24PH101
APPLIED PHYSICS

Course Category: **Physics (PH)**	**Program Core (PC)**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites: **10+2 Physics**		**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

Applied Physics is designed to provide a comprehensive understanding of the fundamental principles of physics and their practical applications in engineering contexts. This course provides a key insight to the principles of lasers, optical fibers, semiconductors, and basic electronics, quantum mechanics, quantum computing. Through a combination of theoretical lectures and problem-solving sessions, students will develop the necessary skills to analyze and solve engineering problems.

Course Objectives:

1. Elucidate the basic concepts of Lasers and Optical fibers and their diverse applications in Science and Technology.
2. Explain the basic concepts of semiconductors with respect to energy bands and their applications.
3. Discuss the basic concepts of electronics in the design and fabrication of diode and transistors.
4. Explain the basic concepts of quantum mechanics and formalism of Schrodinger's equations.
5. Describe the principles of quantum computing and its applications in the present scenario.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Identify different types of Lasers and Optical fibers and their applications	K2
CO2	Apply the concepts of semiconductors towards the classification of materials based on energy bands	K2
CO3	Illustrate the formation of PN junction diode and transistor, and their applications	K2
CO4	Describe the basic concepts of quantum mechanics and its mathematical frame	K3
CO5	Summarize the basic principles of quantum computing and quantum algorithms	K3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**3**		**2**										
CO2	**3**												
CO3	**3**		**1**										
CO4	**3**												
CO5	**3**	**1**			**1**								

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I

Lasers: Introduction, characteristics of laser, basic principles of lasers (absorption, spontaneous emission, and stimulated emission), requirements of lasers, different types of lasers: solid-state lasers (Ruby), gas lasers, (He-Ne), applications of lasers.

Fiber Optics: Introduction, fundamentals of optical fiber, propagation of light through optical fiber, types of optical fibers, numerical aperture, fractional refractive index change, fiber optics in communication and its advantages.

Unit-II

Semiconductor Physics: Introduction, formation of energy bands, classification of crystalline solids, fermi level in intrinsic semiconductors, fermi level in extrinsic semiconductors, large band gap semiconductors, drift and diffusion currents, Einstein's equation, Hall effect and its applications.

Unit-III

Basic Electronics: Introduction, PN-junction diode, current – voltage characteristics of P N-junction diode under forward bias and reverse bias, Zener diode, bipolar junction transistor, biasing of pnp and npn, characteristics of common base, common collector and common emitter configurations, Transistor as an amplifier**.**

Unit-IV

Quantum Mechanics: Dual nature of light, matter waves and debroglie's hypothesis, G. P. Thomson experiment, Heisenberg's uncertainty principle and its application (non – existence of electron inside nucleus), Schrödinger's time independent wave equation, physical significance of wave function, particle in a one-dimensional box.

Unit-V

Quantum Computing: Sustainability of quantum system for information processing – classical Bits and Qu – Bits – Bloch's sphere – quantum gates – multiple Qu-Bits – advantages of quantum computing over classical computation

Text Books:

1. Avadhanulu, M. N. (2019). *A textbook of engineering physics* (11th ed.). S. Chand Publishing.
2. Halliday, D. Resnick, R., & Walker, J. (2020). *Fundamentals of physics* (10th ed.). John Wiley & Sons.

Reference Books:

1. Pandey, B. K., & Chaturvedi, S. (2021). *Engineering Physics* (1st ed.). Cengage Learning.
2. Sharma, S., & Sharma, J. (2018). *Engineering Physics* (1st ed.). Pearson Education India.
3. Srinivasan, M. R. (2009). *Physics for Engineers* (1st ed.). New Age International.
4. Vijay Kumar, K. (2011). *Engineering Physics* (1st ed.). S. Chand Publishing.
5. Mc Mahon, D. (2007). *Quantum Computing Explained* (1st ed.). John Wiley & Sons.
   Nielsen, M. A., & Chuang, I. L. (2001). *Quantum computation and quantum information* (1st ed.). Cambridge University Press.

Web Resources:

1. Introduction to LASER, NPTEL – M. R. Shenoy, Professor, IIT – Delhi, https://onlinecourses.nptel.ac.in/noc21_ph01/preview
2. Fiber Optics, NPTEL – Vipul Rastogi, Professor, IIT – Roorkee, https://onlinecourses.nptel.ac.in/ noc20_ph07/preview
3. Introduction to Semiconductor Devices, NPTEL – Naresh Kumar Emani, Professor, IIT – Hyderabad, https://archieve.nptel.ac.in/courses/108/106/10810610=81/.

4. Fundamentals of Semiconductor Devices, NPTEL – Digbijoy N. Nath, IISc – Bangalore, https://archieve.nptel.ac.in/courses/108/108/108108122/#.
5. Quantum Mechanics, NPTEL – S. Lakshmi Bala, Professor, IIT – Madras, https://nptel.ac.in/ courses/ 115106066.
6. Introduction to Quantum Computing: Quantum Algorithms and Qiskit, NPTEL – Prabha Mandayam, Professor, IIT – Madras, https://archieve.nptel.ac.in/courses/106/106/106106232/