ENGINEERING PHYSICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I & II

Subject Code	:	22EN1109	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39 + 26 Hours
L–T–P	:	3–0–2			

Course Learning Objectives:

This Course will enable students:

1. To comprehend solids' band structure, semiconductors' electrical conductivity, and semiconductor devices such as LEDs, photodiodes, and solar cells, as well as their applications in engineering.
2. To examine many types of engineering materials, including electronic, electrical, and magnetic materials, as well as dielectric material properties and applications in science and engineering.
3. To understand the fundamental ideas of quantum mechanics that are necessary for thoughtful and addressing engineering challenges in Science and technology.
4. To comprehend various crystal systems, Miller indices and determine crystal structure using XRD technique.
5. To understand thin-film phenomena, thin-film production techniques, and applications and to expert how to create Nano materials utilizing a top-down and bottom-up approuches, as well as to explore Nano science and technology applications in engineering and medicine.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

SYLLABUS	
MODULE – I	**10 Hours**
• **Semiconductor Physics**: Classification of Solids, Band structure, Fermi level in intrinsic and extrinsic semiconductors, Density of energy states in conduction and valence bands of a semiconductor (Mention the expression), Expression for concentration of electrons in conduction band (Derivation), Intrinsic carrier concentration, Conductivity of semiconductors, Hall effect, Derivation of Hall Coefficient, Numericals. (7 hours) (Text Book-2: Chapter 24.1 to 24.9, Chapter 25.9 to 25.11) • **Semiconducting devices for optoelectronics applications**: - Principle and working of PN-junction diode, Light Emitting Diode, Photodiode and Solar cell [3 hours] (Text Book-2: Chapter 25.1 to 25.8)	
MODULE – II	**10 Hours**
• **Dielectrics:** Introduction – Dielectric polarization – Dielectric Polarizability, Susceptibility and Dielectric constant - Types of polarizations: Electronic, Ionic and Orientation polarizations (qualitative) – Lorentz Internal field – Claussius - Mossoti equation (derivation), – Applications of Dielectrics – Numericals. (5 hours) **(**Text book 1: Chapter 4.1, 4.2, 4.3, 4.4, 4.5) • **Introduction to Magnetic Materials:** - Magnetic dipole moment - Magnetization- Magnetic susceptibility and permeability - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials – Hysteresis effect - soft and hard magnetic materials – Applications of magnetic materials in Engineering , Numiricals (5 hours) (Text book 1: Chapter 4.9, 4.10, 4.11)	
MODULE – III	**10 Hours**
QUANTUM MECHANICS: • Foundations of quantum theory, Wave function and its properties, de-Broglie hypothesis, Heisenberg Uncertainty principle. One dimensional time independent Schrodinger wave equation, Eigen values and Eigen functions. Applications: one dimensional motion of an electron in a potential-well. Basics of Quantum computing - Concepts of Superposition, entanglement, Interference and Qubit. [7 hours] (Text book 1: Chapter 1.5 and Chapter 2 all units) • **LASER PHYSICS:** Introduction to lasers. Conditions for laser action. Requisites of a Laser system Principle, Construction and working of Nd-YAG and Semiconductor Laser. Application of Lasers in Defense (Laser range finder), Engineering (Data storage) and Applications of Lasers in medicine [3 hours]	

(Text book 1: Chapter 5.1, 5.2, 5.3, 5.4, 5.5)

MODULE – IV	04 Hours

- **Crystallography:** Lattice, unit cell, lattice parameters, crystal systems, Bravais lattices, Packing fraction for SCC, BCC and FCC crystal systems. Introduction to Miller Indices. Determination of Crystal structure by Miller Indices. Expression for Inter-planar distance. X-ray diffraction, Bragg's law and Determination of Crystal structure by Powder method. Numericals [4 hours]

(Text book 1: Chapter 7 all units)

MODULE – V	05 Hours

- **Thin films technology:** Introduction to thin-films-Advantages of thin-films over bulk materials. Introduction to thin film deposition processes (CVD & PVD) - Physical vapour deposition (Thermal evaporation technique and sputtering technique) process, Applications of Thin films. [3 hours]

- **Nano Science &technology**: Introduction to Nano materials, Classification of nano materials, Size dependent properties of materials, Top-down and Bottom-up approach- Ball-milling and Photolithography, Process. Applications of Nano technology in Biology and Engineering. [2 hours]

(Ref. Text Book-2: Chapter 2. All units, Text Book-1: Chapter 8.1 to 8.7)

Course Outcome	Description	Bloom's Taxonomy Level
	At the end of the course the student will be able to:	
1	Illustrate Semiconductors, Semiconductor devices such as Photo diode, LED, Solar cell and its applications in engineering.	L1 & L3
2	Distinguish the different engineering materials such as Di-electric-Ferro, Piezo, Pyro and Electronic materials properties and their applications in engineering also Apply the concept of magnetism to magnetic data storage device fabrication	L2 & L3
3	Describe the concepts of Quantum mechanics and applications of Schrodinger time independent wave equations. To understand the lasing action and its applications in Science and technology	L2 & L3

4	Classify Lattice parameters of different crystalline solids by using X-ray diffraction methods and its applications in science and engineering	L1 & L3
5	Interpret Basic concepts of thin films and thin film deposition processes and their applications leads to Sensors and engineering devices	L2
6	Categorize Nano materials, Properties, and fabrication of Nano materials by using Top-down and Bottom –up approach's - Applications for Science and technology.	L2 & L3

Table: Mapping Levels of COs to POs / PSOs														
COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2													1
CO2	2													1
CO3	2													1
CO4	1													1
CO5	1											1		2
CO6	3											2		3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. P. S. Aithal, H. J. Ravindra, Textbook of Engineering Physics (2011), Acme learning Private Limited, New Delhi, India.
2. Shatendra Sharma, Jyotsna Sharma, Engineering Physics (2019), Pearson, Noida, Uttar Pradesh, India.

REFERENCE BOOKS:

1. M. Young (1977), Optics & Lasers An Engineering Physics approach, Springer

2 K.L. Chopra, Thin film Phenomena, McGraw Hill, New York.

1. S. O. Pillai (2018), Solid State Physics, revised edition, New Age International Publishers, New Delhi
2. M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy (2018), A textbook of Engineering Physics, S Chand, New Delhi.

E-Resources:

1. https://nptel.ac.in/courses/106/101/106101060/
2. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms

Activity Based Learning (Suggested Activities in Class)

1. Demonstration of solution to a problem through Project demo model.

ENGINEERING PHYSICS LAB

Total Contact Hours: 26

Following are experiments to be carried out in Engineering Physics Lab

LABORATORY EXPERIMENTS:

List of Experiments:

1. I-V characteristics of a Zener Diode

I–V Characteristics of a Zener diode in forward and reverse bias condition (Module 2)

2. Planck's constant

Measurement of Planck's constant using LED (Module 2)

3.**Transistor characteristics**

Input and output characteristics of a NPN transistor in C-E configuration (Module2)

4. Dielectric constant

Determination of dielectric constant of a dielectric material (Module 2)

5. Torsional Pendulum

Determination of moment of inertia of a circular disc using torsional pendulum

6. Diffraction grating

Determination of wavelength of a laser light using diffraction grating (Module 4)

7. LCR series and parallel resonance

Study the frequency response of a series and parallel LCR circuit (Module 3)

8. Band gap energy

Determination of energy gap of an intrinsic semiconductor (Module 2)

9. Hall effect

Determination of Hall coefficient and type of semiconductor (Module 2)

*****************THE END**********************************