves, Piezoelectric method; Determination of velocity of ultrasonic waves in solids and liquids (Interferometer method).

UNIT - II **L-8**

MECHANICAL PROPERTIES OF SOLIDS: Introduction, Stress-Strain curve, Elasticity, Poisson's ratio; Creep; Fatigue; Fracture; Factors affecting mechanical properties.

NON DESTRUCTIVE TESTING OF MATERIALS: Introduction, Methods of NDT, Visual inspection, Liquid penetrant method, Ultrasonic testing systems, X-ray radiography.

UNIT - III **L-12**

LASERS: Characteristics of laser light, Spontaneous and stimulated emission of radiation; He-Ne laser; CO_2 laser; Semiconductor laser and laser applications, Holography and its applications.

FIBER OPTICS: Principle of optical fiber, Acceptance angle, Numerical aperture; Types of fibres; Dispersion and attenuation in optical fibres; Optical fibre communication system; fibre optic sensors.

UNIT - IV **L-9**

QUANTUM PHYSICS: Introduction to quantum mechanics, de Broglie's hypothesis; Time independent Schrodinger wave equation, Particle in one dimensional box; Heisenberg's uncertainty principle.

FREE ELECTRON THEORY: Elements of classical free electron theory and its limitations; Quantum theory of free electrons; Fermi level, Density of states; Fermi-Dirac distribution and effect of temperature.

UNIT - V **L-9**

NANO MATERIALS: Introduction to nanoscience and technology, Concept of quantum size effect; Synthesis of nanomaterials - top down and bottom up approaches; Applications of nanotechnology.

EXPERIMENTAL TECHNIQUES FOR CHARACTERIZATION OF MATERIALS: X-Ray diffraction-Bragg's law, Powder method of X-ray diffraction; Optical microscope; Scanning electron microscope (SEM); Atomic force microscopy (AFM).

TEXT BOOKS

1. M.N. Avadhanulu, P.G. Kshirsagar and T.V.S.Arun Murthy, "A text book of Engineering Physics", 11th edition, S. Chand and Company Ltd., 2019.
2. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", Pearson India Eduction Services Pvt. Ltd., 2018.

REFERENCE BOOKS

1. M.R. Srinivasan, "Engineering Physics", 2nd edition, New Age International Publishers, 2014.
2. William T. Silfvast, "Laser Fundamentals" 2nd edition, Cambridge University Press, 2004.
3. M.R.Srinivasan, "Engineering Physics" New Age International Pulishers, 2006.
4. T. Pradeep, "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill, 2003.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS:30**

1. Laser - Determination of wavelength using diffraction grating.
2. Optical fiber – Determination of Numerical aperture – Acceptance angle.
3. Determination of Planck's constant.
4. Melde's Experiment - determination of the frequency of tuning fork.
5. Measurement of Young's modulus by bending beam method.
6. Determination of moment of inertia using torsional pendulum.
7. Determination of velocity of ultrasonic waves velocity in liquid medium using interferometer method.
8. Dye penetrant test method.
9. Seebeck Effect – Determination of Seebeck coefficient.
10. Stewart & Gee's Experiment- Study of magnetic field along the axis of a current carrying coil.
11. Verification of Tangent law.
12. Solar cell – Determination of Fill factor & Efficiency.
13. LED - Study of V-I characteristics.

LABORATORY MANUALS:

1. Dr. Ruby Das, C.S. Robinson, Rajesh Kumar and Prasanth Kumar "A Text Book of Engineering Physics Practical", 1st edition, Sahu University Science press, 2010.
2. Jayaraman, "Engineering Physics Laboratory manual", 1st edition, Pearson Education, 2014.