[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7375 **L**

Unique Paper Code : 2513040027

Name of the Paper : Optoelectronic Devices and Application (DSE)

Name of the Course : **B.Sc. (H) Instrumentation**

Semester : VIII

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. **1** is compulsory. **All** questions carry equal marks. Attempt any **5** questions in all.
3. Use of Non-programable scientific calculator is allowed.

Q.1	(a)	An electromagnetic wave has frequency 5×10^{14} Hz. Calculate its wavelength in free space.	(3)
	(b)	An optical amplifier provides 20 dB gain. If input signal power is 0.1 mW, calculate output power in mW and dBm.	(3)
	(c)	Distinguish between linear, circular and elliptical polarization.	(3)
	(d)	State Malus' Law.	(3)
	(e)	A wave has angular frequency 2×10^{15} rad/s and wave number 1×10^{7} m^{-1}. Find phase velocity.	(3)
	(f)	What is population inversion in semiconductor laser?	(3)
Q.2	(a)	Derive the expression for velocity of EM wave in free space.	(7)
	(b)	Explain construction and working of optical resonator with diagram.	(7)
	(c)	Define (i) temporal coherence and (ii) spatial coherence.	(4)
Q.3	(a)	Explain optical waveguide and their classification. Derive expression for Numerical Aperture (NA) and solve NA for given values n_1=1.5 , n_2=1.48.	(7)
	(b)	Explain working of fiber directional coupler. Derive power transfer equations and calculate power after 5 cm if k = $2m^{-1}$.	(7)
	(c)	For a step-index optical fiber waveguide, core index n_1 = 1.48, cladding n_2 = 1.46, core radius, a = 4 μm, and wavelength λ = 850 nm. Calculate the V-number (normalized frequency) and state whether the fiber is single-mode or multimode.	(4)

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Q.4	(a)	Derive expression for phase velocity of ordinary and extraordinary rays.	(7)
	(b)	Explain nonlinear polarization and derive Second Harmonic Generation (SHG) frequency relation. Calculate SHG wavelength for 800 nm input.	(8)
	(c)	Plane polarized light of intensity 100 W/m² passes through analyzer at 30°. Find transmitted intensity.	(3)
Q.5	(a)	Explain construction and working of a laser diode. Calculate photon energy and frequency for wavelength 1.3 μm.	(7)
	(b)	Differentiate between PIN photodiode and Avalanche Photodiode (APD).	(6)
	(c)	What is a laser diode and describe its principle of operation.	(5)
Q.6	(a)	Derive Bragg condition and calculate Bragg wavelength for n_{eff} = 1.46 nm and grating period (Λ) = 0.5 μm.	(8)
	(b)	In a medium, refractive index varies as $n = 1 + \frac{A}{\lambda^2}$, Derive an expression for group velocity.	(7)
	(c)	A light source has wavelength spread of 2 nm at 600 nm. Calculate the coherence length.	(3)
Q.7	(a)	Explain working of Avalanche Photodiode and derive expression for multiplication factor.	(8)
	(b)	Describe operation of a phototransistor and write an expression for the output current.	(7)
	(c)	In second-harmonic generation, input λ = 800 nm. Calculate the output wavelength.	(3)