Dr Ambedkar Institute of Technology, Bengaluru-56
Department of Physics
Scheme and Syllabus - 2022 -2023

Course Title	**Physics for Electrical & Electronics Engineering Stream**						
Course Code	**22PHT102EE/202EE**						
Category	Applied Science Course (ASC) (IC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	02	02	02	00	06	40+26	04
CIE Marks: 50	**SEE Marks: 50**		**Total Max. marks=100**		**Duration of SEE: 03 Hours**		

COURSE OBJECTIVE: To introduce the Engineering students to the basics of quantum Mechanics, Electric and Dielectric properties of materials, Laser and fiber optics, fundamentals of vector calculus and EM waves and semiconductors and devices with an emphasis on inculcating strong analytical skills among them so that they can understand and analyze complex engineering problems with relative ease.

UNIT I **8 hours**

Lasers: Interaction of radiation with matter: Induced absorption, spontaneous emission and stimulated emission of radiation. Expression for energy density in terms of Einstein's coefficients (derivation). Requisites of a laser system. Condition for laser action. Principle, construction and working of He-Ne laser. Application of laser: Holography: principle, recording (wave front division technique) and reconstruction of 3-D images. Mention of applications of holography. Numerical problems.

Optical fibers: Propagation mechanism in optical fibers. Expression for angle of acceptance and numerical aperture (derivation). Fractional index change, V- number and modes of propagation (N). Types of optical fibers. Attenuation: Discuss the causes for attenuation in optical fibers**.** Expression for attenuation coefficient (derivation). Application of optical fibers: Point to point communication with block diagram. Advantages and limitations of fiber optic communication over conventional communication system. Numerical problems.

Self-study component: Applications of laser in medical and industry. Application of optical fibers in sensing devices and data link.

UNIT II **8 hours**

Quantum Mechanics: de- Broglie hypothesis, de -Broglie wavelength extension to accelerated electron. Concept of wave packet. Phase velocity, group velocity (no derivation). Heisenberg's uncertainty principle and its physical significance. Application of uncertainty principle: Non-confinement of electron in the nucleus. Wave function. Properties and Physical significance of a wave function. Probability density and Normalization of wave function. Setting up of one dimensional time independent Schrödinger's wave equation. Eigen values and Eigen functions. Application of Schrödinger wave equation to a particle in a box: Expression for energy Eigen values and Eigen functions for a particle in one-dimensional potential well of infinite height and finite width, discussion of wave functions and probability density for a particle in a box for ground and first excited state. Numerical problems.

Pre-requisite: Wave-Particle dualism

Self-Study: ***Davisson and Germer experiment, Matter waves and their properties. Discussion of wave functions and probability density for a particle in a box for n=3, Quantum tunneling.***

Electrical Properties of Materials and Applications

Electrical conductivity in metals, Resistivity and Mobility, Concept of Phonon, Matthiessen's rule. Introduction to Super Conductors, Temperature dependence of resistivity, Meissner's Effect, Silsbee Effect, Types of Superconductors, Temperature dependence of critical field, BCS theory (Qualitative), Quantum Tunnelling, High-Temperature superconductivity, Josephson Junction, DC and AC SQUIDs (Qualitative), Applications in Quantum Computing (Mention). Numerical problems.

Pre-requisites: Basics of Electrical conductivity

Self-learning: Resistivity and Mobility

Quantum Computing:

Wave Function in Ket Notation: Matrix form of wave function, Identity Operator, Determination of I|0> and I|1>, Pauli Matrices and its operations on 0 and 1 states, Mention of Conjugate and Transpose, Unitary Matrix U, Examples: Row and Column Matrices and their multiplication (Inner Product), Probability, Orthogonality

Principles of Quantum Information & Quantum Computing: Introduction to Quantum Computing, Moore's law & its end. Single particle quantum interference, Classical & quantum information comparison. Differences between classical & quantum computing, quantum superposition and the concept of qubit.

Properties of a qubit: Mathematical representation. Summation of probabilities, Representation of qubit by Bloch sphere

Quantum Gates: Single Qubit Gates: Quantum Not Gate, Pauli -Z Gate Hadamard Gate, Pauli Matrices, Phase Gate

UNIT V **8 hours**

Applications of Physics in computing:

Physics of Animation: Taxonomy of physics-based animation methods, Frames, Frames per Second, Size and Scale, weight and strength, Motion and Timing in Animations, Constant Force and Acceleration, The Odd rule, Motion Graphs, Numerical Calculations based on Odd Rule, Examples of Character Animation: Jumping, Walking. Numerical problems.

