FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Diploma/Degree/Honors)*			**Semester - III**	Session: **2024-2025**
1	**Course Code**	**CHSC-03T**		
2	**Course Title**	**INORGANIC AND PHYSICAL CHEMISTRY-I**		
3	**Course Type**	**DSC**		
4	**Pre-requisite**(if,any)	*As per Program*		
5	**Course Learning. Outcomes(CLO)**	➢ *Understand fundamental chemical concepts of transition elements and their applications.* ➢ *Master the principles of coordination chemistry.* ➢ *Grasp the core principles of thermodynamics and apply them to various phenomena.* ➢ *Explore the world of electrochemistry and its applications.*		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours -learning & Observation*	
7	**Total Marks**	**Max.Marks: 100**		**Min Passing Marks:40**

PART -B: Content of the Course

Total No.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No. of Periods
I	**Chemistry of d & f-block elements** **A. d-block elements (5 hrs.)** **(i) Chemistry of elements of first transition series:** Characteristic properties of the elements of first transition series with reference to their: Electronic configuration, Atomic and ionic radii, Ionization potential, Variable oxidation states, Magnetic properties, Color, Complex formation tendency and catalytic activity. **(ii) Chemistry of elements of second and third transition series:** Electronic configuration of 4d and 5d transition series. Comparative treatment with their 3d-analogous (Group Cr- Mo-W, Co-Rh-Ir) in respect of oxidation states and magnetic behavior. **B. f-block elements (6 hrs.)** **Chemistry of Lanthanide & Actinides:** Electronic structure, oxidation states, ionic radii, magnetic, and spectral properties. Lanthanide contraction and its consequences, complex formation, occurrence and isolation, Separation of lanthanides: solvent extraction and ion exchange method. General features and chemistry of actinides, Transuranic elements, chemistry of separation of Np, Pu and Am from uranium, similarities between the later actinides and the later lanthanides.	12
II	**Oxidation and reduction (5 hrs)** Various definitions of oxidation and reduction, Balancing of redox reaction by ion-electron method, Latimer diagram of Chlorine and Oxygen, Frost diagram of Nitrogen and Oxygen, and Pourbaix diagrams of Iron. Predicting disproportionation and comproportionation phenomena. **Coordination Chemistry (6 hrs)** **A. Coordination compounds:**Distinction among simple salts, double salts, and coordination compounds. Terminology and nomenclature of Coordination	11

	compounds. Types of ligands based on denticity. Werner's Coordination theory and its experimental verification. Sidgwicks electronic interpretation, EAN rule with examples. Electroneutrality principle, Valence Bond Theory of transition metal complexes. Determination of structures and magnetic properties of complexes based on VBT. Chelates: Classification and their application. **B) Isomerism in coordination compounds:** Structural isomerism and Stereoisomerism (Geometrical and optical) in coordination compounds with four and six coordination numbers.	
III	**Thermodynamics-I: (5 hrs)** **A. Basic concept of thermodynamics**: System, surrounding, types of system (closed, open & isolated). Intensive & extensive properties. Thermodynamic processes: isothermal, adiabatic, isobaric, isochoric, cyclic, reversible & irreversible. State function & path functions and their differentiation, concept of heat & work. Zeroth law of thermodynamics, First law of thermodynamics. Definition of internal energy & enthalpy. Concept of heat capacity, heat capacity at constant volume & at constant pressure, and their relationship. Joule-Thomson experiment, Joule-Thomson coefficient (no derivation) & inversion temperature. Calculations of w, q, E & H for expansion of gases for isothermal & adiabatic conditions for reversible process. **B. Thermochemistry(2 hrs.)** Standard states, Heat of reaction, enthalpy of formation, enthalpy of combustion, enthalpy of solution, enthalpy of neutralization, Hess's law of constant heat of summation & its applications. Variation of enthalpy change of reaction with temperature (Kirchoff's equation). **C. Thermodynamics II (4 hrs.)** **Second law of thermodynamics:** Limitations of first law and need for the second law. Statements of second law. Carnot cycle & Efficiency of heat engine. Thermodynamic principle of working of a refrigerator (Carnot theorem). Concept of entropy: entropy change in a reversible and irreversible process; entropy change in isothermal reversible expansion of an ideal gas. Physical significance of entropy. Gibbs free energy, Gibbs -Helmholtz equation. **D.Third law of thermodynamics (1 hr)** Statement of third law, Nernst heat theorem, Absolute entropy of solids, liquids, and gases.	12
IV	**Electrochemistry-1** Electrolyte conductance: specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, Kohlrausch law, application of Kohlrausch law in determination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titrations. Single electrode potential, standard electrode potential, electrochemical series and its applications. Concept of overvoltage. Theory of strong electrolyte: limitation of Ostwald's dilution law weak and strong electrolyte, Debye-Huckel-Onsager's (DHO) equation for strong electrolytes, relaxation, and electrophoretic effect. Migration of ions: Transport number-definition and determination by Hittorf method and moving boundary method. Electrochemical cells or Galvanic cells: reversible and irreversible cells, conventional Representation of electrochemical cells. EMF of a cell, effect of temperature on EMF of cell, Nernst equation calculation of ΔG, ΔH and ΔS for cell reaction, polarization, Over potential and hydrogen overvoltage.	11
Keywords	***D & f-block elements, Coordination compounds, Werner's theory, VBT, Isomerism, Thermodynamics, Thermochemistry, Electrical/electrolytical conductance, Transport number.***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Jauhar, S. P. (2010). Modern Approach to Inorganic Chemistry: A Textbook for B. Sc. I Students. Modern publishers*
2. *Bajpai, D. N. (1992). Advanced book of physical chemistry. S Chand publishing.*
3. *Sharma, k. K. & Sharma, L. K. (2016). A textbook of physical chemistry. Vikas publishing.*
4. *Bhasin, K. K. (2018). Pradeep's Inorganic Chemistry Vol.III. Pradeep publications.*
5. *Puri, S., & Sharma, L. R. (2008). Kalia "Principles of Inorganic Chemistry".*

