Name of the Department: Chemistry

Semester-VI

DSC 7: Advanced Inorganic & Physical Chemistry

Course Title: Advanced Inorganic & Physical Chemistry	**Course code:** 21BSC6C13CHL
Total Contact Hours: 56	**Course Credits:** 4
Internal Assessment Marks: 40	**Duration of SEE: 2 hrs**
Semester End Examination Marks: 60	

Course Outcomes (CO's):

1. Fundamentals of inorganic compounds like complexes and its identification will be taught.
2. Chemistry of metal ligand bonding with various bonding theories will be taught.
3. Concepts of electronic spectra & magnetic properties of coordination compound will be taught to the students tacking proper examples.
4. Basic concepts of thermodynamics & electrochemistry will be taught**.**
5. Thermo dynamical parameters, different equations and some applications will be taught.
6. Electrochemical parameters, different equations and some applications will be taught.

At the end of the course, students will be able to:

1. Understand the importance of fundamental law and validation parameters in chemical analysis.
2. Know how different metal ligand bonding in various compounds.
3. Understand the metal ligand bonding with different theories.
4. Explain the thermo dynamical parameters, thermodynamic equations & its applications.
5. Understand the importance of fundamental electrochemistry and also various derivations with reference to different electrical models.

DSC 7: Inorganic Chemistry and Physical Chemistry

Unit	Description	Hours
1	**Metal-Ligand equilibria in solution** Step-wise and overall formation constant and their relationship, trends in step-wise constant, kinetic and thermodynamic stability of metal complexes, factors affecting the stability of metal complexes with reference to the nature of the metal ion and ligand, chelate effect, macrocyclic effect and their thermodynamic origin. Determination of binary formation constant by pH metry, spectrophotometry, polarography and ion exchange methods. Structure and bonding- Structure and bonding in hydride, dihydrogen, dioxygen, isocyanide, CO, NO, N2 and tertiary phosphine complexes of transition metals.	10hrs
2	**Metal- ligand bonding** Stereoisomerism- coordination numbers 3 to 8. Crystal field theory, salient features, spectrochemical series, splitting of d-orbitals in tetragonal, square planar, trigonal bipyramidal and square-pyramidal geometry, applications of CFT- colours of transition metal complexes, magnetic properties of octahedral complex, distortion of octahedral complex, CFSE and their uses, factors affecting CFSE, limitations of CFT, experimental evidence for metal-ligand covalent bonding in complexes, nephelauxetic effect, Ligand Field Theory, MO theory: tetrahedral and octahedral complexes (including p- bonding), angular overlap model. Stereochemical non-rigidity, self assembly in supramolecular chemistry.	10hrs
3	**Electronic spectra of coordination compounds** Spectroscopic ground states, selection rules, term symbols for dn ions, Racah parameters, Orgel, Correlation and Tanaube-Sugano diagrams, spectra of 3d metal-aqua complexes of trivalent V, Cr, divalent Mn, Co and Ni, $CoCl_2$-, calculation of Dq, B and ß parameters, CT spectra. Spectral properties of Lanthanide and Actinide metal complexes. **Magnetic properties of coordination compounds** Types of magnetic behaviour, magnetic susceptibility, and its determination- Gouy, Faraday, VSM method. Diamagnetic correction, orbital contribution, spin-orbital coupling, ferro- and antiferromagnetic coupling, spin- crossover. Magnetic properties of Lanthanide and Actinide metal complexes.	10hrs
4	**Thermodynamics-I** Thermodynamics: Concepts of partial molar properties - partial molar free energy, chemical potential, partial molar volume and its significance. Gibbs-Duhem equation , Gibbs-Duhem - Margulus equation. Determination of partial molar volume : Graphical method, intercept method and Apparent molar volume method. Concept of fugacity; Determination of fugacity by graphical method and compressibility factor method. Activity and activity coefficient : Determination of activity coefficient by EMF and solubility method. Thermodynamics of non- ideal system-Excess thermodynamic function, GE ,SE , HE etc. Phase Rule : Derivation of phase rule from the concept of chemical potential. Application of Phase Rule to three components system :Principle of triangular diagram : Plots for a mixture of three liquids consisting of one ,two and three pairs of partially miscible liquids. Statistical Thermodynamics: Objectives of statistical thermodynamics, Concept of distributions, Types of ensembles.	14hrs

