



SEM 2 – 2 (RC07 – 08)

F.E. (Semester – II) (Revised in 2007-08 Course)

Examination, May/June 2015

APPLIED SCIENCE – II (Physics and Chemistry)

Duration : 3 Hours

Total Marks : 100

- Instructions :**
- 1) Answer one question from each Module.
  - 2) Answer two Sections in separate answer books.
  - 3) Draw diagrams wherever necessary.
  - 4) Assume additional data if required.

### Physical Constants :

Planck's constant =  $6.626 \times 10^{-34}$  J-s

Electron charge =  $1.6 \times 10^{-19}$  C

Boltzmann constant =  $1.38 \times 10^{-23}$  J/k

Electron mass =  $9.1 \times 10^{-31}$  kg

Rydberg constant =  $1.097 \times 10^7$  m

Velocity of light =  $3 \times 10^8$  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) Calculate NA, Acceptance angle and Critical angle of a fibre having core R.I. 1.50 and Cladding R.I. 1.488. 5
- c) Discuss various properties of a Laser beam and its advantages over conventional light source. 5
- d) Explain the terms
  - i) Stimulated emission and
  - ii) Resonating cavity. With the help of neat diagram, explain construction and working of a Ruby Laser. 10



2. a) Mention the characteristic properties of laser. Explain in brief any two industrial application of Laser. 5
- b) The relative population of two energy states in a Laser that emits wavelength  $6200\text{A}^\circ$  is  $2.359 \times 10^{-34}$ . Find the temperature at which the Laser emits light. 5
- c) Explain three differences between a Step-Index fibre and Graded Index fibre. 5
- d) Describe in brief
- 1) Construction and viewing of Hologram
  - 2) Optical fibre communication. 10

### Module – II

3. a) Explain in brief
- i) Meissner effect
  - ii) Silsbee effect. 5
- b) A photon of energy  $10\text{keV}$  is made incident on an electron and gets scattered through an angle of  $90^\circ$ . Find energy of scattered photon. 5
- c) With a neat diagram describe the production of X-rays by Coolidge tube. 5
- d) Explain de Broglie's concept of matter waves. Give account of the experiment to show the wave like character of a beam of electrons. 10
4. a) State Moseley's Law. Explain origin of characteristic X-ray spectra. 5
- b) What voltage must be applied to an electron source to produce electron having de Broglie's wavelength of  $0.4\text{A}^\circ$ . What will be K.E. of the electron moving under this potential ? 5
- c) Discuss Type – II Superconductor. What is its advantage over Type – I Superconductor ? 5
- d) What is Compton Effect ? Derive an expression for Compton shift. Discuss various cases with regard to angle of scattering. 10

**SECTION – II**

**(Chemistry)**

**Module – III**

5. a) A polymer was prepared by using methyl methacrylate monomer. 1  
i) Write the structure of the resultant polymer. 1  
ii) State the type of polymerization it undergoes. 1  
iii) Explain briefly the method of bulk polymerization. 3  
iv) State any two properties of the polymer. 1
- b) Explain the process of fluidized bed catalytic cracking process with the help of a neat labeled diagram. 5
- c) Explain the terms involved in grading of gasoline and diesel fuels. 5
- d) Outline the physical and chemical properties of silicon in relation with photovoltaics. 5
- e) Define the following terms : 4  
a) Fuel  
b) Calorific value  
c) Glass transition temperature  
d) Polymer.
6. a) Explain an experimental method using a heat labeled diagram for determination of GCV of a fuel. 6  
b) 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 28.0°C. Water equivalent of calorimeter and latent heat of steam are 325 g and 587 cal/g respectively. If the fuel contains 6% hydrogen calculate its gross and net calorific value. 5  
c) Name and state the function of the ingredients used to compound a polymer to yield a plastic material. 5  
d) Explain the method to obtain solar grade Silicon. 5



e) Define the following terms :

- Elastomer
- Water equivalent of calorimeter
- Degree of polymerization
- Adhesives.

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#### Module – IV

7. a) A sample of water was found to contain 40.5 Mg/L  $\text{Ca}(\text{HCO}_3)_2$ , 46.5 mg/L  $\text{Mg}(\text{HCO}_3)_2$ , 27.6 mg/L  $\text{MgSO}_4$ , 32.1 mg/L  $\text{CaSO}_4$  and 22.45 mg/L  $\text{CaCl}_2$ . Calculate the total hardness of water (Given At. wt of Ca = 40, Mg = 24, S = 32, O = 16, C = 12, Cl = 35.5, H = 1).

6

b) With the help of neat diagram explain the behaviour of cholesteric liquid crystal with respect to change in temperature.

5

c) With the help of neat labeled diagram explain the working of potentiometer.

5

d) Outline the principle involved in the following :

- Flash Evaporation

5

- Reverse Osmosis.

e) Draw the Micelle and Lamellar phases of lyotropic liquid crystals.

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8. a) Distinguish between thermotropic and lyotropic liquid crystals with examples.

6

b) With the help of a neat labelled diagram explain 'Electrodialysis'.

5

c) Define BOD. How is it determined ?

5

d) Draw the block diagram of photoelectric colorimeter.

5

e) Give an account of Nematic liquid crystals.

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