SEM 1 – 2

F.E. (Semester – I) (Revised Course) Examination, Nov./Dec. 2013
APPLIED SCIENCE – I
(Physics and Chemistry)

Duration : 3 Hours | Total Marks : 100

Instructions : *1) Answer **one** question from **each** Module.*
*2) Answer **each** Section in **separate** answer book.*
*3) Draw diagrams **wherever** required.*
*4) Assume additional data **if required.***

SECTION – I
(Physics)
Module – I

1. a) Derive the expression for Hall voltage. Explain how it is useful in determining the type of semiconductor. **5**

   b) Derive the condition of bright and dark interference fringes due to reflected light from a parallel sided thin film. **5**

   c) A wedge shaped air film is formed with two glass plates inclined at an angle of 0.03 rad. If light of wave length 6000 A.U. falls normally on the film what will be the fringe width. If wedge angle is reduced to 0.02 rad and the space between the glass plates is filled with a liquid so that the fringe width remains same. What is refractive index of liquid ? **5**

   d) What is continuity equation ? Derive expression for continuity equation for electrons and holes in a semiconductor. **10**

2. a) Describe Newton's rings method to determine refractive index of a liquid. Derive the necessary expression for R.I. **5**

   b) Explain briefly generation and recombination of charge carriers in a semiconductor. Derive the expression for recombination of minority carriers within a semiconductor. **5**

   c) Explain how interference technique can be used to check the planeness of a surface. **5**

   d) A silicon Hall device at T = 300 K has the following geometry : d = 10^{-2} cm (z-dir), W = 10^{-3} cm (y-dir) and L = 10^{-1} cm (x-dir). The following parameters are measured : $I_x = 0.75$ mA, $V_x = 15$V, $V_H = +5.8$ mV and $B_z = 0.1$ Tesla. Determine :

   i) the conductivity type

   ii) the majority carrier concentration and

   iii) the majority carrier mobility. **5**

P.T.O.

e) Derive Einstein's relation between mobility μ and diffusion constant D. If diffusion constant ot electron is 9.36×10^{-3} m^2 s^{-1} at 300 K, what is its mobility. Given $k = 1.38 \times 10^{-23}$ J/K and $e = 1.6 \times 10^{-19}$ C. 5

Module – II

3. a) Explain piezoelectric method to produce ultrasonic waves. 5

b) Write a short note on ionization chamber. 5

c) Two rods of ferromagnetic material Fe and Ni of length 12.5 cm each and having same diameter are to be used to produce ultrasonic waves in magnetostriction oscillator. Identify the rod which will be useful. 5

Densities of Fe and Ni are 7820 kg/m^3 and 8940 kg/m^3, Young's modulus of Fe and Ni are 21.9×10^{10} N/m^2 and 19.8×10^{10} N/m^2 respectively.

d) Explain how the actual waveform of the signal is traced on the CRO screen with the help of signal generator. Also draw a neat labelled diagram of Cathode Ray Tube (CRT). 10

4. a) Describe acoustic grating method to find the wavelength of ultrasonic waves. Obtain the necessary expression for its wavelength. 5

b) Describe construction and working of electrostatic lens. 5

c) What is GM counter ? Explain why and how quenching is carried out in it. 5

d) Discuss application of ultrasonic waves in : 5

i) Echosounder

ii) Flaw detection in metals.

e) Describe how will you measure wavelength and frequency of ac signal on CRO. 5

SECTION – II
(Chemistry)
Module – III

5. a) A galvanic cell is to be operated at 25°C is set up using the elements Mg and Cu. Write its cell representation and chemical reactions involved in the cell. Also find the emf of the cell assuming that $MgSO_4$ (0.01 M) and ($CuSo_4$) (0.05 M) were used as electrolytes. (Given E°Mg = –2.37V and E° Cu = 0.34V). 8

b) The following cell Zn | Zn^{2+} (0.001 M) || Zn^{2+} (0.01 M) | Zn was used in order to obtain electrical energy. State the principle behind working of this cell and explain its working with the help of a neat diagram. Find its emf. 7

c) Explain the working of a 'polymer electrolyte' fuel cell. 5

d) Explain the working of Zn – air battery with relevant reactions. 5

6. a) A galvanic cell is to be operated at 25°C is set up using the elements Ni and Ag. Write its cell representation and chemical reactions involved in the cell. Also find the emf of the cell assuming that Ni was dipped in 0.02M Ni salt solution and Ag rod was dipped in 0.05 M Ag salt solution. (Given E°Ni = –0.23V and E°Ag = 0.8V). 8

b) The following cell Mg/Mg^{2+} (0.001 M) || Mg^{2+} (0.01 M) | Mg was used in order to obtain electrical energy. State the principle behind working of this cell with the help of neat diagram. Also find its EMF. (Given E°Mg = – 2.37 V). 7

c) Explain the working of $H_2 – O_2$ fuel cell. 5

d) Draw a neat labeled diagram of Ni – NH battery and explain its working. 5

Module – IV

7. a) A article made up of iron was exposed in the environment was found to have undergone corrosion. Explain any two mechanisms involved in the process of corrosion. 10

b) Explain the basic setup of an electroplating bath with the help of a suitable example. 5

c) Explain the process of PCB preparation using electroless method. 5

d) Explain how a metallic structure can be protected against corrosion using metal coating. 5

8. a) Explain any four methods by which corrosion can be controlled or avoided. 10

b) Outline the various constituents of a electroless plating bath. 5

c) Explain the process of electroplating with chromium. 5

d) Explain the type of corrosion a tank made of iron, used for storing water most likely to undergo. 5