

- N.B.**(1) Question Nos. 1 and 6 are **compulsory**.  
 (2) Attempt any **two** questions from **each** section.  
 (3) Attempt **both** the sections in **separate** answer books.  
 (4) Assume **suitable** data and symbols if **required**.  
 (5) **Figures** to the right indicate **full** marks.  
 (6) **Atomic Weights** : Ca-40, Mg-24, C-12, O-16, Cl-35.5, H-1, S-32, K-39, Na-23.

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 Section I

1. Answer any **four** :—
- (a) What is Ligancy ? Give its significance. Calculate critical radius ratio for Ligancy 3. 5  
 (b) Draw the following : 5  
 $(100)$ ,  $(121)$ ,  $[010]$ ,  $(123)$ ,  $[\bar{1}10]$
- (c) Calculate the frequency of fundamental note emitted by piezoelectric crystal using 5  
 following data :  
 Data : Vibrating length = 3 mm  
 Young's modulus =  $8 \times 10^{10}$  N/m<sup>2</sup>  
 Density of Crystal = 2.5 gm/cm<sup>3</sup>  
 What will happen if vibrating length is doubled ?
- (d) Explain how cross electric and magnetic fields can act as a velocity filter for charged 5  
 particles passing at right angles to them. (Draw necessary diagram)
- (e) Calculate de Broglie wavelength associated with a proton moving with a velocity equal 5  
 to  $\frac{1}{20}$ th velocity of light.
2. (a) Explain how energy bands are formed in a solid. Explain with diagram how potential barrier 8  
 is formed in p-n junction.
- (b) What is packing efficiency of a crystal ? Aluminium is FCC monoatomic. Find coordination 7  
 number, no. of atoms per unit cell, atomic radius, packing fraction and packing efficiency  
 of Aluminium.
3. (a) In a cathode ray tube a pair of deflecting plates are 2 m long and are spaced 0.5 cm 8  
 apart. The distance from the centre of the plates to the screen is 24 cm. The final anode  
 voltage is 1000 volts. Calculate :  
 (i) The displacement produced by deflecting voltage of 30 volts.  
 (ii) The angle which the beam makes with the axis of the tube on emerging from  
 the field.  
 (iii) Velocity of the beam on emerging from the field.
- (b) What are ultrasonic waves ? Discuss the effects used in generating ultrasonic waves. 7  
 How will you detect these waves using thermal detector method ?
4. (a) Describe with neat labelled diagram the construction and working of cathode Ray Tube. 8  
 (b) What is cavitation effect ? Explain it and discuss its uses. 7
5. Solve any **three** :—
- (a) What is the distance between planes with Miller indices (i) (200) (ii) (110) (iii) (111) 5  
 of Aluminium (FCC) if its lattice constant is 1.04 A.U. What is coordination no. ?
- (b) Find the depth of sea water from a ship on the sea surface if the time interval of 2 sec 5  
 is required to receive the signal back. Given that the temperature of sea water is  
 10°C and salinity is 10 gm/lit.
- (c) Discuss properties of de Broglie wave. 5
- (d) Show that in a crystal of cubic structure, the distance between the planes with Miller 5  
 indices h, k, and l is equal to  $d = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$  where a is lattice parameter.
- (e) An electron of 50 eV energy enters in a perpendicular field of magnetic strength 5  
 0.04 wb/m<sup>2</sup>. Find the radius of its path in the field.



Section II

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6. Answer any six from the following :— 18
- (a) Distinguish between sludges and scales.
  - (b) What are the characteristics of condensation polymerisation ?
  - (c) Name two solid lubricants. What are the conditions under which solid lubricants are used ?
  - (d) Write a brief note on Photochemical Smog.
  - (e) Calculate the total, Temporary and Permanent hardness of a water sample using the following data :
    - (i) 50 ml of Standard Hard Water having 1.2 gms  $\text{CaCO}_3$  per litre, required 32 ml. of E.D.T.A. solution.
    - (ii) 100 ml. of water sample consumes 14 ml. E.D.T.A.
    - (iii) 100 ml. of boiled and filtered water sample consumes 8.5 ml. of E.D.T.A. solution.
  - (f) Distinguish between thermosetting and thermosoftening plastics.
  - (g) 2.5 gm of an oil sample required 2.5 ml. of 0.01 N-KOH for neutralization of free fatty acids in a given lubricating oil. Find the acid-value. Comment on suitability of this oil for lubrication purpose.
  - (h) What is B.O.D. ? What is its significance ?
7. (a) A water sample was found to contain the following salts : 5
- $\text{CaSO}_4 = 20.4 \text{ PPM}$      $\text{MgCl}_2 : 9.5 \text{ PPM}$   
 $\text{HCl} : 7.3 \text{ PPM.}$          $\text{NaCl} : 5.8 \text{ PPM}$
- Calculate the amount of lime (85% pure) and soda (80% pure) required to soften 80,000 litres of water.
- (b) Explain, with a neat diagram, the mechanism of hydrodynamic lubrication. 5
  - (c) What are the drawbacks of natural rubber ? Explain, how these drawbacks are overcome by the process of vulcanization. 6
8. (a) Explain, with diagram and equations, the zeolite process of softening water. What are the advantages and disadvantages of this process ? 6
- (b) Write a note on 'extrusion moulding'. 5
  - (c) How sewage is treated with activated sludge process ? 5
9. (a) Give preparation, properties and uses of bakelite. 5
- (b) Discuss the disadvantages of using hard water for domestic and industrial purposes. 5
  - (c) Define and explain the significance of the following :— 6
    - (i) Saponification Value
    - (ii) Flash Point and Fire Point.