SEM 2 – 2 (RC 07-08)

F.E. (Semester – II) (Revised in 2007-08) Examination,
November/December 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** answerbooks.*
*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) Explain what is an optical resonator and why is it required in a laser ? **5**

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

   c) The numerical aperture of an optical fibre is 0.488 and the core refractive index is 1.52. Calculate : **5**
      i) Refractive index of cladding
      ii) Fractional refractive index change.

   d) Draw the setup and energy level diagram of He-Ne laser and hence explain its construction and working. **10**

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2. a) Explain the uses of lasers in electronics, industry, medicine, military and science. 5

   b) Derive expression for Acceptance Angle of an optical fibre. 5

   c) The transition to the ground state from the upper and lower energy states in a laser system results in emission of photons of wavelengths 6392 Å and 6438 Å respectively. Determine the ratio of populations of the two energy levels at 27 °C. 5

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

MODULE – II

3. a) Give the industrial, medical and scientific uses of X-rays. 5

   b) With neat diagrams explain type-I and type-II superconductors. 5

   c) Identify the target element used in the Coolidge tube if the wavelength of the Kα line emitted is 1.55 Å. Take nuclear screening constant as unity. 5

   d) What is Compton effect ? Derive an expression for Compton shift. 10

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

   b) Explain briefly "Meissner effect" and "Silsbee effect" in superconductors. 5

   c) In a Compton effect experiment, the wavelength of X-ray radiation scattered at an angle of 45° is 0.022 Å. Calculate the wavelength of incident X-rays. 5

   d) Derive Bragg's Law of X-ray diffraction. Describe Bragg's Spectrometer to verify Bragg's Law. 10

SECTION – II **(Chemistry)**

MODULE – III

5. a) Outline the structure and property relationship of polymers. 10

   b) What is an Elastomer ? Outline the synthesis and application of Neoprene. 5

   c) A fuel weighing 0.85 g was tested in a Bomb calorimeter. The mass of water taken in the calorimeter was 2000 g. Water equivalent of the calorimeter is 540 g. The difference in the initial and final temperature is 1.9° C. Its elemental analysis showed 90% C, 3.6% H and 1.2% O. Calculate the N.C.V. 5

   d) With the help of neat labelled diagram explain the preparation of synthetic petrol using Bergius process. 5

6. a) Explain Bulk, Suspension and Emulsion methods of polymerization. **10**

   b) Give the synthesis and any two properties and two applications of Teflon. **5**

   c) What is a fuel ? Give its classification. **5**

   d) What is Petroleum Cracking ? Explain fluidized catalytic cracking. **5**

MODULE – IV

7. a) With the help of neat labelled diagrams explain the processes of electrodialysis and Reverse Osmosis. **10**

   b) A water sample was analyzed for

   i) D.O. ii) Hardness.

   The test analysis as per standard protocols gave the following data :

   i) 100 ml of the water sample upon titration with 0.01M $Na_2S_2O_3$ required 3.2 ml of the titrant.

   ii) The sample showed the presence of $CaCl_2$ (100 ppm) and $MgCl_2$ (200 ppm). Find the D.O. in ppm and Hardness (in ppm $CaCO_3$ eq.)

   (Data given at.wt. of Ca = 40, C = 12, Mg = 24, Cl = 35.5) **5**

   c) Outline briefly the classification of liquid crystals. **5**

   d) Briefly explain the principle and working of calorimeter. **5**

8. a) Describe in detail the treatment of water by the municipal treatment plant. **10**

   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) 3.2 ml of 0.05 M EDTA

   b) 3.7 ml of 0.05 M HCl

   Calculate the alkalinity and Hardness of the given water sample in ppm $CaCO_3$ equivalents.

   (Data : 1 ml of 0.01 M EDTA = 1 mg $CaCo_3$ eq. Hardness, 1 ml of 1 M HCl = 50 mg $CaCO_3$ eq. alkalinity) **5**

   c) Describe the different phases in lyotropic liquid crystals. **5**

   d) Explain how you will find the BOD of a given water sample. **5**
