RAGHU ENGINEERING COLLEGE

(Autonomous)
(Approved by AICTE, New Delhi, Permanently Affiliated to JNTU-GV, Vijayanagaram
Accredited by NBA (EEE, ME, ECE & CSE) & NAAC by A+ Grade)
Dakamarri, Bheemunipatnam Mandal, Visakhapatnam Dist. – 531 162 (A.P.)
Ph: +91-8922-248001, 248002 Fax: + 91-8922-248011
e-mail: principal@raghuenggcollege.com website: www.raghuenggcollege.com

ENGINEERING PHYSICS

(Common to all Branches of Engineering)

AR – 23 23BS103 **L T P C**

Course Code: [illegible] / [illegible] **3 0 0 3**

COURSE OVERVIEW:

Engineering Physics aims to give an understanding of the concrete use of physical principles and analysis of various fields of engineering and technology. The course will help the future engineers to apply the basic concepts and principles to solve broad based engineering problems by identifying the importance of the optical phenomenon like interference, diffraction etc, enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

COURSE OBJECTIVES:

- Analyse the intensity variation of light due to polarization, interference and diffraction.
- Familiarize with the basics of crystals and their structures.
- Summarize various types of polarization of dielectrics and classify the magnetic materials.
- Explain fundamentals of quantum mechanics apply to one dimensional motion of particles and band theory of solids.
- Identify the type of semiconductor using Hall Effect.

SYLLABUS:

UNIT I: Wave Optics **(12 Lectures)**

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colors in thin films- Newton's Rings- Determination of wavelength and refractive index. **Diffraction:** Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & -slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative). **Polarization:** Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism - Half wave and Quarter wave plates.

Text Book 1: Sec.:6.1, 6.2, 6.3, 6.5.3, 6.5.4, 6.7, 6.8, 6.8.1, 6.11, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.8.3, 7.8.4, 7.8.5, 7.9, 8.1, 8.2, 8.3, 8.5, 8.6, 8.12, 8.16.1, 8.16.2

Learning Outcomes: The students will be able to

1. Apply the phenomena of interference in determining wavelength and refractive index (L3)
2. Compare interference and diffraction (L2)
3. Explain the concept of polarization of light and its applications (L2)

UNIT II:

Crystallography and X-ray diffraction **(10 Lectures)**

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes. **X-ray diffraction:** Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods.

Text Book 1: Sec: 26.1, 26.2, 26.3, 26.4, 26.5, 26.6, 26.8, 26.9, 26.10, 26.14, 26.15, 26.23, 26.24, 26.25, 26.26

Learning Outcomes: The students will be able to

1. understand the structure and structural parameters of crystals (L2)
2. Apply the principals of crystallography to XRD techniques to analyse crystals (L3)

UNIT III:

Dielectric and Magnetic Materials **(10 Lectures)**

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations - Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field – Clausius - Mossotti equation – complex dielectric constant - Frequency dependence of polarization – dielectric loss. **Magnetic Materials:** Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

Text Book 1: Sec: 33.1, 33.2, 33.3, 33.4, 33.6, 33.7, 33.14, 33.18, 33.19, 33.15, 33.20, 34.1, 34.2, 34.4, 34.5, 34.6, 34.7, 34.8, 34.10, 34.11, 34.14, 34.15

Learning Outcomes: The students will be able to

1. Explain the concept of dielectric constant and polarization in dielectric materials (L2)
2. Interpret Lorentz field in Clausius-Mossotti relation (L2)
3. Classify the magnetic materials based on susceptibility and temperature dependence (L2)
4. Summarize the applications of dielectric and magnetic materials (L2)

UNIT IV:

Quantum Mechanics and Free electron theory **(8 Lectures)**

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations – Particle in a one-dimensional infinite potential well. **Free Electron Theory:** Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi - Dirac distribution - Density of states - Fermi energy.

Text Book 1: 20.1, 20.2, 20.5, 20.9, 20.11, 20.17, 20.18, 20.19, 20.22

Learning Outcomes: The students will be able to

1. Apply the concepts of Plank's black body radiation (L3)
2. Derive Schrodinger time independent and dependent wave equations (L3)
3. Calculate Eigen values and Eigen functions for a particle in a one dimensional infinite potential box (L3)

UNIT V:

Semiconductors **(8 Lectures)**

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors – density of charge carriers - dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation - Hall effect and its applications.

Text Book 1: Sec: 30.1, 30.2, 30.3, 30.7, 30.8, 30.11, 30.15, 30.17, 30.23, 30.25, 30.28

Learning Outcomes: The students will be able to

1. Outline the properties of n-type and p-type semiconductors (L2)
2. Apply the principles of Flemings left hand rule to identify the type of semiconductor using Hall effect (L3)
3. Explain the applications of semiconductors in electronic devices (L2)

Textbooks:

- A Text book of Engineering Physics - M.N. Avadhanulu, P.G. Kshirsagar & TVS Arun Murthy, S. Chand Publications, Revised Edition 2016.
- Engineering Physics - D.K. Bhattacharya and Poonam Tandon, Oxford press (2015).

Reference Books:

- Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning
- Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
- Engineering Physics - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press.
- Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

COURSEOUTCOMES:

By the end of the course, the learners will be able to:

S.No.	Description	Bloom's Taxonomy
1	Compute the thickness of thin films, refractive index using Newton's rings, resolving power of grating, polarization using Nicol's prism using principles of interference, diffraction and polarization of light.	L3
2	Apply the physics of crystallography to better understand the crystal structures, their planes and other parameters using X-Ray Diffraction (XRD) techniques.	L3
3	Explain the electrical behavior and field changes induced due to applied fields in dielectric materials. Compare different magnetic materials, leading to the classification of Hard and Soft magnetic materials, their applications.	L2
4	Employ the concepts of Planck's black body radiation, Schrodinger wave equation to calculate the matter waves energy - momentum, probability of finding the particle and wave function of quantum system (particle in a box), to have comprehensive understanding of classical, quantum free electron theories and Fermi energy.	L3
5	Interpret the characteristics of semiconductor materials in terms of crystal structure, charge carriers and energy bands, classify the type of semiconductor based on the understanding of Hall Effect and coefficient.	L3

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CO – PO Mapping:

Course Outcomes (CO)	Program Outcomes (PO)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1						1	1			1
CO2	3	1						1	1			1
CO3	2	1						1	1			1
CO4	3	1						1	1			1
CO5	3	1						1	1			1
Average	2.8	1						1	1			1
Average (rounded)	3	1						1	1			1

1 - Slight (Low); 2 - Moderate (Medium) 3 - Substantial (High)

Program Outcomes (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to solve complex engineering problems.

2. **Problem analysis:** Identity, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety and the cultural, societal, and environmental concerns.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods, including design of experiments, analysis, interpretation of data, and synthesis of the information to provide valid conclusions.

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5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams and multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.