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F.E. Semester-II (Revised Course 2007-2008) EXAMINATION MAY/JUNE 2019
Applied Science-II (Physics & Chemistry)

[Duration : Three Hours]   [Max.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 = 6.626×10^{-34} J-s
Electron charge = 1.6×10^{-19} C
Boltzmann's constant = 1.38×10^{-23} J/K
Electron mass = 9.1×10^{-31} kg
Rydberg constant = 1.097×10^{7}/m
Velocity of light = 3×10^{8} m/s
SECTION – I (Physics)

MODULE – I

Q.1	a) With energy level diagram explain the 4-level pumping scheme.	05
	b) With neat diagrams explain Step-index and GRIN fibres.	05
	c) The numerical aperture of an optical fibre is 0.48 and the core refractive index is 1.5. Calculate:	05
	i) Refractive index of cladding	
	ii) Fractional refractive index change	
	d) Give at least three differences between the following:	10
	i) Spontaneous emission and stimulated emission	
	ii) Step-index fibre and graded index fibre	
	iii) He-Ne laser and Ruby laser	
	iv) Hologram and photograph	

Q.2	a) Explain what is an optical resonator and why is it required in a laser?	05
	b) Define Numerical Aperture of an optical fibre. What is its significance? What is fractional refractive index difference?	05
	c) The transition to the ground state from the upper and lower energy states in a laser system results in emission of photons of wavelengths 6328 Å and 6943 Å respectively. Determine the ratio of populations of the two energy levels at 57°C.	05
	d) Draw the setup and energy level diagram of He-Ne laser and hence explain its construction and working.	10

MODULE – II

Q.3	a) Give the industrial, medical and scientific uses of X-rays.	05
	b) With neat diagrams explain type-I and type-II superconductors.	05

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c) Identify the target element used in the Coolidge tube if the wavelength of the $K\alpha$ line emitted is 1.55 Å. Take nuclear screening constant as unity. **05**

d) What is Compton effect? Derive an expression for Compton shift. **10**

Q.4 a) Describe the Davisson-Germer experiment to prove that electrons behave like waves. **05**

b) Explain effect of temperature and magnetic field on a superconductor. **05**

c) In a Compton effect experiment, the wavelength of X-ray radiation scattered at an angle of 45° is 0.71 Å. Calculate the wavelength of incident X-rays. **05**

d) Derive Bragg's Law of X-ray diffraction. Describe Bragg's Spectrometer to verify Bragg's Law. **10**

SECTION – II (Chemistry)

Module – III

Q.5 a) What is Polymerization? Briefly explain classification of Polymers. **05**

b) What is a photovoltaic cell with the help of a neat diagram explain its working. **05**

c) Outline the deficiencies of Natural rubber and advantages of Synthetic rubber. **05**

d) Give any one method to prepare Synthetic Petrol. **05**

e) Define Gross and Net Calorific Value? What is the difference between the two? **05**

Q.6 a) Describe with a neat diagram how calorific value of a chemical fuel is determined using Bomb Calorimeter. Explain how and why corrections are made in the determination of calorific value. **10**

b) Define the term 'Glass Transition Temp'. Outline its importance by giving examples. **05**

c) Write a note on reforming of Petrol. **05**

d) Outline the mechanism of Free Radical Polymerization by using suitable example of initiator and monomer. **05**

Module - IV

Q.7 a) What are the impurities present in water? **05**

b) Explain 'Reverse Osmosis' method for Purification of water. **05**

c) With the help of Block diagram explain the working of colorimeter. **05**

d) What is a Liquid Crystal? Explain the Thermotropic and Lyotropic types with examples. **05**

e) What is BOD? Explain how you will find BOD of the water sample. **05**

Q.8 a) A water sample was analyzed for **08**

   i) Alkalinity   ii) Hardness

   The test analysis as per Standard protocols gave the following data:

   i) 100 ml of the water sample upon titration with 0.05 M HCl required 16 ml to attain the methyl orange end point.

   ii) Presence of $Ca(HCO_3)_2$ 100mg/L; $Mg(HCO_3)_2$ 73mg/L, $CaCl_2$ 110mg/L; all values are in $CaCo_3$ equivalents. Find the alkalinity, Permanent and Temporary hardness of water.

b) Explain how chlorides and Nitrates can be determined experimentally in a given sample of water.   07

c) Explain briefly the instrumentation and application of Potentiometer.   05

d) Draw a neat labeled diagram for the treatment of Potable water.   05