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Dec. 2025

B.Tech. (ECE/ENC/EE(IoT)/EL) (First Semester)

Physics (Waves and Optics)

(PHU-153-V/BSC-101C)

Time : 3 Hours] [*Maximum Marks : 75*

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other.

Part A

1. (a) A plane transmission grating has 32000 lines per inch over a length of 10 inch. Find the resolving power of the grating in second order. **1.5**

(b) What is meant by population inversion ? How is it achieved ? **1.5**

(c) When a movable mirror of Michelson Interferometer is shifted through 0.059 nm, a shift of 200 fringes is observed. Determine the wavelength in angstrom. **1.5**

(d) What do you understand by laser action ? **1.5**

(e) What is mirage effect ? **1.5**

(f) Find the intensity of a laser beam of 150 mW power and having a diameter of 1.5 m assuming the intensity to be uniform. **1.5**

(g) What is Rayleigh's limit of resolution ? **1.5**

(h) What is meant by Evanescent waves ? **1.5**

(i) Define nodes and antinodes. **1.5**

(j) Explain relation between group velocity and phase velocity in dispersive medium. **1.5**

Part B

2. (a) Derive the expression for velocity of transverse waves along a stretched string. **5**

(b) What are Fresnel equations ? Mathematically explain how the Fresnel's equation describe the reflection and transmission of electromagnetic waves at the interface. **10**

3. (a) A particle executes SHM for period 16s. 2s after it passes the center of oscillation its velocity is found to be 4 m/s. Find the amplitude. **5**

(b) What is driven harmonic oscillator ? Derive differential equation for the forced harmonic oscillator and discuss condition for resonance amplitude. **10**

4. (a) What is impedance matching and why is it required ? If two strings of characteristic Z_1 and Z_3 need to be joined through another string of impedance Z_2 for minimum loss, prove that $Z_2 = \sqrt{Z_1 Z_3}$. **12**

(b) Find the ray transfer matrix for refraction at a spherical boundary. **3**

5. (a) A parallel beam of monochromatic light is allowed to be incident normally on the plane transmission grating having 5000 lines/cm and the second order spectral line is found to be diffracted through 30°. Calculate the wavelength of the light. **5**

(b) What is diffraction grating ? Explain the spectra formed by it and also show that intensity is not uniformly distributed over all maxima. **10**

6. (a) Discuss with suitable diagram the principle, construction and working of Solid-State Laser. **8**

(b) Explain three-level and four-level laser schemes. **4**

(c) Calculate the coherence length for a laser beam for which the bandwidth (Δv) is 3000Hz. **3**

7. Write short notes on the following : **3×5=15**

(a) Newton's ring

(b) LCR electrical oscillator

(c) Fermat's principle and its applications.

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