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M S RAMAIAH INSTITUTE OF TECHNOLOGY

(AUTONOMOUS INSTITUTE, AFFILIATED TO VTU)
BANGALORE – 560 054

SEMESTER END EXAMINATIONS – JANUARY 2016

Course & Branch	: B.E- Common to All Branches	Semester	: I/II
Subject	: Engineering Physics	Max. Marks	: 100
Subject Code	: PHY101 / PHY201	Duration	: 3 Hrs

Instructions to the Candidates:

- Answer ***one*** full question from each unit.
- Physical constants: $h=6.63 \times 10^{-34}$ Js; $k=1.38 \times 10^{-23} JK^{-1}$; $m_e=9.1 \times 10^{-31}$kg; $e=1.6\times10^{-19}$c; $N_A=6.02\times10^{26}$/k.mol; $c=3\times10^8 ms^{-1}$.

UNIT – I

1. a) Determine the expression for moment of inertia of a solid cylinder of mass M, length L and radius R about an axis passing through its centre and perpendicular to its own axis. CO1 (08)

   b) Distinguish between linear and lateral strains. Obtain expression for rigidity modulus in terms of linear and lateral strains CO1 (07)

   c) Define radius of gyration. Four masses each of 100 g are kept at the corners of a rectangular plate of mass 500g, length 20 cm and breadth 10 cm. If rectangular plate is rotating about an axis passing through centre and perpendicular to plane, determine its moment of inertia and radius of gyration. CO1 (05)

2. a) Define Poisson's ratio and mention its theoretical limits. A material has Poisson's ratio 0.3. If a uniform rod of it suffers longitudinal strain 4×10^{-3}, estimate percentage change in its volume. CO1 (05)

   b) Derive the expression for couple per unit twist by considering the torsion of a cylindrical rod clamped at one end. CO1 (07)

   c) Define moment of inertia. Obtain moment of inertia of a circular plate about an axis passing through (i) its midpoint and perpendicular to plane (ii) a tangent perpendicular to the plane. CO1 (08)

UNIT – II

3. a) Define group velocity and phase velocity. If the phase velocity of CO2 (05)

	c)	Explain natural broadening of spectral lines using Heisenberg's uncertainty principle. Calculate intrinsic line width of the emitted spectral line when an atom transits from an excited state to ground state. The excited state has a lifetime of 10^{-6} sec and is separated from the ground state by 2 eV.	CO2	(07)
4.	a)	Apply one dimensional time independent Schrodinger wave equation to determine reflection coefficient when particles of energy E incident on a step potential of height V (E>V).	CO2	(07)
	b)	State Heisenberg's uncertainty principle and give its various forms. A proton is confined in one dimensional region of 2 Å. If the percentage uncertainty in the velocity of proton is 0.01, estimate kinetic energy of proton. (mass of proton= 1.67×10^{-27} kg)	CO2	(06)
	c)	Obtain an expression for group velocity using superposition principle. An electron is accelerated through a potential difference of 250 V. Determine de Broglie wavelength and group velocity associated with the electron.	CO2	(07)

UNIT – III

5.	a)	Distinguish between any three predictions of classical free electron theory and quantum free electron theory.	CO3	(06)
	b)	Define Fermi factor and Fermi energy. Calculate the energy of the state for which probability of occupation is 2% at 300K. (Given: the concentration of electrons in silver is 5.85×10^{28} $/m^3$)	CO3	(07)
	c)	Differentiate between drift current and diffusion current in a p-n junction. Draw and explain energy band diagrams for (i) Forward biased and (ii) reverse biased p-n junction.	CO3	(07)
6.	a)	Define drift velocity and thermal velocity. The density and atomic weight of monovalent copper are 8.92×10^3 kg/m^3 and 63.5 respectively. Compute the mobility and average time of collision of electrons in copper if resistivity of copper is 1.73×10^{-8} Ωm.	CO3	(06)
	b)	Obtain an expression for electron concentration in the conduction band of an intrinsic semiconductor.	CO3	(07)
	c)	Derive the expression for density of energy states in a metal.	CO3	(07)

UNIT – IV

7.	a)	What are the advantages of optical fiber communication? An optical signal lost 25% of its power in a length L in an optical fiber. If length is doubled determine the percentage loss in power of the signal.	CO4	(07)
	b)	Discuss types of optical fibers with refractive index profile and modal dispresion diagrams.	CO4	(06)
	c)	Derive the expression for energy density of radiation and obtain the relation between Einstein's coefficients.	CO4	(07)
8.	a)	Define acceptance angle. Derive the expression for numerical aperture of an optical fiber.	CO4	(05)

	b)	Explain construction and working of a He-Ne laser with diagrams. A laser medium at a thermal equilibrium temperature 350K has two energy levels with a wavelength separation of 1 μm. Calculate the ratio of population densities of the these energy levels.	CO4	(09)
	c)	Describe the recording and reconstruction processes in holography with the help of suitable diagrams.	CO4	(06)

UNIT – V

9.	a)	Define packing factor. Obtain packing factor for bcc and fcc lattices.	CO5	(05)
	b)	Assuming the expression for interatomic force, obtain the expression for cohesive energy of a diatomic molecule. Plot the variation of potential energy of molecule with interatomic spacing.	CO5	(09)
	c)	Explain Bragg's law. A beam of X-rays of wavelength 0.842 Å is incident on a crystal at a glancing angle of 8°35′when first order Bragg's reflection occurs. Calculate the glancing angle for third order reflection.	CO5	(06)
10	a)	Derive expression for interplanar spacing in terms of Miller indices. Calculate interplanar spacing of (131) plane of a fcc structure whose atomic radius is 0.175 nm.	CO5	(09)
	b)	Explain powder crystal diffraction method for identification of cubic crystals. The first order reflection maxima occur at glancing angle of 5.4°, 7.6° and 9.4° from (100) (110) and (111) planes. Determine crystal structure.	CO5	(07)
	c)	Identify the types of unit cells and list the corresponding sub lattices for each unit cell from the following data: (i)a=4.3Å; b=3.2Å; c=5.5Å; $\alpha = \gamma = 90°$; $\beta = 60°$ (ii) a=3.5Å; b=4.5 Å; c= 5.4Å; $\alpha = \beta = \gamma = 90°$	CO5	(04)

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