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

[Duration : Three 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 Constant:

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

Applied Science -II (Physics)

Section I

Module I

- Q.1
- a) Describe Einstein's theory of stimulated emission and hence obtain the conditions required for light amplification. (5)
 - b) Draw and explain structure of an optical fiber cable. (5)
 - c) Explain the differences between conventional and laser source of light. (5)
 - d) With neat diagrams explain the different types of optical fibers. (5)
 - e) A step- index fiber in air has N.A of 0.16, core R.I. of 1.48 and core diameter of $80 \mu\text{m}$. Determine the V-number for the fiber when light of wavelength $0.9 \mu\text{m}$ is transmitted. Also estimate the number of modes the fibre will support. (5)
- Q.2
- a) What is population inversion and why is it necessary for light implication? Why is population inversion sometimes is called negative temperature state? (5)
 - b) With ray diagrams explain the phenomena of total internal Reflection. What are the conditions necessary for total internal reflection? (5)
 - c) What is holography? How is it different from photography? Explain how to record a hologram. (5)
 - d) What are the advantages of optical fibers over copper wires in communication? (5)
 - e) If mode separation of a 6943 \AA ruby laser is 1000 MHz, what must be the length of the laser cavity to ensure that only one longitudinal mode oscillates. (5)

Module II

- Q.3
- a) Draw a neat diagram of Coolidge tube and explain the production of X-ray using Coolidge tube. (5)
 - b) What is Compton Effect? Describe an experimental setup to study Compton Effect. (5)

- c) Explain briefly "Meissner effect" and "Silsbee effect" in superconductors. (5)
- d) With neat diagram explain the working of Bragg's spectrometer (5)
- e) Using the de Broglie's hypothesis, calculate the wavelength of the waves associated with: (5)
 - i) A ball of mass 500 gm moving at a speed of 5 m/s
 - ii) An electron with K.E. of 50 eV.

Q.4

- a) What are matter wave? Write 4 properties of matter wave. (5)
- b) State Moseley's Law and explains its significance. (5)
- c) Discuss the various applications of super conductivity. (5)
- d) Write any five properties of X-rays. (5)
- e) When a potential difference of 20 KV is applied across the x-ray tube a current of 2mA flows through it. Calculate: (5)
 - i) The number of electrons striking the target per second
 - ii) The speed with which they strike
 - iii) The shortest wavelength of x-rays emitted

Applied Science- II (Chemistry)
Section II
Module III

Q.5

- a) What is Polymerization? Briefly explain classification of polymers. (5)
- b) Define gross and Net. Calorific value? What is the difference between the two? (5)
- c) Explain any one method of polymerization you know. (5)
- d) Give one method to prepare synthetic petrol? (5)
- e) Construct solar cell and explain its working? (5)

Q.6

- a) Define the terms (8)
 - i. Fuel ii. Calorific value iii. Cetane number iv. Gross Calorific value

A fuel weighing 0.80 g was tested in a bomb calorimeter. The mass of water taken in the Calorimeter was 2000g. Water equivalent of calorimeter is 530g. The difference in the Initial and final temperature is 1.9°C. Its elements analysis showed 92%C, 3.6% H₂ and 1.2 % O₂. Calculate the Net Calorific value .

- b) Explain i) How doping of silicon is done and ii) any one method for production solar grade silicon (7)
- c) Outline the synthesis 1 properties and application of Teflon. (5)
- d) With the help of heat labeled diagram. Explain the process of synthesis of petroleum by Bergius process. (5)

Module IV

Q.7

- a) What are the impurities present in water? (5)
- b) Explain briefly how you will find 'Hardness' and Dissolved oxygen' of water sample. (5)
- c) What are 'liquid Crystals' Give its applications. (5)
- d) Explain 'Reverse Osmosis' Method for Purification of water. (5)

e) Draw block diagram of colorimeter and explain its working. (5)

Q.8

a) A water sample was analyzed for: (8)

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 $\text{Ca}(\text{HCO}_3)_2$ 100 mg/L; $\text{Mg}(\text{HCO}_3)_2$ 73 mg/L CaCl_2 110 mg/L, all values are in CaCO_3 equivalent; 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 (7)

c) Outline the applications of Lyotropic liquid crystals. (5)

d) Draw a neat labeled diagram for the treatment of water by the municipal treatment plant. (5)