

**Master of Science
in
Chemistry
(Analytical Chemistry)**

Course Structure and Syllabus

For students admitted from academic year 2022-23 onwards
Under Choice Based Credit System (CBCS)

(Regulations:R22)



**Department of Chemistry
Krishna University
Machilipatnam – 521 003
Andhra Pradesh**

VISION

- ❖ To impart skill oriented knowledge in the basic and advanced chemical Sciences ready to serve academics, industry and research.
- ❖ To Bridge the gap between industry and academia.
- ❖ To develop awareness in advanced characterization facilities for cutting edge research
- ❖ To thrive for transformation of laboratory research towards industrial scales so as to acquire support from the industry.
- ❖ To strive for all round development of students for attainment of scientific empowerment both in teaching and research.
- ❖ To establish multi-institutional, interdisciplinary and international collaborations in thrust areas of scientific research so as to acquire national and international recognition.

MISSION

- ❖ Dissemination of knowledge through research-based teaching and learning processes with a motive to inculcate strong research attitude in student community.
- ❖ Build good character and educate students so as to become enlightened individuals, improving the living standards of their families and society.

PROGRAMME OBJECTIVES

- ❖ Develop the basic concepts in core areas of Chemistry in particular, synthesis, Purification, characterization and analysis along with experimental skills..
- ❖ To provide skill based quality higher education by imparting knowledge with the critical and creative analysis and enhance problem-solving skills of students.
- ❖ Undertake small academic and/or research projects in the area of chemistry and write /present a technical report/document.
- ❖ Prepare the students with a working knowledge of experimental techniques required to work independently.
- ❖ Strengthen student's capability in organizing and presenting the acquired knowledge both in oral and written discourse.

PROGRAMME OUTCOMES

- ❖ Acquire knowledge and understanding of fundamental concepts, principles and theories related to the identified subject areas.
- ❖ Develop experimental skills to produce skill oriented human resources to the nation.
- ❖ Develop skills to interpret and explain the limits of accuracy of experimental data in terms of significance and underlying theory.
- ❖ Demonstrate written and oral communication skills for dissemination of scientific results in report, article, or oral presentation formats, which helps to develop his/her professional development.
- ❖ To prepare self-motivated human resources for the promotion of their innovations.

**COURSE STRUCTURE AND REQUIREMENTS FOR M.Sc., CHEMISTRY
(REGULATION: R22)**

1	Title of the Course	M.Sc., Chemistry (Analytical Chemistry)
2	Duration of the course	2 years (Four Semesters)
3	Eligibility criteria for admission	The candidate seeking admission in to M.Sc., Chemistry course should have passed a Bachelor's Degree examination not less than three years duration in any discipline with chemistry at 10+2 level or should have passed Bachelor's Degree Examination not less than three years duration in any discipline with chemistry as one of the subjects.
4	Level of the Course	Post Graduate
5	Mode of Admission	The mode of admission is through KRUCET conducted by Krishna University or any other alternative entrance test approved by the academic senate of Krishna University.
6	Objectives of the course	The Objective of M.Sc., Chemistry course is to provide skilled human resources useful for the research and industry by imparting knowledge in basic concepts in core areas of Chemistry as well as recent advances in chemistry, skill oriented training in laboratory with an aim to make students ready for advanced research.
7	Course Requirement	The course shall include theory (core as well as noncore, open electives, specializations) papers, Laboratories, Assignments, Tests, Seminars and industrial Project Work.
8	Number of working days	In each semester at least ninety (90) working days must be dedicated for theory classes, practical classes and seminars/project work.

KRISHNA UNIVERSITY::MACHILIPATNAM
COURSE STRUCTURE FOR M.Sc., CHEMISTRY
UNDER CHOICE BASED CREDIT SYSTEM (CBCS)
w.e.f. 2022-23 (R22 Regulations)

I SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE	Internal Marks	External Marks	No. of Credits
		L	P	T				
ACH 101	General Chemistry	4	0	0	Core	30	70	4
ACH102	Organic Chemistry	4	0	0	Core	30	70	4
ACH103	Inorganic Chemistry -1	4	0	0	Core	30	70	4
ACH 104	Physical Chemistry –1	4	0	0	Core	30	70	4
ACH 105	Personality Development through Life Enlightenment Skills	3	1	0	Core	30	70	3
ACH 106	Organic Chemistry Lab-1	0	6	0	Core	30	70	3
ACH 107	Inorganic Chemistry Lab	0	6	0	Core	30	70	3
TOTAL FOR FIRST SEMESTER						210	490	25

II SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE / DSE/SEC	Internal Marks	External Marks	No. of Credits
		L	P	T				
ACH 201	Organic Spectroscopy	4	0	0	Core	30	70	4
ACH 202	Physical Chemistry -2	4	0	0	Core	30	70	4
ACH 203	Inorganic Chemistry -2	4	0	0	Core	30	70	4
ACH 204	Research Methodology & IPR	3	1	0	SEC	30	70	3
DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY ONE)								
ACH 205	Heterocyclic Chemistry	4	0	0	DSE	30	70	4
ACH 206	Chemistry of Bioorganic compounds	4	0	0	DSE	30	70	4
ACH 207	Polymers Chemistry	4	0	0	DSE	30	70	4
LAB PRACTICALS								
ACH 208	Organic Chemistry lab-2	0	6	0	Core	30	70	3
ACH 209	Physical Chemistry lab	0	6	0	Core	30	70	3
TOTAL FOR SECOND SEMESTER						210	490	25

At the end of 2nd semester, every student must undergo summer Internship/ Apprenticeship/Project work/Industrial training/Research based Project work for Six weeks and must prepare a report concerned as per approved project guidelines, and submit the same to the University 14 days before the commencement of third semester end examinations.

