PHY101/201

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M S RAMAIAH INSTITUTE OF TECHNOLOGY

(AUTONOMOUS INSTITUTE, AFFILIATED TO VTU)

BANGALORE – 560 054

SEMESTER END EXAMINATIONS – JUNE 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.

UNIT – I

1. a) Derive the equation for bulk modulus in terms α & β, and hence arrive at the relation between Y, k and σ. (06)

   b) State and prove parallel axes theorem. Compare the moments of inertia of a rectangular plate of length 20 cm, breadth 10 cm and mass 1 kg, about the axes passing through its center and perpendicular to its plane, and passing through the edge parallel to the breadth. (08)

   c) Distinguish between stress and pressure. Derive the equation for bending moment of a beam. (06)

2. a) Sketch the different forces acting on a single cantilever loaded at its free end and arrive at the equation for the depression at its free end. (08)

   b) Define radius of gyration. Derive the equation for the moment of inertia of a circular plate about an axis passing through its center and perpendicular to its plane. (06)

   c) A cylindrical wire of radius 0.5 mm and length 25 cm is hung vertically. Calculate the couple to be applied so that its free end is twisted through 1°. The Young's modulus of the material of the wire is 20×10^{10} Nm^{-2} and its Poisson's ratio is 0.43. (06)

UNIT – II

3. a) Distinguish between spontaneous emission and stimulated emission. What are the basic requisites of a laser system and conditions for laser action. (05)

   b) Discuss the principle behind the working of an optical fiber. Calculate the power output from an optical fiber of length 4500 m, with an attenuation coefficient 0.23 dB km^{-1}, if the input power is 130 mW. (05)

   c) Describe the different modes of vibration of CO_2 molecule. Explain the construction and working of a CO_2 laser with relevant figures. (1(

4. a) Define attenuation in an optical fiber and write the expression for attenuation coefficient. Discuss any three mechanisms leading to attenuation. (08)

b) Determine the number modes supported by a step index multimode optical fiber of core and clad refractive indices 1.54 and 1.50 respectively, for a carrier wave of wavelength 0.8 μm. The diameter of the core is 70 μm. (04)

c) Explain the principle and working of a semiconductor laser. (06)

d) Calculate the ratio of populations of two energy levels separated by 2.6 eV at a temperature of 50°C. (02)

UNIT – III

5. a) Explain the de Broglie's hypothesis. Show that particle velocity is equal to group velocity. (06)

b) Apply Schrodinger wave equation to the case of a particle incident on a step potential of height V greater than the energy of the particle, E and show that the particle eventually gets reflected. How is this different from a classical physics . (08)

c) What are the characteristics of a wave function? Calculate the probability of finding a particle in the first quarter of the ground state of a 1-dimensional potential well of infinite height and of finite width. (06)

6. a) Set up 1-dimensional time independent Schrodinger wave equation. (06)

b) Derive the expression for reflection and transmission coefficients when particles of energy E are incident on the step potential with E>V. (08)

c) Explain the Heisenberg uncertainty principle and evaluate the intrinsic line width of 650 nm spectral line if the life time of the excited state is 5 ns. (06)

UNIT – IV

7. a) Derive the expression for electron concentration in conduction band of semiconductor. (08)

b) Define relaxation time. Derive the equation for the electrical conductivity in metals according to the classical free electron theory. (05)

c) What is Hall effect? Derive the expression for Hall voltage. The Hall voltage was found to be 1 mV across the width when a magnetic field of 50 T was applied to a material carrying a current of 600 A. Calculate the free charge carrier concentration and the Hall coefficient. (07)

8. a) Define density of states in metals and derive the equation for the density of states. (08)

   b) Define Fermi factor and discuss its variation with temperature and energy with relevant graph. (05)

   c) Show that the intrinsic Fermi level is at the center of the energy gap of an intrinsic semiconductor if $m_e^* = m_h^*$. The energy gap of Si is 1.1 eV. The effective density of states for electrons and holes are 5.15×10^{19} cm^{-3} and 1.9×10^{19} cm^{-3} respectively at 450K. Calculate the intrinsic carrier concentration. (07)

UNIT – V

9. a) What are the different forces acting between the atoms in a molecule? The energy of interaction between two particles in the field of each other is given by $U(r) = \frac{-a}{r} + \frac{b}{r^9}$ where a and b are constants. Show that the particle form a stable compound for $r = r_0 = \left(\frac{9b}{a}\right)^{\frac{1}{8}}$. (05)

   b) Distinguish between primitive cell and unit cell. Define a bravais lattice. Identify the following systems: a) a=b=c and α=β=γ, b) a≠b≠c and α≠β≠γ and c) a=b≠c and α=β=90° γ=120°. (05)

   c) Define atomic packing fraction and estimate its value in case of an FCC and BCC systems. Estimate the radius of atoms crystallizing into a simple cubic lattice if Bragg planes {101} lead to first order diffraction of X-ray of wavelength 1.2 Å when the angle of incidence is 88°. (10)

10. a) What is a crystal defect? Discuss any three types of crystal defects. (06)

    b) Derive the expression for cohesive energy of a diatomic molecule. Sketch u(r) with r. (08)

    c) Explain how Miller indices of a plane are obtained. Determine the Miller indices of a plane making the intercepts on the major axes in a certain cubic crystal with lattice parameter 1 Å, in the ratio 1:3/2:2 and mark the same plane in a unit cell. Calculate the inter planar spacing. (06)

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