VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in Chemistry

V Semester Syllabus

Bachelor of Science

With effect from 2021-22 and onwards

Name of the Department: Chemistry

Semester-V

DSC 5: INORGANIC CHEMISTRY AND SPECTROSCOPY

Course Title: Inorganic Chemistry And Spectroscopy	**Course code:** 21BSC5C5CHL
Total Contact Hours: 56	**Course Credits:** 4
Internal Assessment Marks: 40	**Duration of SEE: 2hrs**
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. Fundamentals of acids and bases as well as its chemistry & applications will be taught.
4. Principle, basics & some applications of nuclear chemistry will be taught.
5. The various spectroscopic tools like NMR, Mass spectroscopy, UV-Spectroscopy and IR Spectroscopy will be taught tacking proper expels.
6. Molecular spectroscopy including vibrational spectroscopy, Raman spectroscopy etc will be taught to the student level

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

1. Know how different analytes in different matrices (water and real samples) can be determined by spectrophotometric, nephelometric and turbidometric methods.
2. Understanding the importance of fundamental inorganic compounds & its chemistry.
3. Understanding the requirement of nuclear chemistry with its validation
4. Understanding the basic concepts of spectroscopy
5. Utilization of the spectroscopy principle for structural identification.
6. Explain the importance of spectroscopy in predicting the structure.

DSC 5: Inorganic Chemistry and Spectroscopy

Unit	Description	Hours
1	**Main group chemistry & Acid-Base Concept:** Chemistry of main group elements – Structure and bonding in boranes, carboranes, metallocarboranes, Wades rules, borazines, phosphozenes, S,N – compounds. Silicates-classification, structures, isomorphous replacement, pyroxenes, layered and vitreous silicates, zeolites and molecular sieves. HSAB concept: Basis of HSAB concept, acid – base strength, hardness and softness, symbiosis, applications of HSAB concept; Acid – base concept in non aqueous media , reactions in BrF_3, N_2O_4, anhydrous H_2SO_4, CH_3COOH. Isopoly and heteropoly acids of W, Mo, and V preparations, properties structure and applications.	11hrs
2	**Nuclear chemistry:** the atomic nucleus – elementary particles, quarks, classification of nuclides besed on Z and N values, nuclear stability, nuclear potential, binding energy. Nuclear models: shell model-salient features, forms of the nuclear potential, filling orbitals, nuclear configuration, liquid drop model, Fermi gas model, collective model and optical model. Radioactivity, radioactive decay kinetics, Parent- daughter decay growth relationship secular and transient equilibria, theories of α, β-, β+, and γ-decay, internal conversion.	11hrs
3	General principles and Introduction to absorption and emission spectroscopy. **UV Spectroscopy**: Types of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems for Conjugated dienes. **IR Spectroscopy**: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance, and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis	10 hrs
4	**Molecular spectroscopy :** Interaction of electromagnetic radiation with molecules and various types of spectra; Born- Oppenheimer approximation. Rotation spectroscopy: Selection rules, energy level diagrams, effect of isotopic substitution, intensities of spectral lines, determination of bond lengths of diatomic molecules. **Vibrational spectroscopy**: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies. Fundamental frequencies, overtones, hot bands. **Raman spectroscopy**: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines;	12hrs

5	**NMR & Mass Spectroscopy:** Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, Anisotropic effects Interpretation of NMR spectra of simple compounds. **Mass spectroscopy**: Principle, fragmentation process, Instrumentation & Applications	12hrs

References:

1. Basic Inorganic Chemistry- F. A. Cotton, G. Wilkinson and P. L. Gaus; John Wiley and sons. Inc, 6thedition (1999).
2. Advanced Inorganic Chemistry, 6th edition; F. A. Cotton and G. Wilkinson.
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. Chemistry of elements; N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).
6. Concise Inorganic Chemistry, 5th edition; J. D. Lee (1996).
7. Essentials of nuclear chemistry, 4th edition; H. J. Arniker, NAIL publishers (1995); Chapters 1, 3 and 4.
8. Nuclear and Radioactive chemistry; Friedlander, Kennedy and Miller; Chapters 8 and 9.
9. Inorganic Chemistry, 3rd Edition; Gary. L. Miessler and Donald . A. Tarr (2007).
10. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed.Tata McGraw-Hill:New Delhi (2006).
11. Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
12. Kemp, W. Organic Spectroscopy, Palgrave
13. Principles of Instrumental Analysis - 6th Edition by Douglas A. Skoog, F. James Holler, and StanleyCrouch (ISBN 0-495-01201-7).
14. Instrumental Methods of Analysis, 7th ed, Willard, Merritt, Dean, Settle.