L – Lecture, T- Tutorial & P – Practicals

III SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE / ID/DS/ SE/OE/M OOCs	Internal Marks	External Marks	No. of Credits
		L	P	T				
ACH 301	Separation Methods	4	0	0	Core	30	70	4
DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY THREE)								
ACH 302	Applied Analysis-I	4	0	0	DSE	30	70	4
ACH 303	Chemical and Spectral Methods of Analysis	4	0	0	DSE	30	70	4
ACH 304	Quality Control and Standard Methods of Analysis	4	0	0	DSE	30	70	4
ACH 305	Bio Inorganic chemistry, Bioorganic & Bio Physical Chemistry	4	0	0	DSE	30	70	4
ACH 306	Green Chemistry	4	0	0	DSE	30	70	4
ACH 307	Nano Chemistry	4	0	0	DSE	30	70	4
LAB PRACTICALS								
ACH 308	Classical Methods of Analysis Practical	0	6	0	Core	30	70	3
ACH 309	Spectral Methods of Analysis Practical	0	6	0	Core	30	70	3
OPEN ELECTIVE (INTERDISCIPLINARY/MULTIDISCIPLINARY) COURSES (CHOOSE ANY ONE)								
ACH 310	Chemistry in daily life	3	0	0	OEC	30	70	3
ACH 311	Environmental Chemistry	3	0	0	OEC	30	70	3
ACH 312	Techniques for modern industrial application	3	0	0	OEC	30	70	3
TOTAL FOR III SEMESTER						210	490	25

IV SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE/ID/ DS/S/OE/M OOCs	Internal Marks	External Marks	No. of Credits	
		L	P	T					
ACH 401	Instrumental Methods of Analysis	4	0	0	Core	30	70	4	
DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY THREE)									
ACH 402	Traditional and Environmental Methods of analysis	4	0	0	DSE	30	70	4	
ACH 403	Applied Analysis-II	4	0	0	DSE	30	70	4	
ACH 404	Spectroscopic Methods	4	0	0	DSE	30	70	4	
ACH 405	Nuclear and Photo Chemistry	4	0	0	DSE	30	70	4	
ACH 406	Food Chemistry	4	0	0	DSE	30	70	4	
ACH 407	Drug Chemistry	4	0	0	DSE	30	70	4	
LAB PRACTICALS									
ACH 408	Instrumental Methods of analysis Practical	0	6	0	Core	30	70	3	
ENTREPRENEURIAL & INNOVATION/IT SKILL RELATED TO DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY ONE)									
ACH 409	Drug Design and Drug chemistry	3	0	0	SEC	30	70	3	
ACH 410	Energy, environment and soil Chemistry	3	0	0	SEC	30	70	3	
ACH 411	Catalysis	3	0	0	SEC	30	70	3	
* CHOOSE MOOCs FROM SWAYAM/NPTEL SOURCES									
ACH 412	Swayam/ NPTEL or Equivalent								4
ACH 413- PROJECT WORK EVALUATION AND VIVA-VOCE							100	4	
TOTAL FOR IV SEMESTER						180	520	30	

L – Lecture, T- Tutorial & P – Practicals

Note: Students may be allowed to register and appear for MOOCs from the third semester itself. However, students are to complete the MOOCs successfully and submit pass certificate of the same to the University through the Principal of the College concerned for approval and endorsement of the same on grade cards and PCs and ODs as per the regulations of the University.

KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
I SEMESTER
Paper Code & Title: ACH 101: GENERAL CHEMISTRY

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a knowledge for students on Titrimetric Analysis, Treatment of analytical data, Adsorption, Partition, Gas Chromatography and High-Performance Liquid Chromatography.

Unit-I: Analytical data: Accuracy and precision - Classification of errors - Determinate and Indeterminate errors - Minimization of errors - Absolute and Relative errors, propagation of errors - Distribution of Indeterminate errors - Gaussian distribution - Measures of central tendency - Measures of precision - Standard deviation - Standard error of mean - student's t-test - Confidence interval of mean - Testing for significance - Comparison of two means - F-test - Criteria of rejection of an observation - Significant figures and computation rules.

Unit-II: Titrimetric Analysis: Classification of reactions in titrimetric analysis - a) acid base titrations, b) redox titrations, Fe (II) with Ce (IV), precipitation titrations - silver estimation, Volhard's method - Mohr's method, complexometric titrations - calcium magnesium estimations by EDTA, Theory of indicators - Precipitation titrations - Indicators for precipitation titrations.

Unit-III: Methods of purification: 1. **Distillation:** Basic principles, Distillation types - continuous distillation, batch distillation, fractional distillation, vacuum distillation and steam distillation. Industrial applications; 2. **Drying Techniques:** Drying of Hydrocarbons, ethers and alcohols, Tetrahydrofuran, DMF and DMSO; 3. **Solvent extraction:** Basic principles, Different types of extraction. Selection of solvents. Avoiding emulsion formation. Basic concepts on Soxhlet extraction. Industrial applications; 4. **Recrystallization:** Basic principles, choice of solvent, seeding, filtration and centrifugation and drying. Industrial applications. Concepts of fractional crystallization.

Unit-IV: Principles of Chromatography: Introduction to chromatography, Different types of Chromatography: **Adsorption chromatograph:** adsorbents, solvents, solutes, apparatus; **Column Chromatography:** stationary phase, Mobile phase, packing of column, advantages and disadvantages. **Paper chromatography:** Basic Principles. Ascending and descending types. Selection of mobile phase, Development of chromatograms, Visualization methods. Application of paper chromatography in the identification of sugars and amino acids. One- and two-dimensional paper chromatography; **Thin Layer chromatography:** Basic Principles. Common stationary phases, Methods of preparing TLC plates, Development of TLC plates, Visualization methods, R_f value. Application of TLC in monitoring organic reactions. identification and quantitative analysis.

Unit-V: Gas Chromatography And High-

Performance Liquid Chromatography: Gas chromatography: Basic Principles. Different types of GC techniques. Selection of columns and carrier gases. Instrumentation. detectors; RT values. Applications in the separation, identification and quantitative analysis of

organic compounds; **High Performance liquid chromatography (HPLC):** Basic Principles. Normal and reversed Phases. Selection of column and mobile phase. Instrumentation. detectors; RT values. Applications in the separation, identification and quantitative estimation of organic compounds. Concepts on HPLC method development, Principles of Preparative HPLC and Flash Chromatography.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Titrimetric Analysis, Treatment of analytical data, Adsorption, Partition, Gas Chromatography and High-Performance Liquid Chromatography.

