



## SEM 2 – 2 (RC-07-08)

F.E. (Semester – II) (Revised in 2007-08) Examination, May/June 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** answer books.
  - 3) Assume additional data, **if required**.
  - 4) Draw diagrams **wherever** required.

#### Physical constants :

Planck's constant	=	$6.626 \times 10^{-34}$ J-s
Electron charge	=	$1.6 \times 10^{-19}$ C
Boltzmann's constant	=	$1.38 \times 10^{-23}$ J/K
Electron mass	=	$9.1 \times 10^{-31}$ kg
Rydberg constant	=	$1.097 \times 10^7/\text{m}$
Velocity of light	=	$3 \times 10^8$ m/s

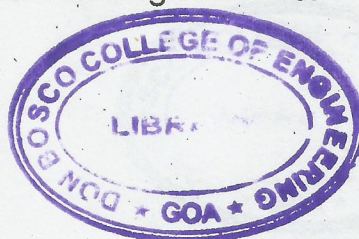
#### SECTION – I

#### (Physics)

#### Module – I

1. a) With neat energy level diagram explain three-level pumping scheme. What are its drawbacks ? 5  
b) Derive expression for acceptance angle of an optical fibre. What is acceptance cone of optical fibre ? 5  
c) With block diagram explain the use of optical fibres in communication. Give any two advantages of optical fibres over copper wires for communication. 5  
d) Describe Einstein's theory of stimulated emission and hence obtain the conditions necessary for light amplification. 5  
e) Calculate numerical aperture, acceptance angle and critical angle for an optical fibre having core R.I. 1.52 and cladding R.I. 1.48. 5

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2. a) With neat diagrams explain construction and working of Ruby laser. 5
- b) With neat diagrams explain the different types of optical fibres. 5
- c) Explain the process of stimulated emission of radiation and how it can be used for light amplification. 5
- d) Draw and explain structure of an optical fibre and hence show how light propagates in an optical fibre. 5
- e) What is population inversion ? Determine the ratio of population of two energy levels if the wavelength of light emitted during transition between these levels is  $6943 \text{ \AA}$  at  $37^\circ\text{C}$ . 5

### Module – II

3. a) Draw a neat diagram of Coolidge tube and explain the production of X-rays using Coolidge tube. 5
- b) What is Compton effect ? Describe an experiment used to study the Compton effect. 5
- c) With neat diagrams explain Type – I and Type – II superconductors. 5
- d) Write any five properties of X-rays. 5
- e) In a Compton effect experiment an X-ray photon of wavelength  $1.55 \text{ \AA}$  strikes an electron at rest and is scattered at an angle of  $60^\circ$  to the original direction. Find the wavelength of the scattered photon. 5
4. a) What is superconductivity ? Explain in brief BCS theory of superconductivity. 5
- b) State de Broglie's hypothesis. What is de Broglie's Wavelength ? State properties of matter waves. 5
- c) Explain the origin of characteristic and continuous X-ray spectra. 5
- d) Describe the Davisson-Germer experiment to prove that electrons behave like waves. 5
- e) Monochromatic X-rays of wavelength  $0.71 \text{ \AA}$  are made to reflect from a crystal with interplanar spacing of  $1.9 \text{ \AA}$ . Determine the highest order of reflection that can be observed with this radiation and the glancing angle corresponding to the highest order. 5







SECTION – II

(Chemistry)

Module – III

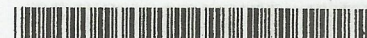
5. a) Define polymerization. Explain the types of polymerization and the free radical mechanism using ethylene as an example. 10
- b) Write the synthesis, 2 properties and 2 applications of PMMA. 5
- c) Explain the following :
- i) Knocking
  - ii) Octane number
  - iii) Cetane number
  - iv) Unleaded petrol
  - v) Synthetic petrol. 5
- d) Explain the importance and working of a photovoltaic cell. 5
6. a) Draw the Bomb calorimeter and explain how you will determine the calorific value of a solid fuel. 10
- b) How is solar grade silicon obtained ? Give any 2 methods. 5
- c) Write the synthesis, 2 properties and 2 applications of Teflon. 5
- d) What is an adhesive ? Give the manufacture and applications of Epoxy resin. 5

Module – IV

7. a) Explain the determination of chloride, nitrate, sulphate and dissolved oxygen in a water sample. 10
- b) Explain with a diagram how water can be purified using the flash evaporation method. 5
- c) Distinguish between thermotropic and lyotropic liquid crystals with examples. 5
- d) Explain the liquid crystalline behaviour in PAA homologous series. 5







8. a) Explain in detail how the sewage is treated at the sewage treatment plant. 10
- b) A sample of water is found to contain 42 mg/L  $\text{Ca}(\text{HCO}_3)_2$ , 47 mg/L  $\text{Mg}(\text{HCO}_3)_2$ , 28 mg/L  $\text{MgSO}_4$ , 33 mg/L  $\text{CaSO}_4$  and 23 mg/L  $\text{CaCl}_2$ . Calculate temporary and permanent hardness of water.  
Given : (Atomic weights of Ca = 40, Mg = 24, S = 32, O = 16, C = 12, Cl = 35.5, H = 1). 5
- c) Give brief account of the following liquid crystal systems  
i) Nematic 5  
ii) Cholesteric. 5
- d) Discuss the applications of liquid crystals in displays and thermography. 5