Statistical Physics for Computing: Descriptive statistics and inferential statistics, Poisson distribution and Normal Distributions (Bell Curves), Monte Carlo Method. Numerical problems.

Pre-requisites: Motion in one dimension

Self-learning: Frames, Frames per Second

TEACHING and LEARNING PROCESS: Chalk and Talk, power point presentation, animatio videos

Course outcome (Course Skill Set) At the end of the course the student will be able to:	
CO1	**Describe** the fundamental principles of Quantum Mechanics and the essentials of Photonics
CO2	**Elucidate** the concepts of dielectrics and superconductivity
CO3	**Discuss** the fundamentals of vector calculus and their applications in Maxwell's Equations and EM Waves
CO4	**Summarize** the properties of semiconductors and the working principles of semiconductor devices
CO5	**Practice** working in groups to conduct experiments in physics and perform precise and honest measurements

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

1. A Textbook of Engineering Physics- M.N. Avadhanulu and P.G. Kshirsagar, 10th revised Ed, S. Chand. & CompanyLtd, New Delhi.
2. An Introduction to Lasers theory and applications by M.N.Avadhanulu and P.S.Hemne revised Edition 2012. S.Chand and Company Ltd -New Delhi.
3. Engineering Physics-Gaur and Gupta-Dhanpat Rai Publications-2017.
4. Concepts of Modern Physics-Arthur Beiser: 6th Ed;Tata McGraw Hill Edu Pvt Ltd- New Delhi 2006.
5. Fundamentals of Fibre Optics in Telecommunication & Sensor Systems, B.P. Pal, New Age International Publishers.
6. Introduction to Electrodynamics, David Griffith, 4th Edition, Cambridge University Press 2017.
7. Lasers and Non-Linear Optics – B.B. Laud, 3rd Ed, New Age International Publishers 2011.
8. LASERS Principles, Types and Applications by K.R. Nambiar-New Age International Publishers.
9. Solid State Physics-S O Pillai, 8th Ed- New Age International Publishers-2018.

Web links and Video Lectures (e-Resources):

Laser:https://www.britannica.com/technology/laser, k
Laser:https://nptel.ac.in/courses/115/102115102124/
Quantummechanics:https://nptel.ac.in/courses/115/104/115104096/
Physics:http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
NumericalApertureoffiber: https://bop-iitk.vlabs.ac.in/exp/numerical-aperture-measurement
NPTELSupercoductivity:https://archive.nptel.ac.in/courses/115/103/115103108/

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

http://nptel.ac.in
https://swayam.gov.in
https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham
https://vlab.amrita.edu/index.php?sub=1&brch=189&sim=343&cnt=1
https://virtuallabs.merlot.org/vl_physics.html
https://phet.colorado.edu
https://www.myphysicslab.com

Laboratory Component:

Any Ten Experiments have to be completed from the list of experiments

Note: The experiments have to be classified into

a) Exercise

b) Demonstration

c) Structured Inquiry

d) Open Ended

Based on convenience classify the following experiments into the above categories. Select at least one simulation/spreadsheet activity.

List of Experiments:

1. Wavelength of LASER using Grating
2. Numerical Aperture using optical fiber
3. Four Probe Method
4. Charging and Discharging of a Capacitor
5. Transistor Characteristics
6. Photo-Diode Characteristics
7. Series and Parallel LCR Circuits
8. Magnetic Field at any point along the axis of a circular coil
9. Plank's Constant using LEDs.
10. Fermi Energy
11. Black Box
12. Energy Gap of the given Semiconductor
13. Dielectric Constant
14. PHET Interactive Simulations (https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype)
15. Online Circuit Simulator (https://www.partsim.com/simulator)
16. Study of Electrical quantities using spreadsheet

COs and POs Mapping (Individual teacher has to fill up)

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	2
CO4	3	2	-	-	1	-	-	-	-	-	-	2
CO5	3	2	1	-	2	-	-	3	3	-	-	2

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

Note: The CO-PO mapping values are indicative. The course coordinator can alter the mapping using **Competencyand Performance Indicators** mentioned in the **AICTE Exam reforms.**