Textbooks/Reference books:

1. Vogel's textbook of quantitative analysis. Addition Wesley Longman Inc.
2. Quantitative analysis R. A Day and A. L. Underwood. Prentice Hall Pvt. Ltd.
3. Principles of Instrumental Analysis by D. A. Skoog, F. J. Holler and T. A. Nieman, Harcourt College Pub.
4. Separation Techniques by M. N. Sastri, Himalaya Publishing House (HPH), Mumbai.
5. Chromatography, E. Helfman, Van Nostrand, Reinhold, New York.
6. Chromatography, E. Lederer and M. Lederer, Elsevier, Amsterdam.
7. Thin layer chromatography, E. Stahl, Academic Press, New York.
8. Introduction to Organic Laboratory Techniques - D. L. Pavia, G. M. Lampman, G. S. Kriz and R. G. Engel, Saunders College Pub (NY).
9. Instrumental methods of Chemical Analysis by H. Kaur, Pragati Prakashan, Meerut.
10. Protein Purification - Principles and practice, III Edn - R. K. Scopes, Narosa Publishing House, Delhi.
11. D. D. Perrin ; Purification of Laboratory Chemicals

KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY) I SEMESTER
Paper Code & Title: ACH102: ORGANIC CHEMISTRY-I

No. of hours per week: 04

Total marks: 100

Total credits: 04

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for students on Nature of bonding, Aromaticity and organic reaction mechanism.

Unit-I: Nature of bonding, Aromaticity and Reactive intermediates: Nature of bonding:

Inductive effect,

Mesomeric effect (Resonance), localized and delocalized covalent bonds, conjugation, cross conjugation,

Hyperconjugation, Steric effects, Tautomerism and their applications. **Aromaticity:** Aromaticity in benzenoid non-benzenoid compounds, Benzene, Cyclobutadiene, Tropyllium cation, 1,3,5,7-

Cyclooctatetraene, aromaticity of Hetero-aromatic Systems, anti-aromaticity and homo-aromaticity,

pseudo aromaticity. **Reactive intermediates:** Generation, reactivity and stability of Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes and Arynes.

Unit-II: Substitution Reactions: Aliphatic Nucleophilic Substitution Reactions: The S_N^2 , S_N^1

, mixed S_N^1 and S_N^2 reactions, S_N^i and their mechanisms, Neighboring Group

Participation, Anchimeric assistance. **Aromatic Electrophilic substitution,** Nitration, alkylation,

acylation, N sulphonation and halogenation. Directing groups.

Aromatic Nucleophilic substitution Reactions: $S_N^2(Ar)$ (Addition-Elimination), $S_N^1(Ar)$ and benzyne mechanisms (Elimination-Addition).

Unit-III: Addition Reactions and Elimination Reactions: Addition reactions involving electrophiles, nucleophiles and free radicals, regio and

chemoselectivity, orientation and reactivity, Hydrogenation of double and triple bonds, hydrogenation of ar

omatic rings, Hydroboration. Elimination Reactions: Type of elimination reactions, mechanisms,

Stereochemistry and Orientation, Hofmann and Saytzeff rules, Syn elimination versus anti-

elimination, competition between elimination and substitution, dehydration, dehydrogenation, dehalogen

ation, decarboxylative eliminations and pyrolytic eliminations.

Unit IV: Named reactions: Definition, mechanism, and synthetic applications of Aldol

condensation, Benzoin condensation, Cannizzaro condensation, Dieckmann condensation, Perkin

condensation, Stobbe condensation, Mannich reaction, Reimer-Tiemann reaction, Vilsmeier-

Haack reaction, McMurray reaction, Michael addition reaction, Oppenauer oxidation reaction,

Clemmensen reduction reaction, Wolf-Kishner reduction, Meerwein-Ponndorf-Verley reduction

reaction, Birch reduction reaction.

Unit-V: Stereo Chemistry:

Chirality, Definition and classification of Stereoisomers, Enantiomer, Diastereomer, Homomer, Epimer, A

nomer, Configuration and Conformation, Configurational nomenclature: D, L and R, S nomenclature. Mole

cular representation of organic molecules: Fischer, Newman and Sawhorse projections and their inter-

conversions. Geometrical Isomerism. Cis-trans, E, Z- and Syn and anti nomenclature.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Nature of bonding, Aromaticity and organic reaction mechanism.

Textbooks/Referencebooks:

1. Advancedorganicchemistry-Reaction,mechanismandstructure,JerryMarch,JohnWiley.
2. Advancedorganicchemistry,F.A. CareyandR.J. Sundberg,Springer, NewYork.
3. AguidebooktoMechanism inorganicchemistry,PeterSykes,Longman.
4. Organicchemistry,I.L.Finar,Vol. I,Fifthed.ELBS.
5. Organicchemistry,Hendrickson,CramandHammond(McGraw–Hill).
6. ModernorganicReactions,H.O.House,Benjamin.
7. Structureandmechanisminorganicchemistry,C.K.Ingold, CornellUniversityPress.
8. Principlesoforganicsynthesis,R.O.C.NormanandJ.M.Coxon,BlakieAcademic&Professional.
9. ReactionMechanisminOrganicChemistry, S.M.MukherjiandS.P.Singh,Macmillan.
10. BasicPrinciplesofOrganicChemistrybyJ.B.Robertsand M.Caserio.
11. Organic chemistry by Morrison and Boyd

KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
I SEMESTER
Paper Code & Title: ACH 103: INORGANIC CHEMISTRY-I

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for students on Introduction to Exact Quantum Mechanical Results, Chemistry of non-transition elements, Structure & Bonding, Metal–ligand bonding, and Metal – ligand Equilibria in solutions.

Unit-I: Structure and Bonding: $p\pi$ - $d\pi$ bonding, Bent's rule, Non-valence cohesive forces, VSEPR theory and limitations, Molecular Orbital theory, Bond order, Symmetry of Molecular orbitals, Molecular orbitals in diatomic (BeH_2) molecules and ions (NO_2^-) and energy level diagrams. Walsh diagrams for linear (BeH_2) and bent (H_2O) molecules.

