ESTD: 1946

THE NATIONAL INSTITUTE OF ENGINEERING

An Autonomous Institution under Visvesvaraya Technological University, Belagavi), Recognised by AICTE, New Delhi, Grant-in-Aid by Government of Karnataka, Accredited by NAAC, New Delhi

Curriculum Structure and Syllabus 2025-26

I Year B.E.

Applied Physics for Electrical and Electronics Engineering

Manandavadi Road, Mysuru-570 008
Phone ; 0821 - 4004900, 2481220 ; Fax : 0821 - 2485802
E-mail : info@nie.ac.in; Website : http://www.nie.ac.in

Code: 1BPHEE102

Course: Applied Physics for Electrical and Electronics Engineering

Credits: 3

SEE: 50 Marks

SEE Hours: 3

L:T:P:S:- 2:2:0

CIE: 50 Marks

Max. Marks: 100

Learning objectives	1. Learn the basic principles of Physics pertaining to Engineering field. 2. To understand and explain the concepts of Physics relevant to Engineering and Technology. 3. Applying the knowledge of Physics in solving problems.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Discuss the concepts about, Quantum Physics, Electrical Properties of Metals, Semiconductor & Semiconductor devices, Physics of Materials and Magnetic Circuits & Electromagnetism.	Understand
CO2	Apply the fundamental concepts to derive the expression and solve the problems pertaining to Quantum Physics, Electrical Properties of Metals, Semiconductor & Semiconductor devices, Physics of Materials and Magnetic Circuits & Electromagnetism.	Apply
CO3	Analyze the behavior of Metals, Semiconductor & Semiconductor devices, Dielectric and Magnetic materials and Magnetic Circuits.	Analyze

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2	PSO3
CO1	3	2	-	-	-	1	-	-	-	-	-		3		
CO2	3	2	-	-	-	-	-	-	-	-	-		3		
CO3	3	3	-	-	-	-	-	-	-	-	-		3		

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Module 1: Physics of Materials		No. of LectureHours	No. of Tutorial Hours
1.1	**Dielectrics:** Polar and Non-polar dielectrics**,** Dielectric constant and polarization of dielectric materials, Types of polarization.	1	0
1.2	Equation for internal fields in solids (one dimensional) [derivation], Clausius–Mossotti equation (derivation)	1	0
1.3	Clausius – Mossotti equation (derivation), Frequency dependence of Dielectric constant, Dielectric loss	0	1

1.4	Application of dielectrics in transformers, Capacitors, numerical problems	1	1
1.5	Magnetism & Magnetic materials : Atomic origins of magnetism, Types of magnetism, Importance of Curie Temperature,	1	0
1.6	Hysteresis and Explanation using Domain theory, Energy loss, Hard and soft ferromagnetic materials and Applications, Magnetostriction	1	1
Module 2: Magnetic Circuits & Electromagnetism			
2.1	Magnetic circuits, Magneto motive force, reluctance, permeance, ohms law of magnetic circuits	1	0
2.2	Similarities and Dissimilarities between magnetic circuits and electric circuits, numerical	1	1
2.3	Magnetic circuit due to a solenoid and toroid, Difference between Solenoid and Toroid, Applications of Toroid,	1	1
2.4	Faraday's law, Transformer and Motional EMFs, Displacement Current	1	0
2.5	Maxwell's equations for time varying fields (qualitative approach), Retarded potentials, Wave equation	1	1
Module 3: Quantum Physics			
3.1	de Broglie Hypothesis and Matter waves, de Broglie wavelength and derivation of expression by analogy, Phase velocity, group velocity.	1	0
3.2	Expression for group velocity, Relation between group velocity and particle velocity (relativistic method), Characteristic properties of Matter-waves, numerical problems.	1	1
3.3	Heisenberg's uncertainty principle and its physical significance (no derivation), Application of uncertainty principle (Non - existence of electron in the nucleus), numerical problems.	1	1
3.4	**Wave function:** Properties and Physical significance (including Probability density and Normalization of wavefunction), Setting up of one dimensional time independent Schrödinger wave equation.	1	0
3.5	Application of Schrödinger wave equation: Energy Eigen values and Eigen functions of a particle in a potential well of infinite depth and extension to free particle, Role of higher dimensions (Qualitative), quantum tunneling (Qualitative), numerical problems.	1	1
Module 4: Electrical Properties of Metals			
4.1	**Quantum free electron theory :** Failure of classical free electron theory, Assumptions.	1	0
4.2	Fermi energy, Fermi factor, Variation of Fermi factor with temperature and energy	1	0
4.3	Density of states (with derivation), Expression for Fermi Energy at zero Kelvin, Merits of Quantum free electron theory	1	0
4.4	Numerical problems.	0	1
4.5	Classification - Intrinsic and extrinsic semiconductors, Intrinsic semiconductors: electron and hole concentration (only mention of expression), Fermi level in intrinsic semiconductors (derivation).	1	1

4.6	Classification - Intrinsic and extrinsic semiconductors, Intrinsic semiconductors: electron and hole concentration (only mention of expression), Fermi level in intrinsic semiconductors (derivation).	1	1
Module 5: Semiconductor devices			
5.1	Direct and indirect band gap semiconductors, Extrinsic semiconductor(Qualitative).	1	0
5.2	Hall effect (derivation), Fermi level in Extrinsic semiconductor (Qualitative)	1	0
5.3	Construction and working of semiconducting laser.	1	0
5.4	Photodiode and power responsivity, Quantum dots (Qualitative), numerical problems.	1	1
5.5	Bipolar Junction Transistor (BJT) – Schematic representation, formation of depletion region, biasing of transistors, roles of emitter base and collector	1	1
5.6	FET - types, biasing, FET over BJT, MOSFET, Insulated Gate Bipolar Transistor(IGBT)	1	0
	Total No. of Lecture Hours	**26**	**-**
		Total No. of Tutorial Hours	**14**

Text Books:

1. Engineering Physics–By Gauer & Guptha, Dhanpathrai and Sons, New Delhi.
2. A textbook of Engineering Physics by M .N. Avadhanulu, P G. Kshirsagar and T V S Arun Murthy, Eleventh edition, S Chand and Company Ltd. New Delhi-110055.

Reference Books:

1. Concepts of Modern Physics by Arthur Beiser, Shobhit Mahajan & S. Rai Choudhury, TataMcGraw–Hill Publication, 7th Edition, 2017.
2. Electronic Devices and Circuits-by Jacob Millman and Christos C. Halkias

Online Resources:

1. Mod-02 Lec-20: Dielectrics – Prof. D. K. Ghosh, IIT Bombay https://www.youtube.com/watch?v=P9VyW2wq9ZE
2. Mod-01 Lec-16: Dielectric (Insulating) Solids – Prof. G. Rangarajan, IIT Madras, https://www.youtube.com/watch?v=etjZmdmr-jSU
3. Semiconductor Optoelectronics – NPTEL (IIT Delhi, Prof. M. R. Shenoy)Direct video link (start relevant lecture): https://nptel.ac.in/courses/108108174/05