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

Code: 1BPHEC202 **Course: Applied Physics for Electronics and Communication Engineering**

Credits: 3 **L:T:P:S:- 2:2:0**
SEE: 50 Marks **CIE: 50 Marks**
SEE Hours: 3 **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, Quantum computation, Semiconductor & Semiconductor devices, Physics of Materials , Laser and optical fiber.	Understand
CO2	Apply the fundamental concepts to derive the expression for and solve the problems pertaining to Quantum Physics, Electrical Properties of Metals, Quantum computation, Semiconductor & Semiconductor devices, Physics of Materials , Laser and optical fiber.	Apply
CO3	Analyze the behavior of Metals, Semiconductor & Semiconductor devices, Dielectric , laser and optical fiber	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	-	-	-	-	-			
CO2	3	2	-	-	-	-	-	-	-	-	-		2	
CO3	3	3	-	-	-	-	-	-	-	-	-			

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

Course Structure

Module 1: Quantum Physics		No. of Lecture Hours	No. of Tutorial Hours
1.1	de Broglie Hypothesis and Matter waves, de Broglie wavelength and derivation of expression by analogy, Phase velocity, group velocity.	1	0
1.2	Expression for group velocity, Relation between group velocity and particle velocity (relativistic method), Characteristic properties of Matter-waves, numerical problems.	1	1
1.3	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
1.4	**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
1.5	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 2: Electrical Properties of Metals and Quantum Computation			
2.1	**Quantum free electron theory :** Failure of classical free electron theory, Assumptions.	1	0
2.2	Fermi energy, Fermi factor, Variation of Fermi factor with temperature and energy	1	1

2.3	Density of states (with derivation), Expression for Fermi Energy at zero Kelvin, Merits of Quantum free electron theory	1	0
2.4	Numerical problems.	0	1
2.5	Quantum Computation : Difference between Classical and quantum computation, qubit, Bloch Sphere, Dirac notation, Superposition	1	0
2.6	Brief discussion on types of qubit, gates, circuits, algorithms, errors and corrections (Qualitative), numericals	1	1
Module 3: Physics of Materials			
3.1	**Dielectrics:** Polar and Non-polar dielectrics**,** Dielectric constant and polarization of dielectric materials, Types of polarization.	1	0
3.2	Equation for internal fields in solids (one dimensional) [derivation], Clausius– Mossotti equation (derivation)	1	0
3.3	Application of dielectrics in transformers, Capacitors, numerical problems	1	1
3.4	**Superconductors:** Introduction to superconductor, temperature dependence of resistivity**,** Properties: critical field and critical current, Meissner Effect, Type-I, Type-II superconductors, High temperature superconductor (Qualitative)	1	0
3.5	BCS Theory (Qualitative), Josephson junction, Flux quantization, DC and AC SQUID (Qualitative),	1	1
3.6	Superconducting circuit(Qualitative), Applications: MAGLEV, numerical problems.	0	1
Module 4: Photonics			
4.1	**Lasers :** Characteristics of Laser, Interaction of radiation with matter: absorption, spontaneous emission and stimulated emission, Requisites of a Laser system, coherence length, spatial and temporal coherence, Condition for Laser action. Expression for energy density equation in terms of Einstein's A and B coefficients and its significance.	2	0
4.2	Construction and working of Ruby Laser. Applications of Laser – LIDAR and Quantum RADAR (Qualitative), numerical problems.	1	1
4.3	**Optical fibers :** Propagation mechanism in optical fibers, TIR, Angle of acceptance, Numerical aperture (derivation), fractional index change, modes of propagation and V number	1	0
4.4	Types of optical fibers, attenuation and Mention of expression for attenuation coefficient, Attenuation spectrum of an optical fiber with optical windows, Discussion of block diagram of point to point communication, Merits and demerits, Twisted beam optical fiber communication (Qualitative)	2	0
4.5	Numerical problems.	0	1
Module 5: Semiconductor devices and Sensors			
5.1	Classification - Intrinsic and extrinsic semiconductors, Intrinsic semiconductors: electron and hole concentration (only mention of expression), Fermi level in intrinsic semiconductors (derivation).	1	1
5.2	Law of mass action, Conductivity of semiconductors (derivation), fermi level in extrinsic semiconductor(Qualitative).	1	1
5.3	direct and indirect band gap semiconductors, Hall effect (Qualitative)	1	0
5.4	Schottky junction (Qualitative), Construction and working of semiconducting laser.	1	0
5.6	Photodiode and power responsivity, Quantum dots (Qualitative), numerical problems.	1	1
	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, 7thEdition, 2017.
2. Solid State Physics by S O Pillai, New Age International, 9th Edition, 2020
3. Electronic Devices and Circuits-by Jacob Millman and Christos C. Halkias
4. Laser Fundamentals-By Willam T Silfvast, Cambridge University Press.

Online Resources:

1. NPTEL – Quantum Mechanics I (IIT Madras): https://nptel.ac.in/courses/115106066
2. NPTEL – Physics: Introductory Quantum Mechanics (NOC):
3. https://archive.nptel.ac.in/courses/115/104/115104096
4. 3. Solid State Physics – NPTEL (IIT Madras) https://nptel.ac.in/courses/115106127
5. 4. A Brief Course on Superconductivity – NPTEL IIT Guwahati (Prof. Saurabh Basu)
6. Introduction to Photonics – NPTEL (IIT Madras, Prof. Balaji Srinivasan) Lecture 03 to Lecture 12
7. cover: Direct video link (start Lecture 03): https://nptel.ac.in/courses/108106135/03
8. 9. Semiconductor Optoelectronics – NPTEL (IIT Delhi, Prof. M. R. Shenoy)Direct video link (start rele-
9. vant lecture): https://nptel.ac.in/courses/108108174/05
10. 2. Lecture 32 – Superconducting Qubits (includes Charge Qubit / Cooper-Pair Box) https://www.youtube.com/watch?v=iYo8ALJ-Mls