Unit II: Metal–ligand bonding: Crystal Field Theory of bonding in transition metal complexes- Splitting of d-orbitals in octahedral, tetrahedral, square planar and Trigonal bipyramidal and Square pyramidal fields, strong and weak field ligands. Tetragonal distortions - Jahn-Teller effect. Applications and limitations of CFT. Experimental evidences for covalence in complexes. Molecular Orbital Theory of bonding for Octahedral, tetrahedral and square planar complexes. π -bonding and MOT - Effect of π - donor and π - acceptor ligands on Δ_o . Experimental evidence for π -bonding in complexes.

Unit III: Metal – ligand Equilibria in solutions: Step wise and over all formation constants. Trends in stepwise constants (statistical effect and statistical ratio). Determination of formation constants by Spectrophotometric method (Job's method) and pH metric method (Bjerrum's). Stability correlations - Irving -William's series, Hard and soft acids and bases (HSAB) Principle, Acid-base strengths.

Unit IV: Chemistry of non- transition elements: Inter halogen compounds, Halogen oxides and oxyfluorides, Clathrate compounds, Spectral and Magnetic properties of Lanthanides and Actinides. Analytical applications of Lanthanides and Actinides. Synthesis, properties and structure of B-N, S-N, P-N cyclic compounds. Intercalation compounds.

Metal π - complexes: preparation, structure and bonding in Nitrosyl, Dinitrogen and Dioxygen complexes.

Unit V: Coordination Chemistry : Nomenclature of ligands, Nature and types of ligands, metal complexes, coordination spheres, Werners theory, isomerism in coordination complexes and spectrochemical series.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Introduction to Exact Quantum Mechanical Results, Chemistry of non-transition elements, Structure & Bonding, Metal–ligand bonding, and Metal–ligand Equilibria in solutions.

Textbooks/Referencebooks:

1. Inorganic Chemistry Huheey, Harper and Row.
2. Physical methods in inorganic chemistry, R.S. Drago. Affiliated East-West Pvt. Ltd.
3. Concise inorganic chemistry, J.D. Lee, ELBS.
4. Modern Inorganic Chemistry, W.L. Jolly, McGraw Hill.
5. Inorganic Chemistry, K.F. Purcell and J.C. Kotz Holt Saunders international.
6. Concepts and methods of inorganic chemistry, B.E. Douglas and D.H.M.C. Daniel, Oxford Press.
7. Inorganic Chemistry, Atkins, ELBS.
8. Advanced Inorganic Chemistry, Cotton and Wilkinson, Wiley Eastern.
9. Textbook of Coordination chemistry, K. Soma Sekhara Rao and K.N.K. Vani, Kalyani Publishers.
10. Inorganic Chemistry by AK Das
11. Selected topics in inorganic chemistry by Madan, Mallik and Tuli

KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
I SEMESTER
Paper Code & Title: ACH 104: PHYSICAL CHEMISTRY-I

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for students on Thermodynamics, Surface phenomena and phase equilibria, Electrochemistry, Chemical kinetics and Microwave Spectroscopy and Rotational Vibrational Spectroscopy.

Unit-I: Quantum Mechanics: Schrodinger equation, importance of wave function, Operators, Eigen values and Eigen functions, derivation of wave equation using operator concept. Discussion of solutions of Schrodinger's equation to some model systems viz. particle in one dimensional box applications.

Unit II Thermodynamics: Classical thermodynamics - Brief review of first and second laws of thermodynamics - Entropy change in reversible and irreversible processes - Entropy of mixing of ideal gases - Entropy and disorder - Free energy functions - Gibbs-Helmholtz equation - Maxwell partial relations. Conditions of equilibrium and spontaneity - Free energy changes in chemical reactions, Van't Hoff reaction isotherm - Van't Hoff equation - Clausius - Clapeyron equation - partial molar quantities - Chemical potential - Gibbs- Duhem equation - partial molar volume - determination of partial molar quantities - Fugacity - Determination of fugacity - Thermodynamic derivation of Raoult's law.

Unit-III: Chemical kinetics: Methods of deriving rate laws - complex reactions - Rate expressions for opposing, parallel and consecutive reactions involving unimolecular steps. Theories of reaction rates - collision theory - Steric factor - Activated complex theory - Thermodynamic aspects - Unimolecular reactions - Lindemann's theory - Lindemann-Hinshelwood theory. Primary and secondary salt effects. Elementary account of linear free energy relationships - Hammett-Taft

Unit IV: Surface phenomena and phase equilibria: Surface tension - capillary action - pressure difference - across curved surface (Young - Laplace equation) - Vapour pressure of small droplets (Kelvin equation) - Gibbs-Adsorption equation - BET equation - Estimation of surface area - catalytic activity of surfaces - ESCA, X-ray fluorescence and Auger electron spectroscopy.

Surface active agents - classification of surface-active agents - Micellization - critical micelle concentration (CMC) - factors affecting the CMC of surfactants, Microemulsions - Reverse micelles.

Unit-V: Electrochemistry-1: Electrochemical cells - Measurement of EMF - Nernst equation - Equilibrium constant from EMF Data - pH and EMF data - Determination of solubility product from EMF measurements. Concentration cells with and without transference - Liquid junction potential and its determination - Activity and activity coefficients - Debye Huckel limiting law and its verification. Effect of dilution on equivalent conductance of electrolytes - Anomalous behavior of strong electrolytes. Debye Huckel-Onsager equation - verification and limitations - Bjerrum treatment of electrolytes.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Thermodynamics, Surface phenomena and phase equilibria, Electrochemistry, Chemical kinetics and Microwave Spectroscopy and Rotational Vibrational Spectroscopy.

Textbooks/Referencebooks:

1. Introductory quantum Mechanics, A.K. Chandra.
2. Quantum Chemistry, R.K. Prasad Physical Chemistry P.W. Atkins, ELBS.
3. Chemical Kinetics- K.J. Laidler, McGraw Hill Pub.
4. Text Book of Physical Chemistry. Samuel Glasstone, Mcmillan Pub.
5. Physical Chemistry, G.W. Castellan. Narosa Publishing House
6. Thermodynamic for Chemists. Samuel Glasstone.
7. Electrochemistry, Samuel Glasstone, Affiliated East West
8. Physical Chemistry, W.J. Moore, Prentice Hall
9. Atomic structure and chemical bond. Manas Chanda. Tata McGraw Hill Company Limited.

