SEM 1 – 2 (RC 07-08)

F.E. (Semester – I) Examination, Nov./Dec. 2014
(Revised in 2007-08)
APPLIED SCIENCE – I (Physics and Chemistry)

Duration : 3 Hours | Total Marks : 100

Instructions *: 1) Answer* ***one*** *question from* ***each*** *Module.*
2) Answer ***Physics*** *and* ***Chemistry*** *Section in* ***separate*** *answer books.*
3) ***Draw*** *diagram* ***wherever*** *required.*
4) ***Assume*** *additional data* ***if required.***

SECTION – I (Physics) — 50

Module – I

1. a) Briefly explain the concept of carrier diffusion in a semiconductor. Obtain an expression for total current density due to drifting and diffusion of charge carriers. 5

   b) Show that the diameter of dark circular Newtons rings are proportional to square root of natural numbers in reflected light. 5

   c) White light is incident on a thin film at an angle of 30°. The reflected light when observed with a spectroscope, two consecutive dark bands corresponding to wavelengths 5890 and 5790A° are seen. Determine thickness of the thin film if its refractive index is 1.4. 5

   d) Briefly discuss the physical origin of Hall effect. Derive an expression for Hall voltage in terms of current through the semiconductor material and hence explain use of Hall effect in identifying the type of semiconductor. 10

2. a) In case of an antireflection coating, show that the minimum thickness should be quarter wavelength of incident light. 5

   b) Assuming a single carrier conduction process, determine mobility and density of charge carries in an extrinsic, semiconductor specimen of resistivity $9\times10^{-3}\,\Omega$m.

   Given :

   Hall coefficient of the semiconductor specimen = 3.8×10^{-4} m^3/c. 5

   c) What are Newton's rings ? How can Newton's rings be used to determine the wavelength of monochromatic light ? 5

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d) Explain the salient features of interference pattern formed in a wedge shaped air film and its use in testing optical flatness of a surface. Derive an expression for fringe width in such films. How is it used to measure thickness of an object ? 10

Module – II

3. a) Write short note on following : 5

i) Ionisation chamber ii) Quenching in a GM counter.

b) Explain the working of an electrostatic electron lens. 5

c) Draw block diagram of a CRO and mention its principle sections. Explain in brief application of CRO to determine amplitude of dc voltage. 5

d) What are ultrasonics ? State three properties of ultrasonic waves. Explain direct and inverse piezoelectric effect. Explain working of a piezoelectric oscillator; draw necessary circuit diagram. 10

4. a) Briefly explain medical and industrial applications of ultrasonic waves (2 each). 5

b) Discuss acoustic grating method for the detection and measuring velocity of ultrasonic waves. 5

c) What do you mean by "magnetostriction" ? Draw circuit diagram of a magnetostriction oscillator and explain its working. 5

d) Describe the principle and working of a GM counter. Give an account of quenching in this counter. Also highlight the difference between a GM counter and proportional counter. 10

SECTION – II 50

(Chemistry)

Module – III

5. a) Calculate the EMF of the following :

i) The cell formed by dipping Zn rod in 0.01 M Zn^{2+} solution and Ni rod in 0.1 M Ni^{2+} solution (Given $E^{\circ}Zn = -0.76\,V$, and $E^{\circ}Ni = -0.25\,V$). 7

ii) $Ag|Ag^{+}\,(0.01M)\,\|\,Ag^{+}(0.1M)\,|\,Ag$.

b) Define the terms :

a) Electrode potential

b) Standard electrode potential and explain their role in Nernst Equation. 6

c) Explain the working of a secondary battery system with relevant reactions. 6

d) With the help of a neat labelled diagram explain the construction of the Zn-air battery. 6

6. a) Outline the construction of a reference electrode and illustrate the use of the same in the determination of pH. 7

b) Explain the following characteristics with reference to battery i) Capacity ii) Voltage iii) Electrolyte concentration. 6

c) Outline the characteristics of the electrolyte in the following fuel cells :

a) Molten-carbonate fuel cell

b) Alkaline fuel cell

c) Solid oxide fuel cell. 6

d) With the help of a neat labelled diagram explain the construction of Ni-MH battery. 6

Module – IV

7. a) Explain how corrosion can be controlled by sacrificial anodic protection and metal coatings. 7

b) Explain with the help of a labelled diagram wet electrochemical mechanism of corrosion in a pH range of 2-3. 6

c) What is metal finishing ? Give its technological importance. 6

d) Describe a method for preparing a conducting surface on a plastic body using electroless plating method. 6

8. a) Describe with the help of a suitable example the electrochemical mechanism of corrosion in a pH range of 6.8 – 7.2. 7

b) Describe the process for cathodic metal coating with the help of a suitable example. 6

c) Outline the various constituents of an electroless plating bath. 6

d) Explain the process of electroplating with chromium along with necessary surface preparation steps. 6