5	**Electrochemistry-I:** Elcetrochemistry of solutions: Ionic atmosphere, Debye-Huckel theory for the problem of activity coefficient, Debye-Huckel limiting Law, Debye-Huckel equation for appreciable concentration, Debye-Huckel Onsagar conductance equation and its extension to ion solvent interations, Debye-Huckel Bjerrum mode, Ion association, triple ions, triple ions and conductance minima. Thermodynamics of electrified interface, derivation of electro capillary Lipmann's equation, surface excess, thermodynamic aspects of surface excess. Structure of electrified interface: Helmholyz theory, Guoy- Chapman theory, Stern model. Overpotential: Concentration overpotential and activation overpotential, Derivation of Butler- volmerequation. Electrocatalysis: Definition and Influence of various parameters. Quantum aspects of charge transfer at electrode solution interface, quantization of charge transfer, tunneling of electrons for hydrogen evolution with reference to electrocatalysis.	12hrs

References:

1. Basic Inorganic Chemistry- F. A. Cotton, G. Wilkinson and P. L. Gaus; John Wiley and sons. Inc, 6th edition (1999).
2. Chemistry of elements- N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).
3. Inorganic Chemistry IV edition; J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley (1993).
4. Inorganic Chemistry, II edition, D. F. Shriver, P. W. Atkins and C. H. Langford, ELBS; Oxford UniversityPress, 1994.
5. Inorganic Electronic spectroscopy, A. B. P. Lever, Elsevier. (1968).
6. Magnetochemistry, R.L. Carlin, Springer Verlag.
7. Electronic Absorption Spectroscopy and related Techniques, D. N. Sathyanarayana, University Press(2001).
8. Inorganic Chemistry A Unified Approach by W. W. Porterfield, Elsevier 2005 2nd edition.
9. Textbook of inorganic chemistry by G. S. Sodhi, Viva books Pvt. Ltd (2011).
10. Molecular thermodynamics, Donald A. Mc Quarrie, John D. Simon University Science BooksCalifornia, (1999).
11. Thermodynamics for Chemists, by S. Glasstone, East-West Press, New Delhi, (1960).
10. Thermodynamics, by Rajaraman and Kuriacose, East-West Press, (1986).
11. Modern Electrochemistry Vol-1 and 2 J. O. M Bockris and A. K. N. Raddy, Plenum NewYork (1978)
12. An introduction to electrochemistry- Samuel Glastone East-West edition New Delhi (1942)
13. Text book of physical chemistry Samuel Glastone , 2nd edition, Mac Millan India Ltd (1991)
14. Electrochemistry, Principles and applications, Edmund, C. Potter, Cleaver-Hume press London(1961).
15. Principles and applications of Electrochemistry- D. R. Crow 3rd edition Chapmanhall London (1988)
16. statically thermodynamics, M C Gupta (Wiley estern Ltd.) 1993.

Date Course Coordinator Subject Committee Chairperson

DSC: INORGANIC & PHYSICAL CHEMISTRY PRACTICAL

Course Title: Inorganic & Physical Chemistry Practical	**Course code:** 21BSC6C14CHP
Total Contact Hours: 4 hrs	**Course Credits: 2**
Internal Assessment Marks: 25 marks	**Duration of SEE: 3**
Semester End Examination Marks: 25 marks	

Course Outcomes (CO's):

1. Impart skills on Gravimetric determination of metals from the ore.
2. To impart skills related to preparation of stock and working solutions and handling of instrumental methods
3. To know the principle of conductometric analysis and construction of calibration plot
4. Techniques to identify the metals volumetrically.
5. To understand the chemistry involved in conductometric titration
6. To determine Rf values of different metal ions present in a mixture
7. To impart knowledge on the importance potentiometric titration.

At the end of the course, students will be able to:

1. Understand the importance of instrumental methods for quantitative applications
2. Apply conductometric methods for acid base titrations.
3. Learn the importance of potentiometric analysis.
4. Learning the gravimetric methods & volumetric methods for analysis of materials.

DSC: Inorganic and Physical Chemistry Practicals

List of Experiments

Sl No	Name of the Experiment
PART-A Preparation	
1	Gravimetric determination of Fe in iron ore as Fe_2O_3.
2	Gravimetric determination of Ni in Cu and Ni solution.
3	Gravimetric estimation of Cu in Cu and Fe solution.
4	Volumetric estimation of Ca and Mg in Dolomite solution.
5	Volumetric estimation of Fe in Cu and Fe solution.
6	Determination of dissociation constant of a given indicator by colorimetric method.
7	Analysis of a binary mixture of two miscible liquids and to determine the composition of the given unknownmixture.
Conductometry	
8	Acid mixture versus NaOH.
9	Weak acid with salt versus NaOH.

