GUJARAT TECHNOLOGICAL UNIVERSITY
B.E. Sem-I Remedial Examination March / April 2010

Subject code: 110011   **Subject Name:** Physics
Date: 30 / 03 /2010   Time: 12.00 Noon – 02.30 pm
                                              Total Marks: 70

Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1
   (a) Explain the method to determine the absorption coefficient of material.   **02**
   (b) A liquid column subjected to ultrasonic waves constitutes an acoustical grating, explain.   **02**
   (c) Why Miller indices are reciprocals of the intercepts of the plane along the three axes?   **02**
   (d) Show that the superconductors are perfectly diamagnetic in nature.   **02**
   (e) Three level laser system is rare whereas four level system is common, explain.   **02**
   (f) Why nano materials exhibit different physical properties of materials from those at a large scale?   **02**
   (g) State the requirements for infinite bandwidth optical fiber link.   **02**

Q.2 **(a)** Distinguish between
   (i)   Spontaneous Emission and Stimulated Emission   **04**
   ii)   Monomode and Multimode optical fiber   **03**
   (b) (i) Show that for a cubic lattice the relation between inter planar distance and Miller indices of a family of   **04**

   planes(hkl) is given by $d = \dfrac{a}{\sqrt{h^2 + k^2 + l^2}}$

   (ii) Show for simple cubic lattice that the ratio of separation between successive (100), (110) and (111) lattice planes   **03**
   is $d_{100}:d_{110}:d_{111} = a : a/\sqrt{2} : a/\sqrt{3}$

OR
   (b) i) Draw circuit diagram of oscillator (Pierce's) and explain magnetostriction method to produce ultrasonic waves.   **04**

   ii) Calculate the length of an iron rod which can be used to produce ultrasonic waves of 20 KH$_z$. Density of iron is 7.23×10^3 kg/m^3 and Young's modulus is 11.6×10^{10} N/m^2.   **03**

Q.3 **(a)** Draw the diagram of variation of electron energy as a function of interatomic spacing; explain the formation of energy bands in a solid. Also explain how it helps to classify the materials into conductors, semiconductors and insulators?   **08**

   (b) The Hall coefficient of a semiconductor is 3.22×10^{-4} m^{3}C^{-1} and its resistivity is 9×10^{-3} Ω-m. Calculate concentration and the mobility of the charge carrier. Given: $e = 1.6 \times 10^{-19}$ C.   **06**

OR
Q.3 **(a)** Silicon and Germanium are not suitable for LED's, explain.   **04**
   (b) Discuss the dependence of critical magnetic field and London penetration depth on temperature.   **05**

(c) Calculate the mean free path between collisions of the free electrons in copper at 20 C°. The resistivity of copper at 20 C° is 1.27×10^{-3} Ω-m and density of free electrons is 8.48×10^{28} m^{-3}. **05**
Given: e = 1.6×10^{-19}, m = 9.11×10^{-31} kg and $k_B = 1.38 \times 10^{-23}$ JK^{-1}.

Q.4 **(a)** Show that the ratio of Einstein A coefficient for spontaneous emission to that of Einstein B coefficient for stimulated emission is given by $8\pi h\nu^3/C^3$. **06**

(b) Explain self focusing property of Graded Index optical fiber. **04**

(c) A refractive index of core for step index fiber is 1.52, diameter is 2.9 μm and a fractional difference of refractive index is 0.0007. It is operated at a wavelength of 1.3 μm. Find the number of modes the fiber will support. **04**

OR

Q.4 **(a)** Draw the schematic diagram of hologram construction and explain the formation hologram. **04**

(b) Derive the expression of the numerical aperture of step index optical fiber. Show that it does not depend on the physical dimensions of the fiber. **06**

(c) Find the core radius, of step index fiber, necessary for single mode operation at 850 nm. The refractive indices of core and cladding are 1.48 and 1.47 respectively. **04**

Q.5 **(a)** Discuss the melt spinning process technique for preparing metallic glasses. **05**

(b) Explain working of ultrasonic flow detector. **05**

(c) The ultrasonic pulse-echo is used to locate the position of defect in a steel bar of 40 cm thick. If pulse arrival times form defective and non defective portion are 30 μs and 80 μs respectively. Calculate the distance of defect from the top surface. **04**

OR

Q.5 **(a)** Explain Shape Memory effect and Pseudo Elastic effect. **06**

(b) Why clean surfaces are required for surface and subsurface defect detection incase of liquid penetration NDT method? **04**

(c) State and explain the factors to select a biomaterial for prosthetic device. **04**

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