U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

October 2024 Supplementary Examinations

Programme: B.E. **Semester: II**
Branch: Mechanical Engineering Stream **Duration: 3 hrs.**
Course Code: 22PH2BSPME **Max Marks: 100**
Course: Applied Physics for Mechanical Engineering Stream

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Physical constants:

Mass of electron, $m_e = 9.1\times10^{-31}$ kg
Electronic charge, $e = 1.602\times10^{-19}$ C
Boltzmann constant, $k_B = 1.38\times10^{-23}$ J/K
Permittivity of free space$=8.85\times10^{-12}$ F/m
Speed of light, $c = 3\times10^{8}$ m/s
Planck constant, $h = 6.626\times10^{-34}$ Js
Mass of neutron, $m_n = 1.67\times10^{-27}$ kg
Mass of proton, $m_p = 1.67\times10^{-27}$ kg

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			MODULE - I	***CO***	***PO***	**Marks**
1	a)		Derive an expression for the energy density of radiation under thermal equilibrium conditions in terms of Einstein's coefficients.	*CO 1*	*PO 1*	**8**
	b)		Define attenuation in optical fiber with the expression for attenuation coefficient. Discuss the causes of attenuation in optical fibers with suitable diagrams.	*CO 1*	*PO 1*	**8**
	c)		A laser beam with power per pulse of 1 mW lasts for 10 ns. If the number of emitted photons per pulse is 3.94×10^{7}, calculate the wavelength of laser.	*CO 1*	*PO 2*	**4**
			OR			
2	a)		Define numerical aperture. Derive an expression for the numerical aperture of an optical fiber and also arrive at the condition for light propagation.	*CO 1*	*PO 1*	**8**
	b)		Describe the construction and working of a semiconductor diode LASER with the help of an energy level diagram.	*CO 1*	*PO 1*	**8**
	c)		A fiber has a diameter of 5 μm, core refractive index of 1.46 and cladding refractive index of 1.42. Calculate the number of modes that can propagate in the fiber, if the wavelength of the source is 1.5 μm.	*CO 1*	*PO 2*	**4**
			MODULE - II			
3	a)		What are forced oscillations? Arrive at the expression for amplitude (A) and phase (ϕ) of the forced oscillations.	*CO 1*	*PO 1*	**8**
	b)		Derive an expression for the total energy of a simple harmonic oscillator and represent graphically the variation of potential, kinetic, and total energy with time.	*CO 1*	*PO 1*	**8**

		c)	The Q-factor of a spring loaded with 0.3 kg is 60. It vibrates with a frequency of 2 Hz. Calculate the relaxation time and damping constant.	*CO 1*	*PO 2*	**4**
			MODULE - III			
	4	a)	What is Fermi energy? Explain the variation of Fermi factor with energy at different temperatures with a neat diagram.	*CO 1*	*PO 1*	**8**
		b)	What is thermal conductivity? Obtain an expression for the thermal conductivity of a conductor using classical free electron theory.	*CO 1*	*PO 1*	**8**
		c)	Calculate the electrical conductivity and Lorentz number of a metal with relaxation time of 10^{-14} s at 300 K. The thermal conductivity of the metal is 124 $Wm^{-1}K^{-1}$ (density of electron is $6 \times 10^{28}\ m^{-3}$).	*CO 1*	*PO 2*	**4**
			OR			
	5	a)	Mention the postulates of quantum free electron theory (QFET) and discuss any two success of QFET.	*CO 1*	*PO 1*	**8**
		b)	Discuss the experimental determination of the thermal conductivity of a given sample by Lee–Charlton's method with suitable diagrams.	*CO 1*	*PO 1*	**8**
		c)	Calculate the probability of an electron occupying an energy level of 0.06 eV above and below the Fermi level at 500 K.	*CO 1*	*PO 2*	**4**
			MODULE - IV			
	6	a)	State Hooke's law. Explain the stress and strain relation using a neat graph.	*CO 1*	*PO 1*	**8**
		b)	What is the bending moment of a beam? Derive an expression for the bending moment of a rectangular beam in terms of moment of inertia with proper cross sectional diagram.	*CO 1*	*PO 1*	**8**
		c)	Calculate the force required to produce an extension of 1 mm in steel wire of length 2 m and diameter 1 mm. (Young's modulus for steel $Y=2\times10^{11}$ N/m^2).	*CO 1*	*PO 2*	**4**
			MODULE - V			
	7	a)	State Bragg's law. Obtain the atomic radius and calculate the atomic packing factor for BCC and FCC structure.	*CO 1*	*PO 1*	**8**
		b)	Define interplanar spacing. Obtain an expression for interplanar spacing in-terms of Miller indices for a cubic crystal.	*CO 1*	*PO 1*	**8**
		c)	The interplanar spacing of the (1 0 1) plane is 2 Å for simple cubic crystal. Calculate the atomic radius.	*CO 1*	*PO 2*	**4**

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