Potentiometry	
10	$K_2Cr_2O_7$ versus FAS
11	Acid mixture versus NaOH

References:

1. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
2. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).

Date Course Coordinator Subject Committee Chairperson

Name of the Department: Chemistry

Semester-VI

DSC 8: Advanced Organic Chemistry & Thermal Methods

Course Title: Advanced Organic Chemistry & Thermal methods	**Course code:** 21BSC6C15CHL
Total Contact Hours: 56	**Course Credits:** 4
Internal Assessment Marks: 40	**Duration of SEE: 2 hrs**
Semester End Examination Marks: 60	

Course Outcomes (CO's):

1. Interrelationship among frequency, wavelength and wave number and importance of validation parameters of an instrumental method will be taught
2. Principle, instrumentation and applications of spectrophotometry, nephelometry and turbidometry will be taught
3. The concept of mechanism and importance of organic chemistry will be taught to the student
4. Concept and importance of intermediates in organic chemistry will be taught taking proper examples
5. The various techniques for identification of reaction mechanism will be taught to the student taking proper examples
6. Concept of biochemistry like V, tamins, peptids, amino acids and its importance will be taught.
7. The various projections on different thermal methods like TGA/DTA/DSC will be taught taking proper examples

At the end of the course, students will be able to:

1. Understand the importance of fundamental law and validation parameters in chemical analysis
2. Know how different analytes in different matrices can be determined by various methods.
3. Understand the requirement for chemical analysis by various analytical methods.
4. Predict the configuration of an organic molecule and able to designate it.
5. Identify the symetri group of various compounds and its structure.
6. Understanding the reaction mechanism of organic compounds.

DSC 8: Advanced Organic Chemistry & Thermal Methods

Unit	Description	Hours
1	**Aromatic Substitution Reactions** Electrophilic Substitution Reactions: The arenium ion mechanism. Orientation and reactivity. Energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles.Effect of leaving group.Amination, sulfonylation reactions; Diazonium coupling, Vilsmeier-Haack reaction, Gatterman reaction, Nucleophilic substitution reactions: The SNAr, SN1, benzyne and SRN1 mechanisms. Reactivity: effect of substrate structure, leaving group and attacking nucleophile. Goldberg reaction, Bucherer reaction, Schiemann reaction.	12hrs
2	**Addition Reactions** Addition to carbon-carbon multiple bonds: mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles, and free radicals. Regio, stereo- and chemoselectivities. Orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Addition of alkenes and/or alkynes to alkenes and/or alkynes. Ene synthesis. Michael reaction. Addition to carbon-heteroatom multiple bonds: Mechanism of metal hydride reduction (NaH, LiH, LiAlH4, NaBH4) of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents and organolithium reagents to carbonyl compounds and unsaturated carbonylcompounds. Conversion of aldehydes to nitriles. **Elimination Reactions** The E2, E1 and E1cB mechanisms and their spectrum.E2C and E2H mechanisms. Orientation of the double bond. Reactivity-effects of substrate structure, attacking base, the leaving group and the medium.	12hrs
3	**Rearrangements:** Wagner-Meerwein, Pinacol-Pinacolone, Fries, Wolff, Beckmann, Hofmann, Curtius, Lossen and Schmidt rearrangements. Benzil-benzilic acid rearrangement, Arndt-Eistert reaction, Tiffeneau - Demjanov reaction, Firtsch-Buttenberg-Wiechell rearrangement. Stevens, Wittig and Favorskii rearrangements, Baeyer-Villiger oxidation. Neber rearrangement. **Amino acids and Peptides** Synthesis and reactions of amino acids. Classification and nomenclature of peptides. Sanger and Edman methods of sequencing. Cleavage of peptide bond by chemical and enzymatic methods. Peptide synthesis- Protection of amino group (Boc-, Z- and Fmoc-) and carboxyl group as alkyl and aryl esters. Use of DCC, EEDQ, HOBt and active esters, acid halides, anhydrides in peptide bond formation reactions.	12 hrs
4	**Symmetry and Group Theory in Chemistry** Definition of groups, subgroups, cyclic groups, conjugate relationships, classes, simple theorems in grouptheory. Symmetry elements and symmetry operations, point groups, Schöenflies notations, representations of groups by matrices, reducible and irreducible representations, characters of representations, Great Orthogonality Theorem (without proof) and its applications, character tables andtheir uses (representations for the Cn, Cnv, Cnh, Dnh etc groups to be worked out explicitly) Mulliken symbols for irreducible representations Direct products, Applications of group theory to quantum mechanics- identifying non-zero matrix elements, derivation of the orthonormalization conditions.	12hrs

