

CB112

FUNDAMENTALS OF PHYSICS

L	T	P	C	Int	Ext
3	-	-	3.0	30	70

Semester I [First Year]

COURSE OBJECTIVES:

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1. To impart knowledge and understanding the basic principles of oscillators.
2. To understand the concept of wave and particle nature of matter and the basics of semiconductors.
3. To introduce the notions of light matter interaction, fabrication of lasers, light propagation in waveguides, applications of lasers and optical fibers.
4. Explain the novel concepts of Sensors and its applications.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Familiarize the physical concepts and terminology used in oscillations.
2. Recognize and apply the Quantum Mechanical concepts, semiconductors and their uses.
3. Explain the concepts of lasers and light propagation in optical fibers their applications.
4. Analyze various sensing technologies and their applications in computer science.

UNIT I

[CO:1] (12)

Oscillations

Periodic motion, Simple Harmonic Oscillator (equation & solution), characteristics, relation between displacement, velocity and acceleration, damped harmonic oscillator (equation & solution) - over damped, critical damped and under damped conditions, energy and power dissipation in damped harmonic oscillator, quality factor, Resonance with examples, forced mechanical oscillator (equation & solution-amplitude & phase), different cases of amplitude & phase, condition of amplitude resonance, sharpness of resonance, comparison between mechanical & electrical forced oscillators with impedance.

UNIT II

[CO:2] (12)

Quantum Physics and Semiconductors

Quantum Physics: Wave particle duality, debroglie's concept of matter waves, Davisson and Germer experiment, Heisenberg's uncertainty principle, experimental verification (diffraction- single slit), Schrodinger's time independent wave equation, Physical significance of Ψ^2 , particle in a one dimensional infinite potential well.

Semiconductors : Types of semiconductors: intrinsic and extrinsic semiconductors, temperature and concentration effects on fermi level (qualitative), Drift and diffusion currents, Formation of PN junction, Hall effect and its applications.

UNIT III

[CO:3] (12)

Applied Optics

Lasers: Interaction of radiation with matter, spontaneous and stimulated emissions, characteristics of lasers, basic requirements for the construction of lasers (Pumping, population inversion and optical resonant cavity), construction and working of Nd: YAG, He-Ne laser and semiconductor (GaAs) laser (Homo junction), applications of lasers.

Fiber optics: principle, basic structure, Numerical aperture & acceptance angle, classification (propagation of light in various fibers based on refractive index), Light wave communication through optical fibers, applications of optical fibers.

UNIT IV**[CO:4] (12)****Introduction to Sensors and Sensing Technologies**

Introduction, Human Body as a Sensor System, Passive and Active sensors, the sensor as part of a measurement system, sensor properties, Classification of Sensors: Piezoelectric Sensors (principle, mechanical force & pressure sensors), Thermal Sensors (metal & semiconductor based thermometers), Quantum Sensors (difference between classical & quantum sensors, over view of common types & applications).

LEARNING RESOURCES:**TEXT BOOK(s):**

1. A Text book of Engineering Physics, M. N. Avadhanulu, & TVS Arun Murthy, S.Chand Publications, 1st Edition 2024.
2. John Vetelino and Aravind Reghu, "Introduction to Sensors", CRC Press, 1st Edition, 2010.

REFERENCE BOOK(s):

1. Ian G. Main, Oscillations and waves in physics.
2. H.J. Pain, The physics of vibrations and waves.
3. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
4. Hand book of Modern Sensors, Jacob Fraden, 4th edition, Springer, 2010.

WEB RESOURCES:

1. Online course: Semiconductor Opto electronics by M R Shenoy on NPTEL.
2. Online course : Optoelectronic Materials and Devices by Monica Katiyar and Deepak Gupta on NPTEL.
3. <https://nptel.ac.in/courses/122/107/122107035>
4. Course relevant website : www.rvrjcce.ac.in/moodle