F.E. (Semester – II) (Revised in 2007-08) Examination, May/June 2018
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) Assume additional data, **if required**.*
*4) Draw diagrams **wherever** required.*

Physical constants :

Planck's constant	=	6.626×10^{-34} J-s
Electron charge	=	1.6×10^{-19} C
Boltzmann's constant	=	1.38×10^{-23} J/K
Electron mass	=	9.1×10^{-31} kg
Rydberg constant	=	1.097×10^{7}/m
Velocity of light	=	3×10^{8} m/s

SECTION – I

(Physics)

Module – I

1. a) With neat energy level diagram explain three-level pumping scheme. What are its drawbacks ? 5

   b) Derive expression for acceptance angle of an optical fibre. What is acceptance cone of optical fibre ? 5

   c) With block diagram explain the use of optical fibres in communication. Give any two advantages of optical fibres over copper wires for communication. 5

   d) Describe Einstein's theory of stimulated emission and hence obtain the conditions necessary for light amplification. 5

   e) Calculate numerical apperture, acceptance angle and critical angle for an optical fibre having core R.I. 1.52 and cladding R.I. 1.48. 5

2. a) With neat diagrams explain construction and working of Ruby laser. 5

b) With neat diagrams explain the different types of optical fibres. 5

c) Explain the process of stimulated emission of radiation and how it can be used for light amplification. 5

d) Draw and explain structure of an optical fibre and hence show how light propagates in an optical fibre. 5

e) What is population inversion ? Determine the ratio of population of two energy levels if the wavelength of light emitted during transition between these levels is 6943 Å at 37°C. 5

Module – II

3. a) Draw a neat diagram of Coolidge tube and explain the production of X-rays using Coolidge tube. 5

b) What is Compton effect ? Describe an experiment used to study the Compton effect. 5

c) With neat diagrams explain Type – I and Type – II superconductors. 5

d) Write any five properties of X-rays. 5

e) In a Compton effect experiment an X-ray photon of wavelength 1.55 Å strikes an electron at rest and is scattered at an angle of 60° to the original direction. Find the wavelength of the scattered photon. 5

4. a) What is superconductivity ? Explain in brief BCS theory of superconductivity. 5

b) State de Broglie's hypothesis. What is de Broglie's Wavelength ? State properties of matter waves. 5

c) Explain the origin of characteristic and continuous X-ray spectra. 5

d) Describe the Davisson-Germer experiment to prove that electrons behave like waves. 5

e) Monochromatic X-rays of wavelength 0.71 Å are made to reflect from a crystal with interplanar spacing of 1.9 Å. Determine the highest order of reflection that can be observed with this radiation and the glancing angle corresponding to the highest order. 5

SECTION – II

(Chemistry)

Module – III

5. a) Define polymerization. Explain the types of polymerization and the free radical mechanism using ethylene as an example. **10**

   b) Write the synthesis, 2 properties and 2 applications of PMMA. **5**

   c) Explain the following :

      i) Knocking

      ii) Octane number

      iii) Cetane number

      iv) Unleaded petrol

      v) Synthetic petrol. **5**

   d) Explain the importance and working of a photovoltaic cell. **5**

6. a) Draw the Bomb calorimeter and explain how you will determine the calorific value of a solid fuel. **10**

   b) How is solar grade silicon obtained ? Give any 2 methods. **5**

   c) Write the synthesis, 2 properties and 2 applications of Teflon. **5**

   d) What is an adhesive ? Give the manufacture and applications of Epoxy resin. **5**

Module – IV

7. a) Explain the determination of chloride, nitrate, sulphate and dissolved oxygen in a water sample. **10**

   b) Explain with a diagram how water can be purified using the flash evaporation method. **5**

   c) Distinguish between thermotropic and lyotropic liquid crystals with examples. **5**

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

8. a) Explain in detail how the sewage is treated at the sewage treatment plant. **10**

b) A sample of water is found to contain 42 mg/L $Ca(HCO_3)_2$, 47 mg/L $Mg(HCO_3)_2$, 28 mg/L $MgSO_4$, 33 mg/L $CaSO_4$ and 23 mg/L $CaCl_2$. Calculate temporary and permanent hardness of water.

Given : (Atomic weights of Ca = 40, Mg = 24, S = 32, O = 16, C = 12, Cl = 35.5, H = 1). **5**

c) Give brief account of the following liquid crystal systems

i) Nematic

ii) Cholesteric. **5**

d) Discuss the applications of liquid crystals in displays and thermography. **5**
