


Name:			
Enrolment No:			
<b>UPES</b> <b>End Semester Examination, December 2023</b>			
<b>Course: Fundamentals of Group theory</b> <b>Semester: VII</b> <b>Program: B.Sc. (Chemistry by Research)</b> <b>Time : 03 hrs.</b> <b>Course Code: CHEM4012</b> <span style="float: right;"><b>Max. Marks: 100</b></span>			
<b>Instructions:</b> <ol style="list-style-type: none"> <li>1. Write your enrolment number on the top left of the question paper</li> <li>2. Do not write any thing else on the question paper except your enrolment number</li> <li>3. Attempt all part of a question at one place only</li> <li>4. Internal choice is given for question number 9 of Section B and question number 11 of Section C only</li> </ol>			
<b>SECTION A</b> <b>(5Qx4M=20Marks)</b>			
S. No.		Marks	CO
Q 1	Discuss The Great orthogonality theorem and its application	4	CO1
Q 2	Determine $\Gamma_{3N}$ for the following molecules or ions: (a) $\text{NH}_3$ ( $C_{3v}$ ) (b) $\text{WF}_5\text{Cl}$ ( $C_{4v}$ )	4	CO2
Q 3	Assign the point group of the following compounds: (a) $\text{XeF}_4$ (b) $\text{C}_6\text{H}_6$	4	CO2
Q 4	Elaborate different types of symmetry elements present in $[\text{PtCl}_4]^{2-}$	4	CO3
Q 5	Calculate the Character of the following symmetry operation. a) $\sigma_{xz}$ b) $S_6$ c) $C_4$	4	CO2
<b>SECTION B</b> <b>(4Qx10M= 40 Marks)</b>			
<b>(Question No. 6, 7 and 8 are Compulsory); attempt any one from question no 9</b>			
Q 6	Obtain the irreducible components of the following reducible representations (use the character tables): (a) $T_d$ (b) $C_{2v}$	10	CO3

Q 7	Deduce the matrix representation for the identity rotational operation and reflectional operation, rotational–reflectional operation and inversion.	10	CO3
Q 8	Elaborate all the forbidden transition in C <sub>3V</sub> and C <sub>2V</sub>	10	CO4
Q 9	Construction of character table for C <sub>2v</sub> point group  OR  How are the irreducible representation symbolized? Write the reduction formula and explain with examples?	10	CO3
<b>SECTION-C</b> <b>(2Qx20M=40 Marks)</b> <b>(Question No. 10 Compulsory); attempt any one from question no 11</b>			
Q 10	(a) Explain IR and Raman active mode in RuO <sub>4</sub> . (b) Consider an octahedral molecule XY <sub>6</sub> whose point group is O <sub>h</sub> . Prove the irreducible representation of O <sub>h</sub> is $\Gamma = A_{1g} + E_g + T_{1u}$ .	10+ 10	CO4
Q 11	(a) Find the irreducible components of the representations generated by a set of five d-orbitals in environments of C <sub>2v</sub> (b) Explain elements of symmetry and symmetry operations.  OR  Construct SALCs corresponding to bond stretches, and in- and out-of-plane bending modes for BF <sub>3</sub> ( D <sub>3h</sub> )	20	CO3