SEM 2 – 2 (RC 07-08)

F.E. (Semester – II) Examination, Nov./Dec. 2012
APPLIED SCIENCE – II
(Physics and Chemistry)
(Revised Course 07 – 08)

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** diagrams **wherever** required.*
4) ***Assume** additional data **if required**.*

Physical Constants :

Planck's constant = 6.626×10^{-34} J-s

Electron charge = 1.6×10^{-19} C

Electron mass = 9.1×10^{-31} Kg

Boltzmann constant = 1.38×10^{-23} J/K

Rydberg constant = 1.097×10^{7}/m

Velocity of light = 3×10^{8} m/s

SECTION – I
(Physics)

MODULE – I

1. a) What do you mean by numerical aperture of an optical fibre ? Obtain an expression for N.A. in terms of refractive indices of core and cladding material. **5**

   b) Explain Einstein's theory of stimulated emission and its physical significance. **5**

   c) Determine normalized frequency of a step index optical fibre when light of wavelength 900 nm is transmitted through it. Further calculate fractional index change of the the fibre. Given : Core diameter of the fibre = 50 μm. refractive index of core material = 1.45 and numerical aperture of fibre = 0.16. **5**

P.T.O.

d) Explain the terms :

"Population inversion and metastable state".

How does stimulated emission take place with exchange of energy between helium and neon atoms in a He-Ne laser ? With the help of a neat diagram, explain construction and working of a ruby laser. 10

2. a) Discuss various properties of a laser beam and its advantages over conventional light source. 5

b) Explain the following : 5

i) Laser holography and construction of hologram.

ii) Resonant Cavity.

c) Refractive Index for core and cladding material of an optical fibre is 1.49 and 1.45 respectively. The light is launched into the fibre from air. Determine the fractional index change, internal critical angle and the external critical acceptance angle of the fibre. 5

d) What are the advantages of optical fibre communication over the conventional one ? Explain the different types of optical fibre along with refractive index profile sketch and mode propagation diagram. 10

MODULE – II

3. a) State and explain Mosley's law. Give an account of its physical significance. 5

b) Explain the following for superconductors : 5

i) Effect of external magnetic field

ii) Silsbee effect.

c) A photon of energy 1000 keV is scattered by a free electron through 90°. Estimate energy of electron and photon after interaction. 5

d) Explain de Broglie concept of matter waves. Describe an experiment to establish wave like character of a beam of electrons. 10

4. a) What are characteristics X-rays ? Explain their origin. 5

b) K_α line of wavelength 1.549Å undergoes reflection from a crystal with inter planar spacing 4.255 Å. Calculate 5

i) the highest order of reflection that can be observed with this radiation

ii) the smallest glancing angle.

c) Briefly explain the phenomenon of Superconductivity and hence distinguish between type-I and type -II superconductors. 5

d) Photons collide elastically with 100 sely bound electrons of a graphite sample. Show that the wavelength shift of the scattered photons depends only on the scattering angle and not on the wavelength of incident radiations. 10

SECTION – II
(Chemistry)

MODULE – III

5. a) Draw a neat diagram of Bomb Calorimeter and explain the determination of Calorific value. 10

b) Explain how the following elastomers are obtained, mention their applications : 5

i) Neoprene

ii) Butyl rubber.

c) What are conducting polymers ? Give examples. 5

d) What is Solar Grade Silicon ? Explain. 5

6. a) What is meant by reforming ? Explain the principal reactions occurring during reforming process. 10

b) Give the preparation, properties and uses of Epoxy resin. 5

c) What are elastomers ? Write the structure of natural rubber, mention its deficiencies. 5

d) What is photovoltaic cell ? Explain its working. 5

MODULE – IV

7. a) Explain the primary, secondary and tertiary treatment methods of sewage. **10**

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

   c) What are the characteristics of potable water. **5**

   d) Define BOD and COD : **5**

   25 ml of sewage sample for COD reacted with 30 ml of $K_2Cr_2O_7$ solution and the unreacted $K_2Cr_2O_7$ requires 10.0 ml of N/4 FAS solution. Under similar conditions in blank titration. 20ml of N/4 FAS is used up. Calculate COD of the sample.

8. a) Define BOD of a sewage. How is it determined ? What are its significances ? **10**

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

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

   d) What is hard water ? What are the causes of hardness ? **5**
