30/11/2013 M.

SEM 2-2 (RC 07-08)

F.E. (Semester – II) Examination, Nov./Dec. 2013
APPLIED SCIENCE – II
(Revised in 2007-08) (Physics and Chemistry)

Duration : 3 Hours | Total Marks : 100

Instructions : *i) Answer **one** question from **each** Module.*

*ii) Draw diagrams **wherever** necessary.*

Data : $h = 6.626 \times 10^{-34}$ J-s $\quad K = 1.38 \times 10^{-23}$ J/K

$e = 1.6 \times 10^{-19}$ C $\quad R = 1.097 \times 10^{7}$/m

$m_e = 9.1 \times 10^{-31}$ kg $\quad C = 3 \times 10^{8}$ m/s.

SECTION – I

MODULE – I

1. a) Give four important characteristic properties of laser. Explain in brief. **5**

   b) Derive the expression for numerical aperture of step-index optical fibre. What is its significance ? **5**

   c) Two step-index fibres S-1 and S-2 have core index 1.52 and fractional difference index 0.00657. They are operated at wavelength 1.6 μm. Core diameter of fibre S-1 is 20.5 μm and that of S-2 is 7 μm. **5**
   Find :

      i) V-number of each fibre

      ii) No. of modes each fibre will support.

   d) Describe : **10**

      i) Fibre scope

      ii) Construction and viewing of hologram.

2. a) What prompted Einstein to bring the concept of stimulated emission of radiation ? Discuss the theory briefly. **5**

   b) What is resonant cavity ? What role does it play in laser ? Obtain an expression for mode separation. **5**

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c) The population ratio of two energy states in a laser that emits wavelength 6328 A.U. is 2×10^{-25}. Find the temperature at which the laser emits light. 5

d) Explain the terms : 10

i) Spontaneous emission

ii) Stimulated emission

iii) Pumping

iv) Metastable State

v) Population inversion.

MODULE – II

3. a) What is superconductivity ? Discuss in brief BCS theory of superconductivity. 5

b) State and explain Mosley's law in characteristic X-rays. Give its significance. 5

c) If the incident radiation is 1.372 A.U., find the wavelength of scattered radiation at an angle of 30° and also find the velocity of recoiled electron. 5

d) Explain deBroglie concept of matter waves. Give an account of the experiment to show the wave like character of a beam of electrons. 10

4. a) Using Bragg's spectrometer, explain the experimental verification of Compton effect. Give explanation for unmodified wavelength in Compton effect. 5

b) Discuss various applications of superconductivity. 5

c) A crystal has its principle planes separated at 5.6534 A.U. First order Bragg reflection is located at 13° 40′. Calculate : 5

i) wavelength of X-rays

ii) the angle for the second order Bragg reflection.

d) Describe the production of X-rays by Coolidge tube. How are intensity and quality of X-rays controlled in X-ray tube ? Why diffraction of X-rays is not possible with ordinary grating ? 10

SECTION – II

MODULE – III

5. a) Explain the different stages involved in purification of Crude oil and name the different fractions obtained from crude oil along with their carbon content. **8**

   b) Explain the Bulk and Suspension methods of polymerization. **6**

   c) Outline the mechanism of Free Radical Polymerization by using suitable example of initiator and monomer. **6**

   d) Explain any two methods to obtain solar grade silicon. **5**

6. a) Explain any two methods for obtaining crude oil by synthetic methods. **8**

   b) Explain the solution and Emulsion methods of polymerization. **6**

   c) A polymer was prepared using 1, 6 hexamethylene diisocyanate and 1-4, butane diol monomers. **6**

      i) Write the structure of the monomers and resultant polymers.

      ii) Outline any two properties and uses of the resultant polymer.

      iii) If the Glass transition temperature of the polymer is 50°C, state the phase in which it is found at room temperature.

   d) Explain the doping methods used for silicon to prepare a photovoltaic cell. **5**

MODULE – IV

7. a) Explain the methods for determination of Chloride, Sulphate, Nitrate and Dissolved Oxygen in given sample of water. **8**

   b) A water sample was tested for Alkalinity and Hardness by the titration method of analysis. A 10 ml of the sample was found to give following end-point for the titration by using the standard methods :

      a) 2.5 ml of 0.05 M EDTA

      b) 3.5 ml of 0.05 M HCl.

      Calculate the alkalinity and Hardness of the given sample of water in ppm $CaCO_3$ equivalents. (Data : 1 ml of 0.01 M EDTA ≡ 1 mg $CaCO_3$ equivalent Hardness; 1 ml of 1 M HCl ≡ 50 mg $CaCO_3$ equivalent alkalinity). **6**

   c) Describe the different phases in Lyotropic Liquid Crystals. **6**

   d) Explain the different phases occurring in Para azoxyanisole homologous series with respect to change in temperature and number of carbon atoms. **5**

8. a) With the help of a neat labeled diagram explain the different stages in the municipal treatment process for potable water. **8**

   b) A sample of water was tested for its COD and BOD by the standard test methods. **6**

      i) A 100 ml of the water sample was analyzed for Dissolved Oxygen (DO) content soon after sampling and was found to contain 8.5 mg. The sample after incubation for five days was tested for DO and was found to contain 7.5 mg 0.01 N $Na_2S_2O_3$ was used as titratant.

      ii) 10 ml of the sample of water to be tested and 10 ml of Distilled water were treated with Potassium dichromate solution along with Sulphuric acid and Mercury sulphate. Upon titration of sample water and distilled water the difference in Burette reading was found to be 2.5 ml 0.25 N Ferrous ammonium Sulphate was used as the Titrant.

   Calculate the BOD and COD of the sample in ppm.

   c) Describe the different phases occurring in Thermotropic Liquid Crystals. **6**

   d) Explain the basic principle and instrumentation involved in Visible Spectrophotometer (Colorimeter). **5**
