F.E. (Semester – I) (Revised in 2007-08) Examination, May/June 2014

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** diagram **wherever** required.
4) **Assume** additional data **if required**.

SECTION – I
(Physics)

Duration : $1\frac{1}{2}$ Hours   Marks : 50

Module – I

1. a) Prove that in reflected light radii of dark Newton's rings are proportional to square root of natural numbers. **5**

   b) Derive the expression for conductivity of a semiconductor in terms of mobility and carrier concentration. Hence write down the expression for resistivity of intrinsic semiconductor. **5**

   c) Two glass plates enclose a wedge shaped airfilm, touching at one edge and are separated by a wire at a distance 15 cm from the edge. A monochromatic light of wavelength 6000 A.U. is allowed to fall normally on the airfilm and fringe width is found to be 0.9 mm. Find the radius of the wire. **5**

   d) What is continuity equation. Derive continuity equation for electrons as well as holes in semiconductor : **10**

2. a) Explain briefly the role of interference in :

   i) AR coating

   ii) Optical planeness of a surface. **5**

   b) Derive Einstein's relation between mobility μ and diffusion constant D. At 300 K if mobility of electron $\mu_n = 2\,\mu_p$, then what will be the diffusion constant μ_n of electron. Given : For holes, $D_p = 4.68 \times 10^{-3}$ m^{2}s^{-1}. **5**

c) In a semiconductor the effective mass of the electron is $0.07m_o$ and that of a hole is $0.4\ m_o$, Where m_o is the free electron mass. Average relaxation time for the holes is half that for the electrons. Calculate mobility of the holes when the mobility of electrons is $0.08\ m^2v^{-1}s^{-1}$. **5**

d) Draw separate ray diagrams for reflected rays and transmitted rays in a parallel sided thin film. Derive the expression for optical path difference for both reflected and transmitted rays. Hence show the interference patterns of reflected and transmitted rays are complimentary to each other. **10**

Module – II

3. a) Discuss acoustic diffraction method to find velocity of ultrasonic waves in liquid. **5**

b) Explain magnetostriction method to produce ultrasonic waves. Draw necessary circuit diagram. **5**

c) Distinguish between ionization chamber and GM counter. Explain why quenching is carried out in GM counter. **5**

d) Explain construction and working of magnetic lens. **5**

e) Describe any two methods for detection of ultrasonic waves. **5**

4. a) Explain :

   i) Flaw detection in metals.

   ii) Echo sounding in marine application. **5**

b) Explain construction and working of electrostatic lens. **5**

c) Explain :

   i) What is electron gun ?

   ii) What is cavitation ? **5**

d) Explain the method of measuring frequency and wavelength of ac signal on CRO. Draw neat labelled diagrams of CRT and CRO. **10**

SECTION – II
(Chemistry)

Duration : $1\frac{1}{2}$ Hours   Marks : 50

Module – III

5. a) Sketch the electrochemical cell and write the cell reactions and representation
       if Zn and Ag electrodes are dipped in their respective salt solutions ie Zn
       dipped in 0.001 M solution and Ag dipped in 0.01 M solution.
       Find out the cell potential (Given $E°Zn = - 0.76V$ and $E° Ag = 0.8$ V)   **8**

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

    c) With the help of a neat labelled diagram explain the construction of the
       Ni-MH battery.   **5**

    d) Explain the working of $H_2 - O_2$ fuel cell.   **5**

6. a) A Galvanic cell 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 the Ni rod was dipped in its salts
       solution of 0.02 M and Ag rod was dipped in its salt solution of 0.05 M. (Given
       $E°Ni = - 0.23$ V and $E° Ag = 0.8$ V)   **8**

    b) The following cell $Zn|Zn^{2+}$ (0.001M) $||Zn^{2+}$ (0.01M)|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) Write down the electrode reactions of lithium-manganese dioxide cell. Explain
       its working.   **5**

    d) Give the construction and working of $H_2 - O_2$ fuel cell.   **5**

Module – IV

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

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

   c) Explain the basic set up of an electroplating bath with the help of a suitable example.   **5**

   d) What is stress corrosion ? Explain.   **5**

8. 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) Give a brief account of electroless plating of Nickel.   **5**

   c) What is anodization ? How does it protect the metal from corrosion ?   **5**

   d) Explain electroplating of chromium.   **5**