PHY101/201

USN	1	M	S							

M S RAMAIAH INSTITUTE OF TECHNOLOGY

(AUTONOMOUS INSTITUTE, AFFILIATED TO VTU)

BANGALORE – 560 054

SEMESTER END EXAMINATIONS – JANUARY 2015

Course & Branch	**: B.E.:- (Common to All Branches)**	**Semester**	**: I/II**
Subject	**: Engineering Physics**	**Max. Marks**	**: 100**
Subject Code	**: PHY101/201**	**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; $\varepsilon_0=8.85 \times 10^{-12} Fm^{-1}$; $e=1.6 \times 10^{-19}$c; $N_A=6.02 \times 10^{26}$/k.mol; $c=3 \times 10^8 ms^{-1}$.

UNIT – I

1. a) Define moment of inertia and radius of gyration. Deduce an expression for the moment of inertia of a circular plate rotating about an axis (i) passing through its centre and perpendicular to the plane (ii) through a diameter. (09)

   b) What is bending moment of a beam? Deduce the expression for Young's modulus of the material of a single cantilever. (08)

   c) A wire of length 0.6 m and radius 0.56 mm twists through 0.61 radian, when equal and opposite torques of 6.2×10^{-3} Nm are applied at its ends. Calculate the rigidity modulus of the material of wire. (03)

2. a) State and prove parallel axes theorem. (05)

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

   c) Define Poisson's ratio. Write the expressions for Bulk and rigidity modulus in terms of Poisson's ratio. A cantilever of length 0.45 m has a depression of 14 mm at its free end. Calculate the depression at a distance of 0.29 m from the fixed end. (08)

UNIT – II

3. a) Outline the modes of vibration of CO_2 molecule and explain the construction and working of a CO_2 laser with neat diagrams. (09)

   b) Define attenuation and write the expression for attenuation coefficient. Discuss the different causes for attenuation of light in optical fibers. (07)

c) Calculate the number of modes supported by an optical fiber of core diameter 85 μm for an operating wavelength 1.2 μm. The refractive index of core is 1.516 and the fractional index change is 5.6×10^{-3}. (04)

4. a) Briefly outline the interaction of radiation with matter and obtain the expression for energy density of radiation in terms of Einsteins's coefficients. (09)

b) Explain different types of optical fibers with refractive index profiles. Explain how intermodal dispersion can be minimized in graded index fibers. (08)

c) A laser beam has power output of 1.5 mW. If the number of photons emitted per second is 3.941×10^{15}, calculate the wavelength of laser. (03)

UNIT – III

5. a) Set up time independent one dimensional Schrodinger's wave equation. Give the characteristics of wave function. (09)

b) Define phase velocity and group velocity. The phase velocity of ripples on liquid surface is $v_p = \sqrt{\frac{2\pi s}{\lambda \rho}}$ where s is surface tension and ρ is density. Find the group velocity in terms of phase velocity. (06)

c) What is step potential? Electrons of energy 2 eV are incident on a step potential of height 4 eV. Determine the relative probability of finding the particles at (i) x=1Å and (ii) x=10Å from the barrier edge. (05)

6. a) Solve the Schrodinger's equation to obtain Eigen energy values and Eigen wave functions for a particle confined to one-dimensional potential well of infinite height. (07)

b) State and give the significance of Heisenberg's uncertainty principle. The excited state of an atom is separated from the ground state by an energy of 2.5 eV and the lifetime of the excited state is 10^{-8} s. Calculate the wavelength of corresponding spectral line and its intrinsic line width. (08)

c) What is quantum mechanical tunneling? Explain the principle of Scanning Tunnelling Microscope (STM) with a diagram. (05)

UNIT – IV

7. a) Define density of states. Derive the expression for density of states in a metal. (08)

b) What is Hall effect? Derive the expression for Hall voltage and Hall coefficient in an n-type semiconductor. (06)

c) Calculate the drift velocity, thermal velocity, relaxation time and mean free path of free electrons in aluminium (Al) at 27 °C in an applied field of 10 Vcm^{-1}. The density, atomic weight and resistivity of trivalent Al are 2700 kg m^{-3}, 26.98 kg and 6.7 $x10^{-8}\Omega m$ respectively. (06)

8. a) Deduce the expression for electrical conductivity of metals based on classical free electron theory. What are the drawbacks of classical free electron theory? (07)

b) What are the assumptions of quantum free electron theory? At what temperature will there be 1% probability for the occupancy of a state with energy 0.5eV above the Fermi level? (06)

c) Derive the expression for electron concentration in conduction band in a semiconductor. (07)

UNIT – V

9. a) What is a Bravais lattice? Explain the seven crystal systems mentioning the possible sub lattices. (07)

b) Define cohesive energy. Obtain the expression for cohesive energy of a diatomic molecule and plot the variation of potential energy of molecule with interatomic spacing. (08)

c) Calculate the radius of atoms in a FCC crystal, if a beam of x-rays of wavelength 1 Å undergoes first order Bragg reflection from (1 0 2) planes at a glancing angle of 10.3°. (05)

10. a) Define atomic packing factor (APF) and coordination number. Calculate the APF for BCC and FCC lattices. (06)

b) Obtain the expression for interplanar spacing of a cubic crystal in terms of Miller Indices. In a simple cubic lattice with a = 0.6 nm, a crystal plane is parallel to the X-axis and has intercepts in the ratio of 2:3 along Y and z axes. Calculate the Miller indices and sketch the plane. Also find the interplanar distance. (10)

c) Describe the crystal structure of ZnS with a neat diagram. (04)

****