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Vellore Institute of Technology

Reg. No. : [ ]

Final Assessment Test(FAT) - Nov/Dec 2024

Programme	**B.Tech.**	Semester	**Fall Semester 2024-25**
Course Code	**BPHY101L**	Faculty Name	**Prof. Justin Raj**
Course Title	**Engineering Physics**	Slot	**D1+TD1**
		Class Nbr	**CH2024250103529**
Time	**3 hours**	Max. Marks	**100**

General Instructions

Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Course Outcomes

CO 1: Comprehend the phenomenon of waves and electromagnetic waves.

CO 2: Understand the principles of quantum mechanics.

CO 3: Apply quantum mechanical ideas to subatomic domain.

CO 4: Appreciate the fundamental principles of a laser and its types.

CO 5: Design a typical optical fiber communication system using optoelectronic devices.

Section - I

Answer any 4 Questions (4 × 10 Marks) *M - Marks

Q.No	Question	*M	CO	BL
01.	(a) Write Maxwell's equation in differential form with their implications. (5 marks) (b) Find the gradient of the function $f(x, y) = 4x^2 + 13y^5 + 24$. (2 marks) (c) A temperature gradient will occur after turning on an air heater in the closed room. If temperature distribution is given by the scalar function $T = 2xy^2z^3$, calculate the change in temperature at a point $(1, -2, 1)$. (3 marks)	10	1	3
02.	Describe, in detail, Davisson-Germer experiment to prove the wave particle duality.	10	2	2
03.	Describe the construction, working and different modes of an instrument that works based on quantum tunneling. Mention the advantages and disadvantages of their instrumentation.	10	3	2
04.	(a) Derive the expression to obtain the threshold gain coefficient and explain their significance. (8 marks) (b) Explain why a two-level laser is not possible. (2 marks)	10	4	2
05.	(a) Derive the expression for the pulse widening in multimode step index fiber with proper diagram. (8 marks) (b) Define V-parameter in optical fiber. (2 marks)	10	5	2

Section - II

Answer any 4 Questions (4 × 15 Marks) *M - Marks

Q.No	Question	*M	CO	BL
06.	(a) Show that $y = A\cos(9\pi t - 8x)$ is a valid wave equation for a string vibration. (5 marks) (b) Explain the principle, construction and working of He-Ne laser with neat energy level diagram. (10 marks)	15	1,4	3
07.	Derive, stating the assumptions and other necessary details, the Schrödinger's time-independent and time-dependent wave equation.	15	2	2
08.	(a) What do you mean by quantum confinement? Explain with diagrams, the nano-structures that arise due to confinement. (10 marks) (b) What is the probability that a particle trapped in a one-dimensional box of length L will be found between $0.15L$ and $0.45L$? Given that the particle is in the $n = 5$ quantum state. (5 marks)	15	3	3
09.	(a) A standing wave is moving at 130 ms^{-1} on a 2.5 m long string. (i) What is the fundamental fequency of this wave? (2 marks) (ii) What is the frequency of the 3rd harmonic? (2 marks) (iii) How many nodes and anti-nodes are present in the wave of the 3rd harmonic? (2 marks) (iv) What is the frequency of the 5th overtone? (2 marks) (v) What is the wavelength of the 3rd overtone? (2 marks) (b) Discuss the characteristic properties of laser light. (5 marks)	15	1,4	2
10.	(a) Describe the structure and operation of photo diode with appropriate diagrams. Distinguish between PN and PIN diode for fiber applications. (10 marks) (b) A PIN photodiode, on an average, generates one electron-hole pair per two incident photons at a wavelength of 0.85 μm. Assuming that all the photo-generated electrons are collected, calculate (i) the quantum efficiency of the diode (2 mark), (ii) the maximum possible bandgap energy (in eV) of the semiconductor, assuming the incident wavelength to be a long-wavelength cut-off (1 marks); and (iii) the mean output photocurrent when the incident optical power is 10W. (2 marks)	15	5	3

BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)

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