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DECEMBER 2022 (INSEM+ ENDSEM) EXAM

F.Y. B. TECH. (SEMESTER - I)

COURSE NAME: Engineering Physics

COURSE CODE: ES10204A

(PATTERN 2020)

Time: [2Hr] [Max. Marks: 60]

(*) Instructions to candidates:

1) **Figures to the right indicate full marks.**
2) **Use of scientific calculator is allowed**
3) **Use suitable data where ever required**

Q No.	Question Description	Marks	CO mapped	Blooms Taxonomy Level
Q.1	(i) Starting from the expression for displacement for undamped oscillations $u(t) = Acos\omega_n t + Bsin\omega_n t$, the acceleration a(t) is given by (a) $-A\omega_n^2 cos\omega_n t + B\omega_n^2 sin\omega_n t$ (b) $-A\omega_n cos\omega_n t + B\omega_n sin\omega_n t$ (c) $-Asin\omega_n t + Bcos\omega_n t$ (d) $-A\omega_n^2 cos\omega_n t - B\omega_n^2 sin\omega_n t$	[2]	[1]	U
	(ii) For a damped spring mass system with m=1kg, k=20.5209N/m, ζ = 0.3, calculate the ratio of damped to undamped frequency (a) 0.84 (b) 0.954 (c) 0.7 (d) 0.91	[2]	[1]	A
	(iii) For a critically damped free oscillation (viscously damped), which of the following statements is true? (a) $\frac{\omega_D}{\omega_n}$ is zero (b) $\frac{\omega_D}{\omega_n}$ is equal to one (c) $\frac{\omega_D}{\omega_n}$ is infinite (d) T_D is zero	[2]	[1]	U
	iv) In Forced Harmonic Oscillations with weak viscous damping, when the frequency of the harmonic driving force is equal to the natural frequency of the system, the deformation response factor is governed by (a) Mass of the system (b) stiffness of the system (c) Applied Force (d) damping ratio	[2]	[1]	U

	v) If the amplitudes for 2nd and 4th oscillations are 10 cm and 2cm, respectively, then the logarithmic decrement for a viscously damped oscillation is (a) $e^{0.8}$ (b) 0.008 (c) 0.08 (d) 0.80	[2]	[1]	A
	vi) For a forced damped oscillation, if the angular frequency of the applied force is twenty times the natural angular frequency of the system, the deformation factor is (a) 0.25 (b) 1 (c) 0.0025 (d) 0.025	[2]	[1]	A
	vii) For a damped free oscillation with a damping ratio of 0.16 and natural frequency of oscillation at 15Hz, the damped time period is (a) 0.068 (b) 0.42 c) 0.68 (d) 0.042	[2]	[1]	A
	viii) For a forced damped oscillation with $\zeta = 0.13$, when the frequency of the force driving the system equals its natural frequency, the value for R_d is (a) 5.38 (b) 5.83 (c) 3.58 (d) 3.85	[2]	[1]	A
	ix) In a p-type semiconductor, the value of $E_{Fi} - E_v$ increases with (a) increase in doping concentration of trivalent impurity (b) increase in doping concentration of pentavalent impurity (c) decrease in doping concentration of trivalent impurity (d) Increase in the band gap of the material	[2]	[2]	U
	x) Which statement given with reference to "The positively charged donor atoms on the n-side and negatively charged acceptor atoms on the p side near the junction of a p-n junction diode at equilibrium" is true? (a) The concentration of these charges is independent of the doping (b) The opposite charges diffuse to neutralize each other (c) They give rise to a potential barrier (d) None of the given options	[2]	[2]	U
	xi) If the value of the Fermi-Dirac distribution function for $E=E_F$ is 0.5 at 300K, its value for $E=E_F$ at 500K is (a) Less than 0.5 (b) Greater than 0.5 (c) Equal to 1 (d) Equal to 0.5	[2]	[2]	U
	xii) If the probability of finding the electron at an energy 0.01eV below E_F is 0.98 at a given temperature, then the probability of absence of an electron 0.01eV above E_F is (a) 0.98 (b) 0.01 (c) 0.02 (d) 1	[2]	[2]	A
	xiii) In a p-n junction diode, which of the following statements is true? (a) The electric field is maximum at the junction (b) The electric field is minimum at the junction (c) The electric field is maximum at the left edge of the depletion layer (d) The electric field is maximum at the right edge of the depletion layer	[2]	[2]	U

	xiv) In a p-type silicon sample, the hole concentration is 2.25 $\times 10^{15}$ cm^{-3}. If the intrinsic carrier concentration is 1.5×10^{10} cm^{-3}, the electron concentration is (a) Zero (b) 10^{10} cm^{-3} (c) 10^{5} cm^{-3} (d) 1.5×10^{10} cm^{-3}	[2]	[2]	A
	xv) For p-type GaAs with a band gap of 1.424eV, if E_{Fi}-E_{Fp}=0.5eV, then E_{Fp}-E_v is equal to (a) 0.924eV (b) 0.212eV (c) 1.012eV (d) 1.212eV	[2]	[2]	A
Q2	**Solve any three out of four** a) What is numerical aperture of an optical fiber? Obtain an expression for the same in terms of the fractional refractive index and explain how the numerical aperture can be controlled.	**[15]** [5]	[3]	U
	b) What are the different types of optical fibers? Explain briefly how light propagates through each type. Which of these optical fibers is useful in long distance telecommunication? Explain why.	[5]	[3]	U, A
	c) With the help of a schematic, explain the working of a fiber optic communication system. What is the optimized wavelength used for communication? State the reason, in brief, why this value is chosen. What would be the consequence of choosing a source having a wavelength in the UV region?	[5]	[3]	U, A
	d) For an optical fiber with a core index of 1.6, calculate the group velocity of the electromagnetic waves propagating in the fiber and the time taken by the wave group to travel a distance of 2.5 km. *Given*, $\lambda = 1500nm$ *and* $\frac{dn_1}{d\lambda} = 2.5 \times 10^{-4} nm^{-1}$.	[5]	[3]	A
Q.3	**Solve any three out of four** a) Explain the phenomena of spontaneous and stimulated emissions using relevant diagrams. What is population inversion? Why is it required to sustain stimulated emission? What are the properties of the light emitted by these two processes?	**[15]** [5]	[4]	U
	b) With the help of neatly labelled diagram/s, explain the action of optical cavity in obtaining a monochromatic laser beam.	[5]	[4]	U
	c) A He-Ne laser has a full width of the gain curve of Δv =2.25GHz at 6328Å. If the length of the optical cavity of the laser is 13cm, what is the 1) mode number m 2) peak frequency 3) width of the gain curve in terms of wavelength ($\Delta\lambda$) 4) mode separation frequency ν_{ms} 5) how many modes are allowed in the width of the gain curve?	[5]	[4]	A
	d) Obtain a relation for the angular divergence of a laser beam emitted through a circular aperture in terms of cross-sectional diameters at two distances from the circular aperture. If the diameters of the cross-section of the laser beam are 1.2 mm and 1.7 mm at distances of 35 cm and 55 cm from the edge of the circular aperture, calculate the angular.	[5]	[4]	U, A