KRISHNA UNIVERSITY, MACHILIPATNAM - 521003

M.Sc.,CHEMISTRY(ANALYTICALCHEMISTRY)

I SEMESTER

**Paper Code & Title: ACH 105: PERSONALITY DEVELOPMENT THROUGH LIFE
ENLIGHTENMENT SKILLS**

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Objectives:

The Course will introduce the students to

- Learn to achieve the highest goal happily.
- Become a person with stable mind, pleasing personality and determination.
- Learn to build positive attitude, self-motivation, enhancing self-esteem and emotional intelligence
- Learn to develop coping mechanism to manage stress through Yoga and meditation techniques
- Awaken wisdom among them.

UNIT- I: Introduction to Personality Development

The concept of personality - Dimensions of Personality – Theories of Personality development (Freud & Erickson) – The concept of Success and Failure – Factors responsible for Success – Hurdles in achieving Success and Overcoming Hurdles – Causes of failure – Conducting SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis.

UNIT- II: Attitude, Motivation and Self-esteem

Conceptual overview of Attitude – Types of Attitudes – Attitude Formation – Advantages/ Disadvantages of Positive/Negative Attitude - Ways to Develop Positive Attitude **Concept of motivation:** Definition and Nature of Motivation/Motive – Internal and external motives – Theories of Motivation – Importance of self-motivation- Factors leading to de- motivation.

Self-esteem - Definition and Nature of self-esteem – Do's and Don'ts to develop positive self- esteem – Low self esteem - Personality having low self esteem - Positive and negative self esteem.

UNIT -III: Other Aspects of Personality Development

Body language - Problem-solving - Conflict Management and Negotiation skills - Decision-making skills - Leadership and qualities of a successful leader – Character building - Team-work – Time management - Work ethics – Good manners and etiquette – Emotional Ability/Intelligence – Dimensions of Emotional Intelligence – Building Emotional Intelligence.

UNIT- IV: Neetisatakam-Holistic Development of Personality

Verses- 19,20,21,22 (wisdom) – Verses- 29,31,32 (pride and heroism) – Verses- 26,28,63,65 (virtue)

Personality of Role Model – Shrimad Bhagwadgeeta

Chapter 2-Verses 17, Chapter 3-Verses 36,37,42 – Chapter 4-Verses 18, 38,39 Chapter 18 – Verses 37,38,63

UNIT -V: Yoga & Stress Management

Meaning and definition of Yoga - Historical Perspective of Yoga - Principles of Astanga Yoga by Patanjali – Meaning and Definition of Stress - Types of Stress - Eustress and Distress – Stress Management – Pranayama- Pranayama: Anulom and Vilom Pranayama - Nadishudhi Pranayama– Kapalabhati-Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama – Meditation techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT) (Theory & Practical).

Learning Outcomes:

At the end of this course the students should be able to:

- ☐ Develop their personality and achieve their highest goals of life.
- ☐ Lead the nation and mankind to peace and prosperity
- ☐ Practice emotional self regulation.
- ☐ Develop a positive approach to work and duties
- ☐ Develop a versatile personality

Text and Reference Books:

1. Hurlock, E.B. Personality Development, 28th Reprint. New Delhi: Tata McGraw Hill, 2006.
2. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar- vairagya, New Delhi, 2010
3. Swami Swarupananda, Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.
4. Lucas, Stephen. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill. 2001
5. Mile, D.J Power of positive thinking. Delhi. Rohan Book Company, (2004).
6. Pravesh Kumar. All about Self- Motivation. New Delhi. Goodwill Publishing House. 2005.
7. Smith, B . Body Language. Delhi: Rohan Book Company. 2004
8. Yogic Asanas for Group Training - Part-I: Janardhan Swami Yogabhyasi Mandal, Nagpur.
9. Rajayoga or Conquering the Internal Nature by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.
10. Nagendra H.R nadNagaratna R, Yoga Perspective in Stress Management, Bangalore, Swami Vivekananda Yoga Prakashan.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. <https://freevidelectures.com/course/3539/indian-philosophy/11>

KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
I SEMESTER
Paper Code & Title: ACH106: ORGANIC CHEMISTRY LAB-I

Total marks: 100

(Internal: 30M & External: 70M)

Course Objectives:

- To develop an insight into the preparation of organic compounds in various reactions
- To understand the process of preparation of organic through various reactions
- To acquire skills in the preparation of organic compounds, their separation, purification and identification

Learning Outcomes: At the end of the course, the learners should be able to Prepare various organic compounds using various reactions Develop skill in handling apparatus, measure the quantities and carry out the reaction, separate the products, purify them and analyze the products formed, Applies the skill in preparing novel organic moieties

Synthesis of Organic compounds

1. β -Naphthyl methyl ether from β -Naphthol
2. m-dinitrobenzene from Nitrobenzene
3. Aromatic acid from ester
4. Benzanilide from aniline
5. p-nitroaniline from Acetanilide
6. p-Bromo acetanilide from aniline
7. Benzanilide from Benzophenone
8. Preparation of Phthalimide from Phthalic anhydride – High Temperature.
9. Preparation of p-nitroacetanilide – Low temperature.
10. Preparation of Iodoform – Room temperature.
11. Preparation of Aspirin (Acetylation)
12. Preparation of Sodium wire – to make Sodium Wire for solvent drying.
13. Preparation of Sodium Granules and preparation of Sodium t-butoxide.
14. Preparation of Grignard Reagent and its usage on a reaction.
15. Preparation of Wittig reagent.

Course Learning Outcome (S): After studying this paper, students will acquire the practical knowledge on organic chemistry practical.

