

5. Write short notes on **any three** :

- (a) Shapes of d orbitals
- (b) Radial and Angular wave functions
- (c) Quantum numbers
- (d) VSEPR theory
- (e) Valence bond theory (5,5,5)

6. (a) Explain the significance of the Born-Landé' equation in calculating lattice energy. Also, discuss the physical meaning of each term in the equation.

(b) Write short notes on following :

- (i) Fajan rule
- (ii) Hydration energy
- (c) Given that the dipole moment of NH_3 is 1.46 D and that of NF_3 is 0.24 D, explain the reason for this difference.
- (d) Arrange the following species in order of increasing bond order: O_2^{2-} , O_2^- , O_2 and O_2^+ . (4,4,4,3)

(200)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4641

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Unique Paper Code : 2174001001

Name of the Paper : GE: ATOMIC STRUCTURE AND CHEMICAL BONDING

Name of the Course : **All Undergraduate Courses except with Chemistry Discipline**

Semester : II / IV / VI

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
 2. Attempt any **four** questions out of **six**.
 3. **All** questions carry equal marks.
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1. (a) Discuss Bohr's Theory of Atomic Model. What were the limitations of Bohr's theory?

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- (b) Write the expected and actual electronic configurations of chromium and copper. Explain why these two elements exhibit exceptional electronic configurations.
- (c) Draw shapes of p_x , p_y and p_z orbital's separately. Make sure to show and label the three coordinate axes in each case.
- (d) In which subshell the electrons with the following quantum numbers will be found?
- (i) $n = 3, l = 2$
- (ii) $n = 1, l = 0$ (5,5,3,2)
2. (a) Write the time-independent Schrodinger wave equation for an electron in a hydrogen atom in Cartesian coordinates, explaining all the terms involved. Which three quantum numbers are derived from its solutions?
- (b) State and explain Heisenberg uncertainty principle and Aufbau principle.
- (c) What do you understand by the terms "shells", "Subshells" and "Orbitals"? Give examples.

- (d) Calculate the wavelength associated with an electron moving with a velocity of 10^3 ms^{-1} (mass of electron $9.1 \times 10^{-31} \text{ kg}$) (5,5,3,2)
3. (a) Write any four postulates of Molecular Orbital Theory.
- (b) Draw radial probability distribution curves for 3s, 3p and 3d orbitals on the same scale.
- (c) What are the allowed values for each of the four quantum numbers: n , l , m_l , and m_s ?
- (d) Calculate the dipole moment of a molecule having a bond length of 0.1 nm and a charge separation of $1.6 \times 10^{-19} \text{ C}$. (4,4,4,3)
4. (a) Using VSEPR theory, explain the geometry of SF_6 and SF_4 . How does the presence or absence of lone pairs affect their shapes?
- (b) Compare the molecular orbital diagrams of NO and NO^+ . How does ionization affect the bond order, stability, and magnetic properties of molecules?
- (c) Compare and contrast the molecular geometries of CH_4 , PCl_5 , and SF_6 on the basis of their hybridization. Discuss how hybridization influences the geometry and bond angles. (5,5,5)