F.E. (Semester – II) Examination, May/June 2013
APPLIED SCIENCES – II
Physics and Chemistry

Duration : 3 Hours Total Marks : 100

Instructions : *1) Answer **one** question from **each** Module.*
*2) Draw diagrams **wherever** necessary.*

Data : $h = 6.626\times10^{-34}$ J-s $K = 1.38\times10^{-23}$ J/k
$e = 1.6\times10^{-19}$ C $R = 1.097\times10^{7}$/m
$m_e = 9.1\times10^{-31}$ kg $C = 3\times10^{8}$ m/s

SECTION – I
(Physics)

MODULE – I

1. a) What is the basic principle of fibre optics ? Explain the classification of optical fibres based on modes of propagation. **5**

   b) Transition occurs between a metastable state E_3 and an energy state E_2, just above ground state. If emission is at 1.3 μm and $E_2 = 0.4\times10^{-19}$ J, find the energy state of E_3 state in eV. **5**

   c) Give Einstein's theory of stimulated emission. **5**

   d) Give atleast three differences between the following :
      i) Spontaneous emission and stimulated emission
      ii) SI fibre and GRIN fibre
      iii) He-Ne laser and Ruby laser
      iv) Hologram and photograph. **10**

2. a) Describe three-level and four-level pumping schemes in a laser with relevant diagrams. **5**

   b) Give industrial, scientific, medical and defence applications of laser. **5**

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c) A step-index fibre has N.A. of 0.16, a core R.I. of 1.450, a core diameter of 50 μm, calculate

i) The acceptance angle

ii) R.I. of cladding

iii) No. of modes with a wavelength of 1.6 μm the fibre can carry

iv) No. of modes if fibre is graded-index type with same specifications. 5

d) Describe the application of optical fibre in

i) Fibre optics communication system and

ii) Fibrescope. 10

MODULE – II

3. a) Explain characteristic X-ray spectra. State Mosley's law. 5

b) Discuss type-II super conductor. What is its advantage over type-I superconductor ? 5

c) Find the wavelength of X-ray photon which produces recoil electron of energy 5keV in Compton effect. The direction of recoil electron is in the direction of incident photon while photon is scattered through an angle of 180°. 5

d) Derive Bragg's equation for X-ray diffraction. Describe Bragg's X-ray spectrometer to verify Bragg's law. 10

4. a) Explain, persistent current, effect of temperature and effect of magnetic field in super conductors. 5

b) Describe an experiment to demonstrate the wavenature of electron. 5

c) Deduce the wavelength of K_α -line for an atom Z = 42 using Mosley's law. For K-series screening constant a = 1. 5

d) What is Compton effect ? Deduce the expression for Compton shift. Discuss different cases with regard to angle of scattering. 10

SECTION – II
(Chemistry)

MODULE – III

5. a) Explain the method of polymerization used to prepare an Elastomer. Name and write the structures of any two elastomers along with their uses and properties. 8

   b) Define the term conducting polymer. Explain the process of conduction in any polymer. 6

   c) Define the term Cracking of Hydrocarbons and explain any one process of Catalytic cracking of hydrocarbons. 6

   d) Outline the chemical and physical properties of Silicon. 5

6. a) Polymethyl methacrylate commonly referred to as acrylic glass is a widely used polymer in the industry. i) Explain any one suitable method of polymerization that would help to prepare the polymer from its liquid monomer in the form of thin films. ii) Write the structure of the monomer from which it is prepared and give any two uses and properties of the polymer. 8

   b) Define Glss Transition Temperature and outline the structure and properties relationship with respect to polymers. 6

   c) Define the terms Octane and Cetane number. Explain the importance of these terms in petroleum industry. 6

   d) Define the terms Gross and Net Calorific value. Write the equations used for the determining the same. 5

MODULE – IV

7. a) Explain with the help of neat labeled diagram Flash evaporation and Electron dialysis process for Potable water. 8

   b) A sample of water was analyzed for Hardness and Alkalinity. The sample was found to posses 50 ppm $CaCl_2$, 60 ppm $MgSO_4$ and 15 ppm $MgCl_2$. A 10 ml of the sample upon titration with 0.1 N HCl required 8.5 ml of the acid to achieve the methyl orange end-point. Calculate the amount of Hardness and Alkalinity present in the sample in terms of ppm $CaCO_3$ equivalents. (Data given : At. Wt. of Ca = 40, Mg = 23, O = 16, Cl = 35.5, S = 32, 1 ml of 1M HCl = 50 mg $CaCO_3$ equivalent alkalinity). 6

c) Explain the different phases occurring in Para-methoxybenzylidiene-para-n-butylaniline (MBBA) homologous series with respect to change in temperature and number of carbon atoms. 6

d) Describe the phenomenon of reflection of different colors in Cholesteric Liquid Crystals. 5

8. a) Explain the causes of Hardness and Alkalinity in water and describe the experimental procedure involved in determining the same. 8

b) Explain the basic principle and instrumentation involved in Visible Spectrophotometer (Colorimeter). 6

c) A sample of water was tested for dissolved oxygen and Biological Oxygen Demand (BOD) using the standard procedure i.e. x ml of sample was treated with 2 ml $MnSO_4$ and 2 ml Alkaline Potassium Iodide followed by 2 ml of Conc. H_2SO_4 and then titrated against 0.1 N $Na_2S_2O_3$ using starch as indicator. The readings were obtained on Day1 and Day 5. 100 ml of the sample gave the following readings :

i) Day 1 : 35 ml of 0.1 N $Na_2S_2O_3$ ii) Day 5 : 2.3 ml of o.1 N $Na_2S_2O_3$.

Calculate the DO on day 1 and the BOD of the sample using BOD_5 test method in ppm. 6

d) Outline briefly the classification liquid crystals. 5