

## SEM 2-2 (RC 07-08)

**F.E. Semester – II Examination, May/June 2012**  
**APPLIED SCIENCE – II (Physics and Chemistry)**  
**(RC 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 =  $6.626 \times 10^{-34}$  J – SElectron charge =  $1.6 \times 10^{-19}$  CElectron mass =  $9.1 \times 10^{-31}$  KgBoltzman constant =  $1.38 \times 10^{-23}$  J/KRydberg constant =  $1.097 \times 10^7$ /mVelocity of light =  $3 \times 10^8$  m/s**SECTION – I (Physics)****Module – I**

1. a) What is metastable state ? How does it help in LASER production ? Mention two applications of laser in industry. 5
- b) Explain the term 'holography'. How does it differ from conventional photography ? 5
- c) A light beam on striking a glass plate at a glancing angle  $33^\circ$  partly gets reflected and refracted. If the reflected and refracted beam makes an angle  $90^\circ$  with each other.  
Determine :  
i) refractive index of glass and  
ii) critical angle for that glass. 5
- d) Explain the operation of He-Ne laser with the essential components. How does stimulated emission take place with exchange of energy between helium and neon atoms ? 10

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2. a) Mention the characteristics of a laser beam. Explain with energy level diagram the physical principle involved in laser action. 5
- b) Define the term 'acceptance angle' of an optical fibre. Hence obtain an expression for numerical aperture of an optical fibre in terms of refractive indices of core and cladding material. 5
- c) A laser system emits light of wavelength  $6925 \text{ \AA}$  and  $6941 \text{ \AA}$  during transitions taking place at ground state from upper and lower energy states. Determine the ratio of population of these energy levels. Also calculate the energy values of these energy levels in eV. 5
- d) Mention the advantages of optical fibre communication over the copper cable communication. Explain the term 'mode of propagation' and hence discuss various types of optical fibres alongwith their typical refractive index profile and mode of propagation sketches. 10

### Module – II

3. a) What is superconductivity ? Discuss in brief BCS theory of superconductivity. 5
- b) Explain the phenomenon of production of characteristic x-ray spectrum. 5
- c) X-rays produced from a target of atomic number 27 have a wavelength of  $1.785 \text{ \AA}$ . In addition the two impurities present in the target material gives  $K\alpha$  lines of wavelength  $2.285 \text{ \AA}$  and  $1.537 \text{ \AA}$  respectively. Find the atomic numbers of impurities present. Given screening constant=unity. 5
- d) Briefly explain the experimental arrangement to observe Compton effect. Obtain necessary formula for wavelength shift and hence show that the wavelength shift of scattered photons in Compton effect depends any on the scattering angle and not on the wavelength of incident radiation. 10
4. a) What are matter waves ? Using the concept of matter waves, obtain Bohrs condition for Quantization of angular momentum. 5
- b) Explain the following :
  - i) Meissner effect
  - ii) High temperature super conductors. 5
- c) Compare the momentum and kinetic energy of an electron with de Broglie wavelength of  $1 \text{ \AA}$  with that of a photon having same wavelength. 5
- d) Briefly give an account of x-ray diffraction. Describe how Bragg's spectrometer is used for determination of inter planar spacing of a crystal and deduce the formula used. 10



## SECTION – II

## (Chemistry)

## Module – III

5. a) Explain the free radical polymerization mechanism of a vinyl compound. 10  
b) How is petrol manufactured artificially by Fischer-Tropsch process ? 5  
c) What are the advantages and disadvantages of a photovoltaic cell ? 5  
d) What is meant by cracking ? Describe with a neat diagram fluidized bed cracking method. 5
6. a) Describe the following method of polymerization 10  
i) Suspension ii) Emulsion  
b) What is power alcohol ? What are the advantages and disadvantages of blending alcohol with petrol ? 5  
c) Explain Bergius process to prepare synthetic petrol. 5  
d) What is a photovoltaic cell ? Explain its working. 5

## Module – IV

7. a) Explain the primary, secondary and tertiary treatment methods for sewage. 10  
b) Explain the liquid crystalline behaviour in PAA homologous series. 5  
c) Give brief account of the following 5  
i) Nematic ii) Cholesteric  
d) A sample of water is 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 : Atomic weights of Ca=40, Mg=24, S=32, O=16, C=12, Cl=35.5, H=1). 5
8. a) Explain how you will determine the chloride and sulfate content of water. 10  
b) Distinguish between thermotropic and lyotropic liquid crystals with examples. 5  
c) Draw the block diagram of photoelectric calorimeter, label and explain the essential parts. 5  
d) What are the characteristics of potable water ? 5