	Thermal methods of analysis Theory of thermogravimetry (TGA/DTA/DSC), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.	
5	**Electroanalytical methods** Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.	08hrs

References:

1. Advanced Organic Chemistry - Reactions, Mechanism and Structure, Jerry March, John Wiley (2008).
2. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum (1990).
3. A Guide Book to Mechanism of Organic Chemistry, Peter Sykes, Longman (2000).
4. Structure and Mechanism of Organic Chemistry, C. K. Ingold, Cornell University Press.
5. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall (1998).
6. Modern Organic Reactions, H. O. House, Benjamin (1972).
7. Principles of Organic Synthesis, ROC Norman and J. M. Coxon, Blackie Academic and Professional(1996).
8. Stereochemistry of Organic Compounds, D. Nasipuri, New-Age International (1999).
9. Stereochemistry of Carbon Compounds, E. L. Eliel, S. H. Wilen and L. N. Mander, John Wiley (1994).
10. Organic Chemistry, Volumes I and II, I L Finar, Longman. (1999).
11. Medicinal Chemistry, A Kar, Wiley (2000).
12. Peptides Chemistry: A practical text book, M. Bodansky, Springer-Verlag NY, 1988.
13. Solid-phase peptide synthesis: A practical approach-E. Artherton & R.C. Sheppard, I R L, Oxford Univ. Press, 1989.
14. Peptides: Chemistry and Biology, N Selwad and H.-D. Jakubke, Wiley-VCH, 2002.
15. Chemical Applications of Group Theory, F. A. Cotton, Wiley Eastern (1976).
16. Molecular Symmetry, D. S. Schonland, Van Nostrand (1965).
17. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
18. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
19. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
20. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International
21. Publisher, 2009.
22. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.

Date Course Coordinator Subject Committee Chairperson

DSC: ORGANIC CHEMISTRY PRACTICALS

Course Title: Organic Chemistry Practicals	**Course code:** 21BSC6C16CHP
Total Contact Hours: 4 hrs	**Course Credits: 2**
Internal Assessment Marks: 25 marks	**Duration of SEE: 3 hrs**
Semester End Examination Marks: 25 marks	

Course Outcomes (CO's):

1. To impart skills related to preparation of stock, and working solutions.
2. To impart knowledge on the importance of functional groups in organic compounds.
3. Techniques to identify the functional groups in an compound by performing physical and chemical tests
4. To record its melting point/boiling point.
5. To prepare suitable derivative for that compound and to characterize it.

At the end of the course, students will be able to:

1. Understand the importance of instrumental methods for quantitative applications
2. Understand how functional groups in an compound is responsible for its characteristic property
3. Learn the importance of qualitative tests in identifying functional groups.
4. Learn how to prepare a derivative for particular functional groups and how to purify it

DSC: Organic Chemistry Practicals

List of Experiments

Sl No	Name of the Experiment
PART-A Preparation (Two and three stages)	
1	2,4-Dinitrophenylhydrazine from chloronitrobenzene.
2	Anthranilic acid from phthalic acid.
3	Benzanilide from benzophenone.
4	Benzilic acid from benzoin.
5	Synthesis of Acridone.
6	Synthesis of Hydantoin.
PART-B Quantitative analysis	
1	Titrimetric estimation of amino acids.
2	Saponification value of oil.

4	Estimation of keto group.
5	Estimation of phenols.
6	Iodine value of oil (chloramine-T method).

References:

1. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, NewDelhi, (1996).
2. Practical Organic Chemistry - Mann and Saunders, (1980).
3. Text Book of Practical Organic Chemistry- A. I. Vogel, (1996).
4. Test Book of Quantitative Organic Analysis- A. I. Vogel, (1996).
5. Comprehensive practical organic chemistry : Preparation and quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.
6. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency,Calcutta, 2000.
7. Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
8. Practical organic chemistry (Quantitative analysis), B. B. Dey, M. V. Sitaraman and T. R. Govindachari, AlliedPublishers, New Delhi, 1992.

Date Course Coordinator Subject Committee Chairperson