

October 2025

B.A./B.Sc.

First Semester

MAJOR – 1

CHEMISTRY

Course Code: CHM 1.11

(Atomic Structure, Periodicity of Elements & Chemical Bonding)

Total Mark: 50

Pass Mark: 20

Time: 2 hours

I. Answer the following questions.

1. (a) How many orientations are possible for d-orbitals? Name and draw the orientations. 1+3=4
(b) Half-filled and full-filled electronic configurations are very stable. Explain. 2
(c) What is effective nuclear charge? Calculate the effective nuclear charge felt by: 2+2+2=6
 - (i) 3d electron of Cr-atom
 - (ii) 3p electron of N-atom
2. (a) Define lattice energy. Calculate the enthalpy of formation of KCl from the given values.
(Heat of sublimation = 102.5 KJ/mol, D = 230.5 KJ, IE of K = 450.6 KJ, EA of Cl = -350.2 KJ, U of KCl = -737.9 KJ) 1+4=5
(b) Write Kapustinskii expression for lattice energy for CaCl₂. 1
(c) What elements form hydrogen bonding? Explain different types of hydrogen bonding with one example each. What are London forces? 1+3+2=6
3. (a) Based on VSEPR theory, discuss the shapes of SF₄ and PCl₅ molecules and give reasons why they have different shapes. 4
(b) With a pictorial representation, explain the process of dsp² hybridisation. 1+3=4
(c) Write the MO electronic configuration of N²⁺ ion and draw its MO energy level diagram. 1+3=4

II. Answer any two of the following questions.

4. (a) What is ionization enthalpy? Discuss its variation across a period and down the group. 1+3=4
(b) State the Aufbau principle. Explain why 4s orbital is lower in energy than 3d orbitals. 1+2=3
5. (a) Explain percent ionic character from electronegativity difference. 3
(b) What is ionic bond? Give three general characteristics of ionic bond. 1+3=4
6. (a) Draw the Lewis dot structures of NO, H₂O, PCl₃, and CCl₄.
What are the characteristics of resonance? 2+2=4
(b) Write any three postulates of molecular orbital theory (MOT). 3
-