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SEM 1 – 2

F.E. (Semester – I) Examination, May/June 2013
APPLIED SCIENCE – I (RC 07-08)

Duration: 3 Hours Total Marks: 100

Instruction : *Attempt* ***any four*** *questions, at least* ***one*** *from* ***each*** *Module.*

SECTION – I
(Physics)
Module – I

1. a) Derive $\alpha = \frac{\lambda}{2\mu w}$ for a wedge shaped film, where α is wedge angle and w is fringe width. **5**

   b) Find the conductivity of intrinsic silicon at 300 K. **5**

   Given : $n_i = 1.5 \times 10^{16}/m^3$, $\mu_n = 0.13\ m^2v^{-1}s^{-1}$ and $\mu_p = 0.05\ m^2v^{-1}s^{-1}$.

   Also calculate the conductivity if donor type impurity is added to the extent of one impurity atom in 10^8 silicon atoms. Density of silicon atoms is $5 \times 10^{28}/m^3$.

   c) Why antireflection film is needed for a good camera lens ? Briefly explain the phase requirement in such films. Why multilayer coatings is preferred over a single layer coating ? **5**

   d) What is continuity equation ? Derive expression for one dimensional continuity equation for electrons as well as for holes. **10**

2. a) What is Hall effect ? Derive expression for Hall voltage. **5**

   b) White light falls at an angle of 50° on a parallel soap film of R.I. 1.33. At what minimum thickness of the film will it appear bright yellow of wavelength 5800 Å in reflected light. **5**

   c) The Hall coefficient of a certain specimen of silicon was found to be $-7.35 \times 10^{-5}\ m^3c^{-1}$. Is this semiconductor n-type or p-type. Electrical conductivity at room temperature was found to be $200\Omega^{-1}m^{-1}$. Calculate the density and mobility of charge carriers at room temperature. **5**

   d) i) Write briefly on use of interference in checking flatness of a surface. **10**

   ii) What is the necessity of extended source for the interference based on division of amplitude.

P.T.O.

Module – II

3. a) Describe the working of an ionisation chamber. Mention its use. 5

   b) Draw the block diagram of a CRO. Briefly explain the use of CRO to determine frequency of ac mains. 5

   c) Explain the principle and working of magnetic lens. 5

   d) Draw the circuit diagram of piezoelectric oscillator and explain its working. If 1.5 MHz frequency is to be generated in above circuit using tourmaline crystal of density 2.82 g/cc and Young's modulus 7.9×10^{11} dyne/cm^2. What should be the thickness of the crystal ? 10

4. a) What is cavitation ? Give atleast two applications of it. 5

   b) Give any two methods of detection of ultrasonic waves. 5

   c) Explain the principle and working of electrostatic lens. 5

   d) Explain the working of GM counter. In what way it differs from ionization chamber. 5

   e) Describe acoustic diffraction method to find velocity of ultrasonic waves in liquid. 5

SECTION – II
(Chemistry)
Module – III

5. a) Outline the construction of a glass electrode and illustrate how it can be used to find the pH of an unknown solution. 7

   b) Describe the functioning of solid polymer electrolyte fuel cell. 6

   c) Explain how the following characteristics affect a battery system : 6

      i) Voltage

      ii) Capacity.

   d) Derive the equation to express the electrode potential for the following system Cu^{2+} (0.01 M)/Cu and calculate its electrode potential at 25°C (Given E°Cu = 0.34 V). 6

6. a) The following metals are provided Mg, Al and Cu and their metal salt solutions in concentrations of 0.1, 0.01 and 0.001 M are available. Using the above materials construct voltaic type cell that would give the highest cell potential and calculate the cell potential at 25°C.

   (Given : E°Mg = –2.37 V, E°Cu = 0.34 V, E°Al = –1.66 V). 7

b) Give the characteristic of the electrolyte in the following fuel cells :
   i) Phosphoric acid fuel cell
   ii) Solid oxide fuel cell. 6

c) With the help of a neat labeled diagram explain the construction of calomel electrode and give the reactions involved. 6

d) Outline any six characteristics of a battery system. 6

Module – IV

7. a) An alloy made up of copper and zinc was found to undergo corrosion under service conditions. State and explain at least four possible modes of corrosion which may be due to inherent and external forces, this allay can suffer corrosion. All possible type of environmental conditions can be assumed. 8

   b) A article made up of iron was kept exposed in the environment was found to have undergone corrosion. Consider the above example and explain electrochemical theory of corrosion. All possible type of environmental conditions can be assumed. 6

   c) Explain how the following factors affect the nature of electrodeposit
      i) pH
      ii) Organic additives and
      iii) Throwing power. 6

   d) Give a brief account of electroless plating of nickel. 5

8. a) Explain the phenomenon of differential aeration corrosion with regard to pitting and waterline corrosion. 8

   b) Outline the various constituents of a electroless plating bath. 6

   c) Explain the process of galvanizing with the help of a heat labeled diagram. 6

   d) Draw a neat labeled diagram and explain electroplating of chromium. 5