Textbooks/Reference books:

1. A Textbook of Practical Organic Chemistry by A. I. Vogel, ELBS and Longman group.
2. Practical Organic Chemistry by Mann and Saunders, ELBS and Longman group.
3. A. I. Vogel, "Elementary Practical Organic Chemistry", Longman
4. F. G. Mann and B. C. Saunders, "Practical Organic Chemistry", Longman
5. Reaction and Synthesis in Organic Laboratory, B. S. Furniss, A. J. Hannaford, Tatchell, University Science Books, Millers Valley.
6. Purification of Laboratory chemicals, manual, W. L. F. Armarego, E. D. Perrin
7. Reaction and Synthesis in Organic Chemistry Laboratory, Lutz-Friedjan-Tietze, Theophil Eicher, University Science Book.
8. Laboratory manual of organic chemistry, B. B. Dey, M. V. Sitaraman and T. R. Govindachari, Allied publisher limited.

KRISHNA UNIVERSITY, MACHILIPATNAM -

521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
I SEMESTER

Paper Code & Title: ACH107: INORGANIC CHEMISTRY LAB

Total marks: 100

(Internal: 30M & External: 70M)

Course Objectives:

To develop an insight into the preparation of inorganic complexes

To understand the process of preparation of inorganic complexes

To acquire skills in the preparation of inorganic complexes

1. Synthesis of Inorganic Metal Complexes: Synthesis of 3d transition metal complexes of tetrahedral, square planar and octahedral geometries.

- (i) Preparation of TetraammineCopper(II) sulphate monohydrate
- (ii) Potassium tris-oxalatoferrate (III) trihydrate
- (iii) Tris-thiourea copper(I) sulphate
- (iv) Preparation of Cis and trans potassium diaquodioxalatochromium(III).
- (v) Preparation of Hexaamminecobalt(III) chloride.
- (vi) Determination of Zn^{2+} with potassium Ferrocyanide.
- (vii) Determination of Mg^{2+} using EDTA.
- (viii) Determination of Ni^{2+} using EDTA.
- (ix) Determination of hardness of water using EDTA.
- (x) Gravimetric determination of nickel using dimethylglyoxime.
- (xi) Gravimetric determination of Copper using ammonium thiocyanate.
- (xii) Gravimetric determination of Zn using diammonium hydrogen phosphate.

2. Systematic Semimicro Qualitative Analysis of Inorganics six radical mixtures : In systematic semi micro qualitative inorganic analysis, inorganic mixture contains three cations and three anions. The analysis involves identification and confirmation of cations and anions containing one less familiar cation (Tungsten, Molybdenum, Zirconium, Thorium, Titanium, Uranium, Cerium, Vanadium, Lithium, Berkelium Etc... and one interfering anion

Anions: CO_3^{2-} , S^{2-} , SO_3^{2-} , Cl^- , Br^- , I^- , NO_3^- , SO_4^{2-} , CH_3COO^- , $C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, PO_4^{3-} , CrO_4^{2-} , AsO_4^{3-} , F^- , BO_3^{3-} **Cations :** Ammonium (NH_4^+), 1st group: Hg, Ag, Pb, Tl, W ; 2nd group: Hg, Pb, Bi, Cu, Cd, As, Sb, Sn, Mo; 3rd group: Fe, Al, Cr, Ce, Th, Ti, Zr, V, U, Be 4th group: Zn, Mn, Co, Ni 5th group: Ca, Ba, Sr 6th group: Mg, K, Li

Note: A minimum of 4 inorganic mixtures must be analysed in this Semester

Learning Outcomes:

At the end of the course, the learners should be able to Prepare various inorganic complexes

Develop skill in handling apparatus, measure the quantities and carry out the reaction and analyze the inorganic mixtures. Apply the skill in preparing new metal complexes and analysis of inorganic mixtures Understand the regulations in handling and disposal of chemicals.

REFERENCE BOOKS:

1. Practical Inorganic Chemistry, G. Marr and B. W. Rockett.
2. Practical Inorganic Chemistry by G. Pass H. Sutchiffe, 2nd edn John Wiley & Sons.
3. Experimental Inorganic/Physical Chemistry, M. A. Malati, Horwood Publishing, Chichester, UK (1999)
4. Vogel's Text Book of Quantitative Analysis, revised J. Bassett, R. C. Denny, G. H. Jeffery and J. Mendhan, ELBS.
5. Synthesis and Characterization of Inorganic Compounds, W. L. Jolly. Prentice Hall.

KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
II SEMESTER
Paper Code & Title: ACH 201: ORGANIC SPECTROSCOPY

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on UV-

Visible spectroscopy, Infrared spectroscopy, ¹H NMR Spectroscopy and Mass spectrometry.

Unit-I: UV-Visible spectroscopy: Lambert's law, Beer-Lambert's law, Instrumentation, Energy transitions—Simple chromophores-Auxochrome, Absorption shifts (Bathochromic, Hypsochromic, Hyper chromic and Hypo chromic shifts), UV absorption of Alkenes, Polyenes unsaturated cyclic systems. UV absorption of carbonyl compounds: α , β -unsaturated carbonyl systems, UV absorption of aromatic systems, solvent effects, geometrical isomerism, acid and base effects. Calculation of λ_{max} values using Woodward-Fieser rules with examples.

Unit-II: Infrared spectroscopy: Mechanics of measurement-Fundamental modes of vibrations-stretching and bending vibrations-Factors affecting Vibrational frequency-hydrogen bonding. Fingerprint region and its importance, typical group frequencies for functional groups like -CH, -OH, -NH, -CC, -CO and aromatic systems. Application in structural determinations.

Unit-III: ¹H-NMR Spectroscopy-I: Introduction: Basic principle of NMR, Nuclear spin, nuclear resonance, saturation, Relaxation, Instrumentation. Shielding and deshielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, spin-spin interactions, factors influencing coupling constant J and factors affecting J value.

Unit-IV: ¹H-NMR Spectroscopy-II: Improving the PMR spectrum: Chemical and Magnetic Equivalence. Chemical exchange, First and Non-First Order Spectra and analysis of AB, AMX

and ABX systems. **Simplification of complex spectra:** Nuclear Magnetic double resonance, Lanthanide shift reagents, Deuterium Exchange, spectra at higher fields, solvent effects, Fourier transform technique, Nuclear Overhauser Effect (NOE). Hindered Rotations and Rate processes.

