08. (a) Explain two, three and four level laser pumping schemes with necessary diagrams and also explain their merits. (10M)

(b) Consider a two level system at temperatures 300 K and 3000 K. What are the relative populations N_1 / N_0 corresponding to transitions that would occur at 632 nm? (5M)

[15] (CO4/K3)

09. (a) Describe how a PN junction can be used as (i) source and (ii) detector of light. (10M)

(b) A glass clad fiber is made with core glass of refractive index 1.50 and the cladding is doped to give a fractional index difference of 0.0002. Find the (i) cladding index (ii) acceptance angle and (iii) Numerical Aperture. (5M)

[15] (CO5/K2)

BL-Bloom's Taxonomy Levels - (K1-Remembering,K2-Understanding,K3-Applying,K4-Analysing,K5-Evaluating,K6-Creating)

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(Deemed to be University under Section 3 of UGC Act, 1956)
CHENNAI

Final Assessment Test(FAT) - Apr/May 2025

Programme	B.Tech.	Semester	Winter Semester 2024-25
Course Code	BPHY101L	Faculty Name	Prof. Korlepara Divya Bharathi
Course Title	Engineering Physics	Slot	F2+TF2
		Class Nbr	CH2024250500312
Time	3 hours	Max. Marks	100

Instructions To Candidates

- Write only your registration number in the designated box on the question paper. Writing anything elsewhere on the question paper will be considered a violation.

Course Outcomes

CO1: Comprehend the phenomenon of waves and electromagnetic waves.
CO2: Understand the principles of quantum mechanics.
CO3: Apply quantum mechanical ideas to subatomic domain.
CO4: Appreciate the fundamental principles of a laser and its types.
CO5: Design a typical optical fiber communication system using optoelectronic devices.

Section - I

Answer any 4 Questions (4 × 10 Marks)

01. (a) Prove that $y = 3\text{Sin}(2\pi t - 8x)$ is a valid wave equation in a string vibration. (5M)
(b) Write and explain Maxwell's equation in free space. (5M)

[10] (CO1/K2)

02. (a) State and explain Heisenberg uncertainty principle using any one conjugate pair. (3M)
(b) In a Compton experiment, the frequency of an incident photon is 3×10^{16} Hz. Calculate the wavelength of the scattered photon when the scattering angle of the photon is 45°. (3M)
(c) A particle moving with kinetic energy equal to its rest mass energy has a de Broglie wavelength of 1.58×10^{-6} Å. If the kinetic energy doubles, what is the new de Broglie wavelength? (4M)

[10] (CO2/K2)

03. (a) What do you understand by Quantum tunneling? Write down the equation for transmission coefficient. (5M)
(b) An electron is confined in an infinite potential well of length L = 20 nm. Calculate the zero point energy of the electron and the energy in state n=3. (5M)

[10] (CO3/K3)

04. Without any detailed explanation, write down the active medium, output wavelength and energy level diagram of He-Ne, Nd:YAG and CO_2 lasers

[10] (CO4/K1)

05. (a) Describe the types of fibers based on the modes and index classification with suitable diagram. (8M)
(b) Calculate the quantum efficiency of a p-i-n photodiode whose responsivity is 0.55 A/W for photons of wavelength 1550 nm. (2M)

[10] (CO5/K1)

Section - II

Answer all Questions (4 × 15 Marks)

06. Using assumptions, derive Schrödinger time independent and time dependent wave equation.

[15] (CO2/K1)

07. (a) What do you mean by Quantum confinement? Explain with diagrams the nanostructures that arise due to confinement. (10M)
(b) Electrons with energies of 0.6 eV are incident on a barrier 4 eV high and 0.1 nm wide. Find the approximate probability for the electrons to penetrate the barrier. (5M)

[15] (CO3/K2)

07. Consider a particle of mass M confined in an one-dimensional infinite potential box of length L. Derive the relations for the energy eigenvalue and associated wave function of the particle. Draw the wave function and their corresponding probability for the particles in the 3rd and 4th excited states.

[15] (CO3/K1)

08. a) A system has three energy levels E_1, E_2 and E_3. The energy levels E_1 and E_2 are at 0.4 eV and 1.4 eV respectively. If the lasing action takes place from the energy level E_3 to E_2, and emits a light of wavelength 1.15 μm, find the value of E_3. [5 Marks]

10

b) Explain the principle, construction and working of He-Ne laser with neat energy level diagram. [10 Marks]

[15] (CO4/K3)

09. a) Derive the condition for light propagation through optical fibers for step index fiber.[8 Marks]

7

b) Describe the structure and operation of LED device with appropriate diagrams. [7 Marks]

[15] (CO5/K2)

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(Deemed to be University ... of UGC Act, 1956)
CHENNAI

Final Assessment Test(FAT) - Apr/May 2025

Programme	B.Tech.	Semester	Winter Semester 2024-25
Course Code	BPHY101L	Faculty Name	Prof. Karthikeyan S
Course Title	Engineering Physics	Slot	F1+TF1
		Class Nbr	CH2024250500320
Time	3 hours	Max. Marks	100

Instructions To Candidates

- Write only your registration number in the designated box on the question paper. Writing anything elsewhere on the question paper will be considered a violation.

Course Outcomes

CO1: Comprehend the phenomenon of waves and electromagnetic waves.
CO2: Understand the principles of quantum mechanics.
CO3: Apply quantum mechanical ideas to subatomic domain.
CO4: Appreciate the fundamental principles of a laser and its types.
CO5: Design a typical optical fiber communication system using optoelectronic devices.

Section - I

Answer any 4 Questions (4 × 10 Marks)

01. a) Prove that $y = 5\ \mathrm{Sin}(6\pi t - 4x)$ is a valid wave equation in a string vibration. [5 marks]
b) Write and explain Maxwell's equation in free space? [5 Marks]

[10] (CO1/K2)

02. a) Define a wave function and write down their five distinct properties. [5 marks]
b) X-ray of wavelength 0.450 nm undergo Compton scattering from free electrons in carbon. If photons are scattered at 60° relative to the incident ray
(i) Calculate the wavelength of the scattered photon. [2 marks]
(ii) What percentage of initial X- ray photon energy is transferred to an electron in such a scattering? [3 marks]

[10] (CO2/K3)

03. Reason out as to why the properties of nanoparticles are superior when compared with their bulk counterpart. Highlight some of the properties that change when the particles are reduced to their nanoregime. Mention the applications of nanoparticles in various industries.

[10] (CO3/K1)

04. a) What are the components needed to build a laser system? Describe each component in detail. [6 marks]
b) Find the ratio of population of the two states in He-Ne laser that produces light of wavelength 6328 Å at 27 °C. [4 marks]

[10] (CO4/K3)

05. a) Describe the types of fibers based on the modes and index classification with suitable diagrams. [8 marks]
b) A p-n photodiode has a quantum efficiency of 70% for photons of energy $\mathbf{1.52 \times 10^{-19} J}$. Calculate the wavelength at which the diode is operating.[2 marks]

[10] (CO5/K3)

Section - II

Answer all Questions (4 × 15 Marks)

06. a) Select out of the following two experiments which prove an electron is a wave. [10 Marks]
(i) Compton experiment (ii) Davisson-Germer experiment. Explain the experiment with theory, diagram and mathematical formulations.

b) Determine the minimum uncertainties in the positions of the following objects if their speeds are known with a precision of 1.0×10^{-3} m/s (i) an electron and (ii) a bowling ball of mass 6.0 kg. Comment on your observations. [5 Marks]

[15] (CO2/K2)