Date Course Coordinator Subject Committee Chairperson

DSC: PHYSICAL & INORGANIC CHEMISTRY PRACTICALS

Course Title: Physical & Inorganic Chemistry Practicals	**Course code:** 21BSC5C5CHP
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. To impart skills related to preparation of stock and working solutions and handling of instrumental methods
2. To know the principle of condutometric analysis and construction of calibration plot
3. To understand the chemistry involved in condutometric titration of weak acid &weak base & strong acid & weak base
4. To prepare the metal complexes in a simple procedure.
5. To impart the knowledge on the importance of conductometric titration of acids & basis
6. A technique to identify the metal ions by coloromertic methods.

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

1. Understand the importance of instrumental methods for quantitative applications
2. Apply condutometric methods for accurate abseration of acids & Basis.
3. Apply colorometric methods for aureate absorption of light passed through solution.
4. Learn the importance of preparation methods and also determination of metal solutions.
5. Understand the mechanism of absorption and titrometric estimations.

DSC: Physical & Inorganic Chemistry Practicals

List of Experiments

Sl No	Name of the Experiment
PART-A Preparation and quantitative analysis of inorganic complexes.	
1	Cis and trans potassium dioxalatodiaquachromium(III) complex (Analysis of oxalate and chromium)
2	Hexamminecobalt(III)chloride (Analysis of cobalt)
3	Mercurytetrathiocyanatocobaltate.
4	Preparation of pentamminechlorocobalt(III)chloride.
5	preparation of hexamminenickel(II)chloride.
1. PART-B (Physical Chemistry)	
1	Conductometric titration of weak acid vs weak base.

2	Conductometric titration of mixture of strong acid and weak acid with strong base.
3	Determination of degree of dissociation of weak electrolyte (acetic acid).
4	Determination of dissociation constant of weak electrolyte.
5	Estimation of Fe^{+2} ion in given solution by titration of FAS vs $KMnO_4$ colorimetrically.
6	Estimation of Fe^{+2} ion concentration using EDTA through colorimetric method.
7	Adsorption isotherm of acetic acid on activated charcoal.
8	Titration of $AgNO_3$ versus KCl.

References:

1. Vogel's Text book of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
2. 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).
3. Inorganic Semimicro Qualitative Analysis, V. V. Ramanujam; The National Pub. Co. (1974).
4. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).
5. Findlays practical physical chemistry revised by P. B. Levitt, Longman's London (1966).
6. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill International Edn. (1966)
7. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut (1988)
8. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987)
9. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
10. Practical Physical Chemistry by A.M James and P. E. Pritchard, Longman's Group Ltd (1968)
11. Experimental Physical Chemistry by Wilson, Newcombe & others, Pergamon Press, New York (1962)
12. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983)
13. Experimental Physical Chemistry by V. D. Atavale and Parul Mathur, New Age International, New York (2
14. Physical Chemistry Laboratory Principles and Experiments by H. W. Salberg J. I. Morrow, S. R. Cohen anGreen Macmillan publishing Co .new York.

Practical's in physical chemistry A. Modern Approach by P.S Sindhu, Mac. Millan Publishers Delhi (200)(1986).

Date Course Coordinator Subject Committee Chairperson

Name of the Department: Chemistry

Semester-V

DSC 6: ORGANIC & PHYSICAL CHEMISTRY

Course Title: Organic & Physical Chemistry	**Course code:** 21BSC5C6CHL
Total Contact Hours: 56	**Course Credits:** 4
Internal Assessment Marks: 40	**Duration of SEE: 2hrs**
Semester End Examination Marks: 60	

Course Outcomes (CO's):