Reference Books recommended-

Inorganic Chemistry

1. *Lee, J. D. (2008). Concise inorganic chemistry. John Wiley & Sons.*
2. *Cotton, F. A., Wilkinson, G., &Gaus, P. L. (1995). Basic inorganic chemistry. John Wiley & Sons.*
3. *Huheey, J. E., Keiter, E. A., Keiter, R. L., & Medhi, O. K. (2006). Inorganic chemistry: principles of structure and reactivity. Pearson Education India.*
4. *Douglas, B. E., McDaniel, D. H., & Alexander, J. J. (1994). Concepts and models of inorganic chemistry, John Wiley & Sons*

Physical Chemistry

1. *Puri, L. B., Sharma, L. R., & Pathania, M. S. (2013). Principles of physical chemistry. Vishal Publishing Co.*
2. *Atkins, P. W., De Paula, J., & Keeler, J. (2023). Atkins' physical chemistry. Oxford university press.*
3. *McQuarrie, D. A., & Simon, J. D. (2004). Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://www.geeksforgeeks.org/d-block-elements/**
- **https://www.vedantu.com/evs/lanthanides-vs-actinides**
- **https://www.livescience.com/50776-thermodynamics.html**
- **https://byjus.com/jee/electrochemistry/**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA):30 Marks
EndSemester Exam(ESE): 70 Marks

Continuous InternalAssessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20** ~~/20~~ Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

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PART-A: Introduction				
Program: Bachelor in Science *(Diploma / Degree/Honors)*			**Semester - III**	Session: **2024-2025**
1	**CourseCode**	**CHSC-03P**		
2	**CourseTitle**	**CHEMISTRY LAB. COURSE-III**		
3	**CourseType**	**DSC**		
4	**Pre-requisite(if,any)**	-		
5	**Course Learning. Outcomes(CLO)**	➢ ***Understand the principle of determining transition temperature of hydrated or other allotropic salts.*** ➢ ***Employ the principle of determination of solubility of a given salt at different temperatures.*** ➢ ***Apply Born-Haber cycle to determine enthalpy and lattice energy.*** ➢ ***Determine strength of an acid, ionization constant of weak acid and solubility product by conductometric or potentiometric titrations.***		
6	**CreditValue**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**TotalMarks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content of the Course

Total No. of learning-Training/performancePeriods:30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Transition Temperature** 1) Transition temperature of a salt hydrate – determination of molecular weight. 2) Determination of the transition temperature of the given substance by thermometric /dialometric method (e.g. $SrBr_2.2H_2O$ or $MnCl_2.4H_2O$). **Thermochemistry** **A. Determination of solubility:** 1) To determine the solubility of benzoic acid at different temperatures and to determine **ΔH** of the dissolution processes. **B. Calorimetry:** 1) To determine the enthalpy of neutralization of hydrochloric acid (strong acid) by sodium hydroxide (strong base) solution. 2) (a) To determine the enthalpy of neutralization of a weak acid (acetic acid) versus strong base (sodium hydroxide) and determine enthalpy of ionization of weak acid. (b) To determine the enthalpy of neutralization of a weak base (ammonium hydroxide) versus strong acid (hydrochloric acid) and determine enthalpy of ionization of weak base. 3) To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy. **Conductometry** 1) Conductometry – Determination of limiting molar conductance of a strong Electrolyte (KCl). 2) To determine the strength of the given acid (HCl or CH3COOH)conductometrically	**30**

	using standard alkali (NaOH) solution. 3) To determine the strength of strong acid and a week acid in the given mixture conductometrically against a standard alkali solution. 4) To determine the ionization constant of weak acid conductometrically. **Solubility Product** 1) To determine the solubility and solubility product of a sparingly soluble salt conductometrically. 2) Potentiometry – Determination of solubility product of a sparingly soluble substance.	
Keywords	***Solution, Acid, Alkali. Transition temperature, Thermochemistry, Temperature, Enthalpy, Conductometric titrations, Potentiometric titrations, Solubility product.***	

SignatureofConvener&Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Vishwanathan, B. & Raghavan, P. S. (2017). Practical Physical Chemistry. Viva books originals publishing.*
2. *Yadav, J. B. (2006). Advanced Practical Physical Chemisty. Krishna Prakashan Media.*
3. *Sahu, D. P.& Bapat, K. N. (2022) Unified practical chemistry, Navbodh Prakashan.*

Reference Books recommended:

1. *Moudgil, H. K. (2010). Textbook of physical chemistry. PHI Learning Pvt. Ltd.*
2. *Adamson, A. (2012). A textbook of physical chemistry. Elsevier.*
3. *Findlay, A. (1923). Practical physical chemistry. Longmans, Green.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://tech.chemistrydocs.com/Books/Physical/Advanced-Physical-Chemistry-Experiments-by-J-N-Gurtu-&-Amit-Gurtu.pdf**
- **https://byjus.com/chemistry/conductometric-titration/**
- **https://chem.libretexts.org/Courses/University_of_California_Davis/Chem_4B_Lab%3A_General_Chemistry_for_Majors_II/1%3A_Thermochemistry_(Experiment)**
- **https://www.ulm.edu/chemistry/courses/manuals/chem1010/experiment_10.pdf**

Online Resources–

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PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment(CIA): 15 Marks

End Semester Exam(ESE): 35 Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **G. Performed the Task based on lab. work - 20 Marks** **H. Spotting based on tools & technology (written) – 10 Marks** **I. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS: