SEM 2 – 2 (RC 07-08)

F.E. (Semester – II) (Revised in 2007-08) Examination, Nov./Dec. 2017

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** diagram **wherever** required.*
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} leg *Velocity of light = 3×10^{8} m/s.*

SECTION – I

(Physics)

Module – I

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

1. a) Discuss three-level and four level pumping schemes in laser. **5**

   b) Discuss Einstein's theory of Stimulated emission. **5**

   c) An optical fibre has core R.I. = 1.55 and $\Delta = 0.0005$, Find :

      i) Cladding R.I.

      ii) Critical angle

      iii) Acceptance angle

      iv) Numerical aperture. **5**

P.T.O.

d) Explain the following terms :

i) Acceptance angle

ii) Numerical aperture

iii) Stimulated emission

iv) Population inversion

v) Pumping. 10

2. a) Discuss the advantages and disadvantages of fibre optics communication over the conventional cable communication. 5

b) Derive the expression for N.A. of S.I. optical fibre. Express it in fractional index difference. 5

c) What is optical resonator ? What role does it play in laser ? 5

d) Explain the following :

i) Any four important properties of laser.

ii) Any six important applications of laser. 10

Module – II

3. a) State and explain Mosley's law. Give its significance. 5

b) Discuss in brief : Silsbee effect and Meissner effect. 5

c) A photon of energy 12 keV is made incident on an electron and gets scattered through an angle of 90°. Find the energy of scattered photon. 5

d) Derive Bragg's equation for reflection of X-rays by crystal plane. Describe Bragg's X-ray spectrometer to verify Bragg's law. 10

4. a) Explain Type-I and Type-II superconductor. 5

b) What is characteristic X-rays ? How does it help in identifying different elements ? 5

c) When an electron is transferred in an atom from L shell to K shell, the X-rays emitted have wavelength of 0.788 $\mathring{A}$, what is the atomic no. of this atom. Take screening constant = 1. 5

d) What is compton effect ? Derive an expression for compton shift. Is it possible to observe compton effect with visible light ? 10

SECTION – II

(Chemistry)

Module – III

5. a) Explain an experimental method using a neat labeled diagram for determination of GCV of a fuel. 8

   b) Explain the bulk and suspension methods of polymarization. 6

   c) With the help of a neat diagram, explain the construction and working of a photovoltaic cell. 6

   d) On burning 0.93 gm of a solid fuel in a bomb calorimeter, the temperature of 2500 gm of water increased from 25.5°C to 28°C. Water equivalent of calorimeter and latent heat of steam are 325 g and 587 cals/g respectively. If fuel contains 6% hydrogen, calculate its gross and net calorific value. 5

6. a) What are elastomers ? Outline the synthesis of any one elastomer you know. Also state any two of its properties and applications. 8

   b) With the help of neat labeled diagram explain the synthesis of petroleum by using the Bergius process. 6

   c) Explain the process of electrical conduction in polyacetylene polymer. 6

   d) A fuel weighing 0.80 g was tested in a Bomb calorimeter. The mass of water taken in the calorimeter was 2000 g. Water equivalent of the calorimeter is 530 g. The difference in initial and final temperature is 1.9°C. Its elemental analysis showed 92% C, 3.6% H and 1.2% O.

   Calculate the Net Calorific Value. 5

Module – IV

7. a) Explain with the help of neat labeled diagram flash evaporation and electrodialysis 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 MHCl 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 $CaCO_3$ equivalents. (Data given : At.wt of Ca = 40, Mg = 23, O = 16, Cl = 35.5, 1 ml of 1 M HCl = 50 mg $CaCO_3$ equivalent alkalinity). 7

   c) Outline the instrumentation and working of a potentiometer. 5

   d) Describe the different phases in Lyotropic liquid crystals. 5

8. a) Explain how hardness and alkalinity of a water sample can be determined experimentally. 8

b) i) 20 ml of sewage sample was diluted to 600 ml and equal volumes were filled in two BOD bottles. The dissolved oxygen content soon after sampling 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 of 0.01 N $Na_2S_2O_3$ was used as titrant. 7

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

d) Draw the block diagram of photoelectric colorimeter, label and explain the essential parts. 5