7. Interrelationship among frequency, wavelength and wave number and importance of validation parameters of an instrumental method will be taught
8. The concept of mechanism and its importance will be taught to the student
9. Concept and importance of intermediates in organic chemistry will be taught taking proper examples
10. The various techniques for identification of reaction mechanism will be taught to the student taking proper examples
11. Concept of stereochemistry and its importance will be taught.
12. The various projection formulae and the techniques of designating the molecules into R,S, D, L will be taught taking proper examples
13. The theory and concept of Cis-, Trans- isomerism and its importance and the techniques to differentiate between them will be taught taking examples.
14. Basic concepts of quantum mechanics and chemical dynamic will be taught.
15. The various applications of quantum chemistry and also chemical kinetics 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 analytes in different matrices (water and real samples) can be determined by spectrophotometric, nephelometric and turbidometric methods.
3. Explain mechanism for a given reaction.
4. Predict the probable mechanism for an reaction Eexplain the importance of reaction intermediates, its role and techniques of generating such intermediates
5. Explain the importance of Stereochemistry in predicting the structure and property of organic molecules.
6. Predict the configuration of an organic molecule and able to designate it.
7. Identify the chiral molecules and predict its actual configuration
8. Explain the importance of quantum mechanics for various applications.
9. Predict the possible importance & applications of some chemical reaction with kinetic study

DSC 5: Organic & Physical Chemistry

Unit	Description	Hours
1	**Reaction Mechanism:** Alternant and nonalternant hydrocarbons, Energy levels in odd and even-alternant hydrocarbons, energy levels for the benzyl cation, benzyl free- radical and benzyl carbanion. Hyperconjugation. Tautomerism. Methods of determining mechanisms based on structure of products, determination of the presence of the intermediates, isotopic labeling, isotopic effects from stereochemical evidence, Effect of structure on reactivity:- resonance and field effects, steric effects, the Hammett equation and linear free energy relationship, Substituent and reaction constants, Taft equation.	10hrs
2	**Stereochemistry** & **Carbohydrates:** Stereochemistry: Cram's and Prelog's rules. Conformational analysis: Conformational analysis of cycloalkanes: cyclobutane, cyclopentane, cyclohexanes (monosubstituted e.g., methyl, iso-propyl, tert-butyl and di-substituted cyclohexanes e.g.,dialkyl, dihalo, diols), and cycloheptane. **Carbohydrates.** Introduction and classification, mechanism of osazone formation. Interconversion of glucose into fructose and vice-versa, chain lengthening in aldoses (Killiani Fischer synthesis). Chain shortening in aldoses (Ruff degradation). Epimerization and mutarotation. Elucidation of open chain structure of D-glucose. Cyclic structures of glucose, maltose and sucrose (Fischer and Haworth representation). Synthesis of aldonic, uronic, aldaric acids and alditols.	10hrs
3	**Heterocyclic compounds** Nomenclature of heterocyclic compounds. Structure, reactivity, synthesis and reactions of pyrazole, imidazole, oxazole, isoxazole, thiazole, isothiazole, pyrimidine, purine and indole. **VITAMINS :** Biological importance and synthesis of Vitamins A, Vitamin B1 (thiamine), Vitamin B6 (pyridoxine), folic acid, pantothenic acid, riboflavin, Vitamin C, Vitamin E (?-tocopherol), Vitamin H (biotin).	12 hrs
4	**Quantum mechanics** Concepts of Operators: Laplacian, Hamiltonian, Linear and Hermitian operators. Angular Momentum operators and their properties. Commutation of operators. Solutions of Schrödinger wave equation for a free particle, particle in a ring, particle in a three-dimensional box. Quantum mechanical degeneracy, tunneling (no derivation). Application of Schrödinger equation to harmonic oscillator, rigid rotator. Eigenfunctions and eigenvalues of angular momentum. Ladder operator method for angular momentum.	09hrs

5	**Chemical dynamics** Concept of Steady state kinetics, Chain reactions - chain length and chain inhibition, comparison of photochemical and thermal reactions, Mechanisms of thermal and photochemical reactions between hydrogen-bromine and hydrogen-chlorine. Comparative study of thermal and photochemical hydrogen- halogen reactions. Pyrolysis of acetaldehyde, Decomposition of ethane. Kinetics of fast reactions- Introduction, Study of reactions by relaxation method (Temperature and pressure jump), flow method (Plug flow method and Stopped flow method), Flash photolysis and Shock tube method. Kinetics of homogeneous catalysis-kinetics of auto catalytic reactions, kinetics of acid-base catalysed reactions. Comparison of enzyme catalysed and chemical catalysed reactions, Mechanism (Lock and Key theory), Kinetics of enzyme catalyzed reactions - Henri-Michaelis-Menten mechanism, Significance of Michaelis-Menten constant, Lineweaver-Burk plot. Effects of enzyme concentration, pH, Temperature, Activators and Inhibitors on enzyme activity.	15hrs

