Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course: Chemistry of d-Block Elements… (Generic Elective – III) **Semester: IV**
Program: B.Sc. (Geology)/ B.Sc. (Maths) **Time: 03 hrs.**
Course Code: CHEM 2007 **Max. Marks: 100**

Instructions: Read all the below mentioned instructions carefully and follow them strictly

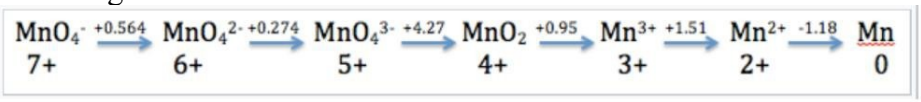
1) Write your name and enrollment no. at the top of the question paper.
2) Do not write anything else on the question paper except your name and roll number.
3) Attempt all the parts of a question at one place only.
4) Internal choices are given for question number 9 and 11.
5) CO1, CO2, CO3 & CO4 in the last column stand for course outcomes and are for official use only.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	(a) Write the gross selection rule of Vibrational spectroscopy? (b) Identify the IR active molecules with suitable justifications: H2O, N_2, $CHCl_3$, CO_2, H_2	2+2	CO3
Q 2	Write the Schrodinger equation of 1-D simple harmonic oscillator. Explain all the terms involved in the equation.	4	CO3
Q 3	Explain the linkage isomerism and geometric isomerism using examples, as shown by coordination compounds.	4	CO1
Q 4	Write basic postulates of Werner's theory. Explain bonding in coordination compounds in terms of this theory using an example.	4	CO1
Q 5	For each of the following pairs of complexes, identify the one that has the larger CFSE, give the explanation : (a) $[Cr(OH_2)_6]^{2}$ or $[Mn(OH_2)_6]^{2}$ (b) $[Fe(OH_2)_6]^{3}$ or $[Fe(CN)_6]^{3}$	4	CO2

SECTION B
(4Qx10M= 40 Marks)

Q 6	Derive the expression of wave function and energy of a particle with mass "m" in one dimensional box of length "L".	10	CO2
Q 7	(a) The energy of v=2 level of 1D SHO is 500 cm^{-1}, what is the zero point energy? (b) Find the eigen value of the wavefunction e^{-ikx} with an operator $\frac{-h^2}{8\pi^2 m}\frac{\partial^2}{\partial x^2}$	5+5	CO2

Q 8	(a) Explain the structure of $[Ni(CO)_4]$ using valence bond theory. (b) Write a note on "Jahn - Teller Effect".	**5+5**	**CO2**
Q 9	Using the Latimer diagram of Mn calculate the electrode potential (E^o) for the following reaction.  (a) MnO_4^- to Mn^{2+} (b) MnO_4^- to MnO_2 **OR** Write the IUPAC name or the formula of the following complexes: (a) $[Ag(NH_3)_2]Br$ (b) $K_2[Cd(CN)_4]$ (c) $[Co(H_2O)_6]\ [Ag(CN)_2]_3$ (d) diaquodicyanocopper(II) (e) potassium hexachloropalladate(IV)	**10**	**CO1**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	(a) Using the valence bond theory, predict the type of hybridization involved, along with the geometry and calculate the magnetic moment for $[Ni(CN)_4]^2$ and $[MnF_6]^3$. (b) Write a short note on inner and outer orbital octahedral complexes.	**10+10**	**CO2**
Q 11	(a) The vibration of $^1H^{80}Br$ molecule can be considered as simple harmonic oscillation. The force constant is 500 Nm^{-1}. Calculate the fundamental vibration frequency and the zero point energy of this molecule. **OR** Give the expression relating rotational constant B to moment of inertia. If B = 10 cm^{-1}, calculate the rotational energy levels of this molecules for J= 0, 1,2,3 levels. (b) Assume 1,3,butadiene as particle in one dimensional box with L= 0.50 nm. What is the wavelength (nm) of light required for the transition from ground state to the first excited state? Given: mass of electron = 9.1×10^{-31} kg, h = 6.626×10^{-34} Js. **OR** Discuss the origins of spectral broadening.	**10+10**	**CO3**