iii) Gold can form stable **auride ion** with appropriate cation.

M. Sc. (Chemistry) Examination, 2023

(4th Semester)

Paper: XIII–I

[Inorganic Chemistry Special]

Time : Two Hours Full Marks : 40

(20 marks for each unit)

Use a separate answer script for each unit.

Unit: I-4131

Answer ***all*** questions.

1. Mention the splitting of ^3F state under D_{4h} Symmetry. 5
2. Evaluate the symmetries of IR and Raman vibrations of *trans*-N_2F_2. 5
3. What will be the state generated (including spin multiplicity) from t_{2g}^2 configuration in a strong field octahedral complex? 5
4. Show that in $[NiCl_4]^{2-}$ all three transitions are electronically allowed. 5

Character table for D_4

	E	$2C_4(z)$	$C_2(z)$	$2C_2'$	$2C_2''$
A_1	1	1	1	1	1
A_2	1	1	1	–1	–1
B_1	1	–1	1	1	–1
B_2	1	–1	1	–1	1
E	2	0	–2	0	0

O_h	C_{2v}
A_{1g}	A_1
A_{2g}	A_2
E_g	$A_1 + A_2$
T_{1g}	$A_2 + B_1 + B_2$
T_{2g}	$A_1 + B_1 + B_2$

C_{2v}	E	$C_2(z)$	$\sigma_v(xz)$	$\sigma_v(yz)$
A_1	1	1	1	1
A_2	1	1	–1	–1
B_1	1	–1	1	–1
B_2	1	–1	–1	1

Character table for T_d

T_d	E	$8C_3$	$3C_2$	$6S_4$	$6\sigma_d$		
A_1	1	1	1	1	1		$x^2+y^2+z^2$
A_2	1	1	1	–1	–1		
E	2	–1	2	0	0		$(2z^2-x^2-y^2, x^2-y^2)$
T_1	3	0	–1	1	–1	(R_x, R_y, R_z)	
T_2	3	0	–1	–1	1	(x, y, z)	(xy, xz, yz)

Character Table of C_{2h}

E	C_2	i	σ_h			
A_g	1	1	1	1	R_z	x^2, y^2, z^2, xy
B_g	1	–1	1	–1	R_x, R_y	xz, yz
A_u	1	1	–1	–1	z	
B_u	1	–1	–1	1	x, y	

Unit: I-4132

5. Consider an octahedral complex, $[TiF_6]^{2-}$.

a) Determine the **LGO**s of the six terminal F atoms using projection operator. (Character Table may be consulted). 6

O (432)	*E*	$8C_3$	$3C_2$	$6C_4$	$6C_2'$
A_1	1	1	1	1	1
A_2	1	1	1	–1	–1
E	2	–1	2	0	0
T_1	3	0	–1	1	–1
T_2	3	0	–1	–1	1

b) Write down the **Mulliken symbol** of the valence AOs of Ti atom and draw a qualitative **MO energy level diagram** of $[TiF_6]^{2-}$ with clear depiction of **FMOs**. 4

c) Predict the **geometry of CH_2^+** and **BeH_2** in their ground and first excited states with the aid of appropriate Walsh diagram. 4

d) Explain the following phenomena: 2×3

i) Non-relativistic gold would be white like silver.

ii) In platinum group metals, **{M(η^2-H_2)}** description in comparison to **{M(H_2)}** becomes less significant down the group.