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 in Organic Chemistry, Peter Sykes, Longman, (2000).
4. Structure and mechanism of Organic Chemistry, C K Ingold, Cornell University Press (1999).
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, R O C 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. Stereochemistry, Potapov, MIR, Moscow, 1984.
11. Organic Chemistry, Volumes I and II, I L Finar, Longman, (1999).
12. Introduction to Quantum Chemistry, A. K. Chandra, Tata McGraw Hill, (1988).
13. Quantum Chemistry, Ira. N. Levine, Prentice Hall, New Jersey, (1991).
14. Quantum Chemistry, R. K. Prasad, New Age International, 2nd edition, (2000).
15. Quantum Chemistry through problems and solutions, R. K. Prasad, New Age International (1997).
16. Chemical Kinetics- K. J. Laidler, McGraw Hill. Inc. New York (1988).
17. Principles of Chemical Kinetics - House J. E. Wm C Brown Publisher, Boston, (1997).
18. Kinetics and Mechanism - A. A. Frost and R. G. Pearson, John-Wiley, New York, (1961).
19. Chemical Kinetic Methods - C. Kalidas, New Age International Publisher, New Delhi (1995)
20. S.H. Maran and C. F. Pruton, 4th Edn., Oxford, & IBH publishing Co. Pvt. Ltd. New Delhi (1965).
21. Physical Chemistry- P. Atkins and J. D. Paula, 9th Edn., Oxford University Press (2010).
22. Biochemistry, - Geoffrey Zubay, 2nd Edn.,Macmillan Publishing Co. New York (1981).
23. Kinetics and Mechanism of Chemical Transformations- J. Rajaraman and J. Kuriakose, Mc Millan.

Date Course Coordinator Subject Committee Chairperson

DSC: ORGANIC CHEMISTRY PRACTICALS

Course Title: Organic Chemistry Practicals	**Course code:** 21BSC5C6CHP
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):

7. To impart skills related to preparation of stock and working solutions.
8. To impart knowledge on the importance of functional groups in organic compounds.
9. Techniques to identify the functional groups in an compound by performing physical and chemical tests
10. To record its melting point/boiling point.
11. To prepare suitable derivative for that compound and to characterize it.

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

6. Understand how functional groups in an compound is responsible for its characteristic property
7. Learn the importance of qualitative tests in identifying functional groups.
8. Learn how to prepare a derivative for particular functional groups and how to purify it.
9. Learn the detection of melting point or boiling point.
10. The understanding of complete mechanisum of organic reactions.
11. Identification of nature of the organic compounds.

DSC: Physical & Inorganic Chemistry Practicals

List of Experiments

Sl No	Name of the Experiment
PART-A	**Qualitative analysis:**
1	Separation and identification of organic compounds in the following types of mixtures.
2	**A + N, A + B, P + B, P + N, B + N**, (The compounds should be given according to availability in respective institution only mixtures of solid compounds.)
PART-B	**Preparation (one stage)**
1	1. Cannizarro reaction: Benzaldehyde.
2	2. Fries rearrangement: Phenyl acetate.
3	3. Friedel-Crafts reaction: Benzene and Acetyl chloride.

4	Sandmeyer reaction: 4-Chlorotoluene from 4-toluidine.
5	Pechmann reaction: Resorcinol and ethylacetoacetate.
6	Oxidation of Cyclohexanol.
7	Preparation of S- Benzylisothiuronium chloride.
8	Synthesis of p-iodonitrobenzene
9	Synthesis of N-Phenyl-2,4-dinitroaniline.
10	Synthesis of 2,4,6-tribromoaniline.
11	Synthesis of 2,4-dichlorophenoxyacetic acid.

References:

1. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied PublishDelhi, (1996).
2. Practical Organic Chemistry - Mann and Saunders, (1980).
3. Textbook of Practical Organic Chemistry- A. I. Vogel, (1996).
4. Textbook of Quantitative Organic Analysis- A. I. Vogel, (1996).
5. A Handbook of Organic Analysis - Clarke and Hayes, (1964).
6. Comprehensive practical organic chemistry: Preparation and quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.
7. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S. Dhingra, Universiti(India), 2000.
8. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central bookCalcutta, 2000.
9. Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
10. Practical organic chemistry (Quantitative analysis), B. B. Dey, M. V. Sitaraman and T. R. Govindachari,Publishers, New Delhi, 1992.

Date Course Coordinator Subject Committee Chairperson