SEM 2 – 2 (RC 07 – 08)

F.E. (Semester – II) (Revised in 2007 – 08)
Examination, November/December 2016
APPLIED SCIENCE – II
(Physics and Chemistry)

Duration : 3 Hours Total Marks : 100

Instructions *: 1) Answer **one** question from **each** Module.*
*2) Answer the **two** Sections in **separate** answer books.*
*3) Draw diagrams **wherever** necessary.*
*4) **Assume** additional data, **if required**.*

Physical Constants :

Planck's constant = 6.626×10^{-34} J-s Boltzmann's Constant = 1.38×10^{-23}J/k

Electron charge = 1.6×10^{-19} C Rydberg Constant = 1.097×10^{7}/m

Electron Mass = 9.1×10^{-31} kg Velocity of light = 3×10^{8} m/s

SECTION – I

(Physics)

Module – I

1. a) Derive the expression for numerical aperture of optical fibre in terms of fractional R.I. difference. **5**

   b) Write down any three characteristic properties and any two applications of Laser. **5**

   c) A S.I. fibre with a core index 1.5 and fractional difference index 0.005, has a core diameter of 12.75 μm. It is operated at wavelength 1.5 μm. Find V-number and no. of modes the fibre will support. **5**

   d) Describe construction and working of He-Ne laser. In what way it differs from ruby laser (any two differences). **10**

2. a) Describe how a hologram is produced and viewed. **5**

   b) Distinguish between : **5**

      i) SI fibre and GRIN fibre

      ii) He-Ne laser and Ruby laser.

P.T.O.

c) SI fibre A has $n_1 = 1.5$ and $n_2 = 1.45$ and SI fibre B has $n_1 = 1.6$ and $n_2 = 1.59$, Light signal makes incident angle of 15° at the input end of both fibres. Find which fibre will allow the light to propagate ? 5

d) Describe construction and working Ruby laser. In what way it differs from He-Ne laser (any two differences) ? 10

Module – II

3. a) i) What is Meissner effect ? 5

ii) What is Silsbee effect ?

b) Write down various properties of X-rays. 5

c) If P.D. applied across an X-ray tube is 10 kV and current through it is 2.5 mA, calculate : 5

i) No. of electrons striking per sec.

ii) The speed at which they strike.

d) What is Compton effect ? Derive an expression for Compton shift. Also find Compton shift for scattering angle of π rad. 10

4. a) Describe how X-rays are produced in Coolidge tube ? Explain how intensity and quality of X-rays are controlled in it ? 5

b) Describe an experiment to verify the Compton effect. Give an account for unmodified peak in the graph. (intensity vs scattering angle). 5

c) What voltage must be applied to an electron source to produce electron having wavelength of 0.3 Å ? What will be K.E. of the electron moving under this potential ? 5

d) Write applications in : 10

i) Superconductivity

ii) X-rays.

SECTION – II

(Chemistry)

Answer **one** question from **each** Module :

Module – III

5. a) Explain the free radical polymerization mechanism by taking suitable examples of monomer and initiator. **6**

   b) Compare the Bulk and Solution method of polymerization in terms of the parameters involved in the process. **5**

   c) Explain the various stages involved in purification of crude oil. **5**

   d) Outline the chemical process for production of solar grade silicon. **5**

   e) Explain how the structure of the polymer influences the following properties : **4**

      i) Crystallinity

      ii) Glass transition temperature.

6. a) Define the term 'Reforming' of Hydrocarbon. Outline the various reactions involved and its use in hydrocarbon industry. **6**

   b) A fuel weighing 0.9 g was ignited in a bomb calorimeter having a water equivalent of 530 g. The mass of the water taken in the calorimeter was 2000 g. The difference in the initial and final temperature was 2.1° C. The elemental analysis of the fuel showed 4.5% hydrogen content. Calculate the N.C.V. of the fuel. **5**

   c) Polymers were synthesized by using phenol and formaldehyde : **5**

      i) Write the structures of at least two resultant polymers from the above reactants which are commercially available.

      ii) Comment on the structural features of the polymers.

      iii) Outline the properties and applications of the polymers.

   d) Define the term 'Glass Transition Temperature' and outline various ways it can be modified. **5**

   e) Explain the functioning of photovoltaic cell. **4**

Module – IV

7. a) Explain with the help of neat diagram the molecular arrangement in Smectic and Cholestric thermotropic liquid crystals. 6

   b) Draw a neat labelled diagram and explain Electrodialysis method of desalination. 5

   c) Draw the various phases of lyotropic liquid crystals in order of the increasing concentration of the solution. 5

   d) A water sample was analyzed for hardness and alkalinity. The test analysis as per standard protocols gave the following data : 5

      i) 50 ml of the water sample upon titration with 0.01 M EDTA required 5.0 ml of the titrant.

      ii) 50 ml of the water sample upon titration with 0.01 M HCl required 5.0 ml to attain the methyl orange end point. Find the alkalinity and hardness of the water sample in ppm. (Given : 1 ml of 0.01 M EDTA ≡ 1 mg $CaCO_3$ equivalents. Hardness; 1 ml of 1 M HCl ≡ 50 mg $CaCO_3$ equivalents alkalinity.)

   e) Outline the instrumentation and working of potentiometer. 4

8. a) Explain the various stages involved in the treatment of sewage in a Municipal Sewage Treatment Plant. 6

   b) What are Lyotropic liquid crystals ? State the structural requirements of a compound to exhibit Lyotropic LC behaviour and draw any two lyotropic phases. 5

   c) A 100 ml of sample of water was found to contain Ca $(HCO_3)_2$ = 41.5 mg; Mg $(HCO_3)_2$ = 50 mg and $MgSO_4$ = 25.0 mg. Calculate the temporary, permanent and total hardness of the water sample in ppm $CaCO_3$ equivalents. All values reported above are in $CaCO_3$ equivalents. 5

   d) Explain the liquid crystalline behaviour in PAA homologous series. 5

   e) Outline the instrumentation and application of colorimeter. 4