**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(END SEMESTER EXAMINATION)**

**CLASS: BTECH** **SEMESTER : I/ADD**
**BRANCH: CSE/AIML/ECE/EEE** **SESSION : MO/2025**

**SUBJECT: CH24101 / CH101 CHEMISTRY**

**TIME: 3 Hours** **FULL MARKS: 50**

**INSTRUCTIONS:**

**1. The question paper contains 5 questions each of 10 marks and total 50 marks.**
**2. Attempt all questions.**
**3. The missing data, if any, may be assumed suitably.**
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
**5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

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|---|---|---|---|---|
| Q.1(a) | (i) Using Werner's theory, explain why the series of cobalt (III) ammine complexes show successively decreasing electrical conductivity?<br>$[Co(NH_3)_6]Cl_3$<br>$[Co(NH_3)_5Cl]Cl_2$<br>$[Co(NH_3)_4Cl_2]Cl$<br>$[Co(NH_3)_3Cl_3]$<br>(ii)$[Co(NH_3)_6]^{3+}$ is diamagnetic and orange yellow whereas $[CoF_6]^{3-}$ is paramagnetic and blue . Explain. | [2+3] | 1 | 4,4 |
| Q.1(b) | Draw and explain the splitting of orbital for a Jahn–Teller distorted octahedral complex with a $d^9$ electronic configuration. Discuss the distortion in terms of *Z-in* and *Z-out* elongation/compression and explain how it affects the energies of the $e_g$ and $t_{2g}$ orbitals. | [5] | 1 | 3 |
| Q.2(a) | (i) What is the fundamental difference between resonance and tautomerism? Give examples.<br>(ii) Explain the following terms with suitable example: (i) angle strain (ii) torsional strain (iii) steric strain. | [2+3] | 2 | 2,2 |
| Q.2(b) | Compare SN1 and SN2 reactions on the basis of mechanism, reagents and substrate. Explain why polar aprotic solvents increase the rate of SN2 reactions, whereas polar protic solvents decrease it. | [3+2] | 2 | 4 |
| Q.3(a) | Derive the expression for the relaxation time (τ) for a fast reversible reaction<br>$A \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} B$<br>using relaxation theory. Explain all assumptions clearly. | [5] | 3 | 5 |
| Q.3(b) | Derive the Michaelis – Menten equation using the steady-state approximation.<br>An enzyme hydrolysed urea at [S]= 0.03 mmol/L with a Km value of around 0.06 mmol/L. The initial rate observed was $1.5x10^{-3}$ mmol/L.$min^{-1}$. Calculate the maximum rate of the enzymatic reaction. | [3+2] | 3 | 5,3 |
| Q.4(a) | (i) Instead of a single electronic transition, absorption spectrum is broad - explain.<br>(ii)How a change in solvent from a nonpolar to a polar affects the UV spectrum of acetone? | [2+3] | 4 | 2,3 |
| Q.4(b) | (i)Discuss the effect of electron donating and electron withdrawing groups on the secondary bands of aromatic compounds.<br>(ii)Why TMS is used as internal control for NMR recording? Show the NMR spectrum of 1,1,2-Trichloroethane and 2-Chloropropanoic acid | [2+3] | 4 | 4,3 |
| Q.5(a) | (i) What is the supercooled state of water? Describe this phenomenon and illustrate your explanation with the help of a suitable phase diagram.<br>(ii) Draw a neat, labeled cooling curve for a pure substance. Explain why the temperature remains constant during solidification. | [3+2] | 5 | 3,3 |
| Q.5(b) | (i) Explain the concept of chemical equilibrium. Discuss why equilibrium is considered dynamic rather than static<br>(iii) Give the importance of the lead–acid battery and the nickel–cadmium battery. Also write the cell reactions for both types of batteries.<br>Calculate the standard reduction potential of $Ni^{2+}$\|Ni electrode when the cell potential for the cell Ni \| $Ni^{2+}$ (1M)\|\| $Cu^{2+}$ (1M) \| Cu is 0.59 V ($E^\circ$ $Cu^{2+}$ \| Cu = 0.34 V) | [2+2+1] | 5 | **2,3,3** |

**:::::17/12/2025:::::M**