



Course Module			
Course: Applied Physics for CSE Stream		Course Code: BPHYS102/BPHYS202	
Course Teacher:		Academic Year:	
Course Type (Theory/Practical/Integrated)	Integrated	CIE Marks	50
		SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03+02
Total Hours of Pedagogy	40 hours Theory + 10 to 12 Lab slots	Credits	04
Course objectives <ul style="list-style-type: none"> To study the essentials of photonics for engineering applications. To study the principles of quantum mechanics and its applications in quantum computing. To study the electrical properties of materials. To study the essentials of physics for computational aspects like design and data analysis. 			
Teaching-Learning Process These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes and make Teaching-Learning more effective <ol style="list-style-type: none"> Flipped Class Chalk and Talk Blended Mode of Learning Simulations, Interactive Simulations and Animations NPTEL and Other Videos for theory topics Smart Class Room Lab Experiment Videos 			
Module-1 (8 Hours)			
Laser and Optical Fibers: LASER: Basic properties of a LASER beam, Interaction of Radiation with Matter, Einstein's A and B Coefficients, Laser Action, Population Inversion, Metastable State, Requisites of a laser system, Semiconductor Diode Laser, Applications: Bar code scanner, Laser Printer, Laser Cooling. Numerical problems. Optical Fiber: Principle and structure, Acceptance angle and Numerical Aperture (NA) and derivation of Expression for NA, Classification of Optical Fibers, Attenuation and Fiber Losses, Applications: Fiber Optic networking, Fiber Optic Communication. Numerical Problems. Pre-requisite: Properties of light Self-learning: Total Internal Reflection & Propagation Mechanism (Optical Fibers)			
Module-2 (8 Hours)			
Quantum Mechanics: de Broglie Hypothesis and Matter Waves, de Broglie wavelength and derivation of expression by analogy, Phase Velocity and Group Velocity, Heisenberg's Uncertainty Principle and its application (Nonexistence of electron inside the nucleus-Non Relativistic), Principle of Complementarity, Wave Function, Time independent Schrodinger wave equation, Physical Significance of a wave function and Born Interpretation, Expectation value, Eigen functions and Eigen Values, Particle inside one-dimensional infinite potential well, Waveforms and Probabilities. Numerical problems. Pre-requisite: Wave-Particle dualism Self-learning: de Broglie Hypothesis			
Module-3 (8 Hours)			
Quantum Computing: Wave Function in Ket Notation: Matrix form of wave function, Identity Operator, Determination of $ 0\rangle$ and $ 1\rangle$, 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 (or S Gate), T Gate

Multiple Qubit Gates: Controlled gate, CNOT Gate, (Discussion for 4 different input states). Representation of, Swap gate, Controlled-Z gate, Toffoli gate, Accounting for the extra-ordinary capability of quantum computing, Model Realizations.

Pre-requisites: Matrices.

Self-learning: Moore's law

Module-4 (8 Hours)

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 Tunneling, 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

Module-5 (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

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	Describe the principles of LASERS and Optical fibers and their relevant applications.
CO2	Discuss the basic principles of Quantum Mechanics and their application in Quantum Computing.
CO3	Summarize the essential properties of superconductors and applications in Quantum Computing.
CO4	Illustrate the application of physics in design and data analysis.
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. Solid State Physics, S O Pillai, New Age International Private Limited, 8th Edition, 2018.
2. Engineering Physics by Gupta and Gour, Dhanpat Rai Publications, 2016 (Reprint).
3. Concepts of Modern Physics, Arthur Beiser, McGraw-Hill, 6th Edition, 2009.
4. Lasers and Non-Linear Optics, B B Loud, New age international, 2011 edition.
5. 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.
6. Quantum Computation and Quantum Information, Michael A. Nielsen & Isaac L. Chuang, Cambridge Universities Press, 2010 Edition.
7. Quantum Computing, Vishal Sahani, McGraw Hill Education, 2007 Edition.
8. Engineering Physics, S P Basavaraj, 2005 Edition,
9. Physics for Animators, Michele Bousquet with Alejandro Garcia, CRC Press, Taylor & Francis, 2016.
10. Quantum Computation and Logic: How Quantum Computers Have Inspired Logical Investigations, Maria Luisa Dalla Chiara, Roberto Giuntini, Roberto Leporini, Giuseppe Sergioli, Trends in Logic, Volume 48, Springer.
11. Statistical Physics: Berkeley Physics Course, Volume 5, F. Reif, McGraw Hill.
12. Introduction to Superconductivity, Michael Tinkham, McGraw Hill, INC, II Edition.

Web links and Video Lectures (e-Resources):

- LASER:** <https://www.youtube.com/watch?v=WgzynezPiyc>
Superconductivity: <https://www.youtube.com/watch?v=MT5X15ppn48>
Optical Fiber: https://www.youtube.com/watch?v=N_kA8EpCUQo
Quantum Mechanics: <https://www.youtube.com/watch?v=p7bzE1E5PMY&t=136s>
Quantum Computing: <https://www.youtube.com/watch?v=jHoEjvuPoB8>
Physics of Animation: https://www.youtube.com/watch?v=kj1kaA_8Fu4
Statistical Physics Simulation: https://phet.colorado.edu/sims/html/plinko-probability/latest/plinko-probability_en.html
NPTEL Superconductivity: <https://archive.nptel.ac.in/courses/115/103/115103108/> NPTEL
Quantum Computing: <https://archive.nptel.ac.in/courses/115/101/115101092> Virtual
LAB: <https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham> Virtual LAB:
<https://vlab.amrita.edu/index.php?sub=1&brch=189&sim=343&cnt=1>

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

- <http://nptel.ac.in> <https://swayam.gov.in>
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 the 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. Transistor Characteristics
5. Charging and Discharging of a Capacitor



6. Photo-Diode Characteristics
7. Series & Parallel LCR
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 a given semiconductor
13. GNU Step Interactive Simulations
14. Study of motion using spread Sheets
15. Application of Statistic using Spread Sheets
16. PHET Interactive Simulations

<https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype>

COs and POs Mapping

Course Teacher:

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	3	-	-	-	-	-	-	-	-	-	2
CO3	3	3	-	-	-	-	-	-	-	-	-	2
CO4	3	2	1	-	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 **Competency and Performance Indicators** mentioned in the **AICTE Exam reforms**.



Course Module			
Course: Applied Physics for CSE Stream		Course Code: BPHYS102	
Course Teacher: Prof. Raghavendra R		Academic Year: 2023-24 (Odd Semester)	
Course Type (Theory/Practical/Integrated)	Integrated	CIE Marks	50
		SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03+02
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Quantum Computing: <https://archive.nptel.ac.in/courses/115/101/115101092> Virtual
LAB: <https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham> Virtual LAB:
<https://vlab.amrita.edu/index.php?sub=1&brch=189&sim=343&cnt=1>

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Course Teacher: Prof. Raghavendra R

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