U.S.N.										

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

Autonomous Institute Affiliated to VTU

September 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 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

Q. No.	MODULE - I	CO	PO	Marks
1.(a)	Derive an expression for the energy density of radiation under equilibrium conditions in terms of Einstein's coefficients.	CO 1	PO 1	**8**
(b)	What is numerical aperture? Derive an expression for the numerical aperture of an optical fiber.	CO 1	PO 1	**8**
(c)	In a LASER system, the energy difference between two energy levels is 2×10^{-19} Joules. The average output power of a LASER beam is found to be 4 mW. Calculate the number of photons emitted per second.	CO 1	PO 2	**4**
	OR			
2.(a)	Describe the construction and working of semiconductor laser with a neat schematic and energy level diagram.	CO 1	PO 1	**8**
(b)	Discuss the different types of optical fibers with neat diagrams.	CO 1	PO 1	**8**
(c)	The attenuation of light in an optical fiber is 3.6 db/km. What fraction of its initial intensity remains after 3 km.	CO 1	PO 2	**4**
	MODULE - II			
3.(a)	Define free oscillations. Derive the differential equation for free oscillations and hence obtain the expression for natural frequency of vibrations.	CO 1	PO 1	**8**

(b)	What are forced vibrations? Obtain an expression for amplitude of vibration of a body undergoing forced vibrations.	*CO 1*	*PO 1*	**8**
(c)	The amplitude for the resonance of a spring-mass system is 5 cm. If the angular frequency of the driving force is 100 rad/sec and the damping constant is 50 gm/sec, then find the amplitude of the driving force.	*CO 1*	*PO 2*	**4**
	MODULE - III			
4.(a)	Mention any four assumptions of quantum free electron theory. Discuss any two success of quantum free electron theory.	*CO 1*	*PO 1*	**8**
(b)	Describe the experiment to determine the thermal conductivity of a poor conductor by Lee-Charlton's method with neat diagram.	*CO 1*	*PO 1*	**8**
(c)	Find the temperature at which there is 1% probability of occupation of an energy level 0.5 eV above Fermi level.	*CO 1*	*PO 2*	**4**
	OR			
5.(a)	Define Fermi energy and Fermi factor. Discuss the variation of Fermi factor with temperature and energy with suitable graph.	*CO 1*	*PO 1*	**8**
(b)	State Wiedemann-Franz law. Deduce the classical expression for thermal conductivity of a conductor.	*CO 1*	*PO 1*	**8**
(c)	Calculate the probability of an electron occupying an energy level 0.02 eV above the Fermi level at 200 K and 400 K in a material.	*CO 1*	*PO 2*	**4**
	MODULE - IV			
6.(a)	State Hook's law and explain different moduli of elasticity in detail.	*CO 1*	*PO 1*	**8**
(b)	What is couple force? Derive an expression for couple per unit twist when one end of the cylinder is fixed and couple is applied at the other end.	*CO 1*	*PO 1*	**8**
(c)	Calculate the shearing force required to distort a block of steel by 0.75 cm, if its thickness is 15 cm and surface area is 6 cm^2. The shear modulus for steel is 7 x 10^{10} Nm^{-2}.	*CO 1*	*PO 2*	**4**
	MODULE - V			
7.(a)	What are Miller indices? Derive an expression for interplanar spacing in terms of Miller indices.	*CO 1*	*PO 1*	**8**
(b)	Define atomic packing factor. Obtain the atomic radius and calculate the atomic packing factor for BCC and FCC structures.	*CO 1*	*PO 1*	**8**
(c)	Calculate the crystal size when the peak width is 0.5 cm and the peak position is 25^0 for a simple cubic crystal. The wavelength of the X-ray used is 1.54 Å and Scherer's constant, k=0.94.	*CO 1*	*PO 2*	**4**

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