Unit-V: Mass spectrometry: Introduction & Instrumentation, Ion production-EI, CI, ES, MALDI and FAB, determination of Molecular weight and formulae, behavior of organic compounds in mass spectrometer- factors affecting fragmentation, Mass spectral fragmentation of organic compounds, Common functional groups, molecular ion peak, meta stable peak, isotopic peak, McLafferty rearrangement, Nitrogen rule. Structural determination of organic compounds using mass spectra.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of UV-Visible spectroscopy, Infrared spectroscopy, $^1\text{H-NMR}$ Spectroscopy and Mass spectrometry.

Textbooks/Referencebooks:

1. Introduction to Spectroscopy—D.L.Pavia, G.M.Lampman, G.S.Kriz, 3rd Ed. (Harcourt college publishers).
2. Spectrometric identification of organic compounds R.M.Silverstein, F.X.Webster, 6th Ed. John Wiley and Sons.
3. Spectroscopic methods inorganic chemistry- D.H.Williams and I. Fleming Mc.Graw Hill.
4. Absorption spectroscopy of organic molecules—V. M.Parikh
5. Nuclear Magnetic Resonance—Basic Principles-Atta-Ur-Rehman, Springer-Verlag (1986).
6. One- and Two-dimensional NMR Spectroscopy—Atta-Ur-Rehman, Elsevier (1989).
7. Organic structure Analysis-Phillip Crews, Rodriguez, Jaspars, Oxford University Press (1998).
8. Organic structural Spectroscopy-Joseph B.Lambert, Shurvell, Lightner, Cooks, Prentice-Hall (1998).
9. Organic structures from spectra—Field L.D., Kalman J.R. and Sternhell S. 4th Ed. John Wiley and Sons Ltd.
10. Elementary organic spectroscopy Y R Sharma
11. Organic spectroscopy William Kemp

KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
II SEMESTER
Paper Code & Title: ACH202: PHYSICAL CHEMISTRY-II

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on Third law of Thermodynamics and Statistical thermodynamics, Polymer chemistry and Raman Spectroscopy, Electro Chemistry, Chemical kinetics and Photochemistry, Symmetry and Group theory in chemistry.

Unit-I: Third law of Thermodynamics and Statistical thermodynamics: Nernst Heat theorem - Third law of thermodynamics - Its limitations - Determination of absolute entropy - Thermodynamic probability and most probable distribution, Entropy and probability - Boltzmann-Planck equation. Ensembles, Maxwell-Boltzmann distribution, Fermi-Dirac statistics, Bose Einstein statistics. Partition function - calculation of thermodynamic properties in terms of partition function.

Unit-II: Chemical kinetics and Photochemistry: Branching Chain Reactions - Hydrogen-oxygen reaction - lower and upper explosion limits - Fast reactions - Study of kinetics by flow methods - Relaxation methods - Flash photolysis. Acid base catalysis - protolytic and prototropic mechanism. Enzyme catalysis - Michaelis-Menten kinetics. **Photochemistry:** Jablonsky diagram, Quantum yield and its determination, Actinometry, Reactions with low and high quantum yields, Photo sensitization, Exciplexes and Excimers, Kinetics of collisional quenching - Stern-Volmer equation.

Unit-III: Symmetry and Group theory in chemistry: Symmetry elements, symmetry operation, definition of group, sub group, relation between order of a finite group and its sub group. GM Tables Abelian and non-abelian groups. Point group. Schoenflies symbols, Find out Point group of a molecule (yes or no Method). Representation of groups by Matrices (representation for the C_n , C_{nv} , C_{nh} , D_n etc. groups to be worked out, explicitly). Character of a representation. The great Orthogonality theorem (without proof) and its importance. Character tables and their use. Construction of Character tables

Unit -IV Microwave Spectroscopy and Rotational Vibrational Spectroscopy: Motion of molecules - Degrees of freedom - Energy associated with the degrees of freedom Type of spectra. Microwave spectra of polyatomic molecules. **Rotational Vibrational Spectroscopy:** Harmonic oscillator, vibrational energies of diatomic molecules, zero-point energy, force constant and bond strengths, anharmonicity Morse potential energy diagram. Vibration - rotation spectroscopy. selection rules, Classical and quantum theories of Raman effects, pure rotational, vibrational and Vibrational-rotational Raman spectra, selection rules, mutual exclusion principle.

Unit-V: Electro Chemistry-II: Reference electrode - Standard hydrogen electrode. Calomel electrode - Indicator electrodes: Metal-metal ion electrodes - Inert electrodes - Membrane electrodes - theory of glass membrane potential, potentiometric titrations, Conductometric titrations. Electrode potentials - Double layer at the interface - rate of charge transfer - Decomposition potential - Over potential - Tafel plots - Derivation of Butler-Volmer equation for one electron transfer - electrochemical potential.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Thirdlaw of Thermodynamics and Statistical thermodynamics, Polymer chemistry and Raman Spectroscopy, Electro Chemistry, Chemical kinetics and Photo chemistry, Symmetry and Group theory in chemistry.

Textbooks/Referencebooks:

1. Physical chemistry, G.K. Vemulapalli (Prentice Hall of India).
2. Physical chemistry, P.W. Atkins. ELBS.
3. Chemical kinetics - K.J. Laidler, McGraw Hill Pub.
4. Textbook of Physical Chemistry, Samuel Glasstone, Macmillan pub.
5. Statistical Thermodynamics - M.C. Gupta.
6. Polymer Science, Gowriker, Viswanadham, Sreedhar.
7. Quantitative Analysis, A.I. Vogel, Addison Wesley Longman Inc.
8. Physical Chemistry by G.W. Castellan, Narosa Publishing House, Prentice Hall.
9. Physical Chemistry by W.J. Moore, Prentice Hall.
10. Polymer Chemistry by Billmeyer.
11. Fundamentals of Physical Chemistry by K.K. Rohatgi - Mukherjee. Wiley Eastern Ltd publications.
12. Statistical Thermodynamics by M. Dole.
13. Introductory Group Theory for Chemists by George Davidson.
14. Group theory for chemistry by A.K. Bhattacharya.
15. Fundamentals of Molecular spectroscopy by C.N. Banwell.
16. Molecular spectroscopy by B.K. Sharma.
17. Vibrational Spectroscopy by D.N. Sathyanarayana New Age Int. Pub.

KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL
CHEMISTRY) II SEMESTER
Paper Code & Title: ACH203: INORGANIC CHEMISTRY-II

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on Non-metal cages and metal clusters, Organometallic chemistry of transition metals, Reaction mechanism of transition metal complexes, Term symbols and Electronic spectra and Bio-inorganic chemistry and Magnetic properties of complexes.

Unit-I: Non-metal cages and metal clusters: Structure and bonding in phosphorous-oxygen, phosphorous-Sulphur cages; structure and bonding in higher boranes with (special reference to B₁₂icosahedra). Carboranes, metalloboranes, metallocarboranes. Classification - LNCs and HNCs, Isoelectronic and Isolobal relationships, electron counting rules: Jemmis rule, Wade's and Lauher's rules. M-M multiple bonding; preparation, structure and bonding in dinuclear [Re₂Cl₈]²⁻ ion, trinuclear [Re₃Cl₉], tetra nuclear W₄(OR)₁₆, hexa nuclear [Mo₆Cl₈]⁴⁺ and [Nb₆Cl₁₂]²⁻.

Unit-II: Organometallic chemistry of transition metals: Classification and electron counting rules, hapticity, synthesis, structure and bonding of Ferrocene, dibenzene chromium, cyclo heptatriene and tropylium complexes of transition metals. Reactions of organometallic compounds - oxidative addition reductive elimination, insertion and elimination. Applications of organometallic compounds - Catalytic hydrogenation, Hydroformylation.

Unit-III: Reaction mechanism of transition metal complexes: Kinetics of octahedral substitution, acid hydrolysis, base hydrolysis-conjugate base (CB) mechanism. Direct and indirect evidences in favour of CB mechanism. Anation reactions. Reactions without metal-ligand bond cleavage. Factors affecting the substitution reactions in octahedral complexes. Trans effect on substitution reactions in square planar complexes. Mechanism of redox reactions, outer sphere mechanism, cross reactions and Marcus-Hush equation, inner sphere mechanism.

Unit-IV: Term symbols and Electronic spectra: Term symbols: Term symbols and their derivation Microstates, Hund's rules to predict ground terms and ground states. List of ground energy and higher energy terms from d¹ to d⁹ configurations; **Electronic spectra of transition metal complexes** Spectroscopic terms. Selection rules, Slater-Condon parameters, Racah parameters, Term separation energies for dⁿ configurations Correlation diagrams and Orgel diagrams. Tanabe-Sugano diagrams for d¹ to d⁹ configurations. Calculation of Dq, B and β parameters. Charge transfer spectra.

Unit-V: Bio-inorganic chemistry and Magnetic properties of complexes: Storage and transport of dioxygen by Hemoglobin and Myoglobin, Chlorophyll, Vitamin B₁₂ and its importance. **Magnetic properties of transition metal complexes:** Orbital and spin contribution, spin-orbit coupling and magnetic moments. Types of magnetism, factors affecting on Paramagnetism, Dia, ferro and Anti magnetism.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Non-metal cages and metal clusters, Organometallic chemistry of transition metals, Reaction mechanism of transition metal complexes, Term symbols and Electronic spectra and Bio-inorganic chemistry and Magnetic properties of complexes.

Textbooks/Reference books:

1. Inorganic Chemistry by Huheey, Harper and Row.
2. Concise inorganic chemistry by J.D. Lee, ELBS.
3. Inorganic chemistry, K.F. Purcell and J.C. Kotz, Holt Saunders international
4. Organometallic chemistry by R.C. Mehrotra and A. Singh. New Age International.
5. Advanced Inorganic Chemistry by Cotton and Wilkinson, Wiley Eastern
6. Inorganic reaction mechanism by Basolo and Pearson, Wiley Eastern
7. Bioinorganic Chemistry by K. Hussan Reddy
8. Biological Aspects of inorganic chemistry by A. W. Addison, W. R. Cullen, D. Dorphin and G. J. James. Wiley Interscience.
9. Photochemistry of coordination compounds by V. Balzani and V. Carassiti. Academic Press.
10. Textbook of Coordination chemistry by K. Soma Sekhara Rao and K.N.K. Vani, Kalyani Publishers.

**KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
II SEMESTER**

Paper Code & Title: ACH204: RESEARCH METHODOLOGY & IPR

No. of hours per week: 04

Total credits: 04

Total marks: 100 (Internal: 30M & External: 70M)

Course Objectives:

- To understand some basic concepts of research and its methodologies
- To develop an understanding of the basic framework of research process.
- To develop an understanding of various research designs and techniques.
- To identify various sources of information for literature review and data collection.
- Ability to write a research Proposal, report and thesis
- To demonstrate knowledge and understanding of IPR Filing and Rights

UNIT- I: Foundations of Research & Research Design

Meaning of Research – Definitions of Research – Motivation in Research – General Characteristics of Research – Criteria of Good Research – Types of Research – Research Process – Research Methods vs. Methodology – Defining and Formulating the Research Problem – Review of Literature – Approaches to Critical Literature Review – Importance of Literature Review in Identifying Research Gaps and Defining a Problem – Development of Working Hypothesis.

UNIT- II: Research Design, Sampling Concepts, and Data Collection Methods

Meaning, Significance and Characteristics of Good Research Design – Types of Research Design: Exploratory, Conclusive Research and Experimental – Sampling Theory: Types of Sampling and Errors in Sampling – Data Collection: Types of Data – Data Collection Methods and Techniques for Primary and Secondary Data.

UNIT-III: Measurement & Scaling Techniques, Hypothesis Formulation and Testing, Overview of Data Analysis and Report Writing

Basic measurement scales – Reliability & Validity – Definition and Types of Hypothesis – Hypothesis Formulation and Testing Procedure – Overview of Data Analysis: Methods, Process and Types – Report Writing: Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report Precautions for Writing Research Reports – How to Write a Research Proposal – Research Ethics, Conflict of Interest and Plagiarism.

UNIT- IV: Intellectual Property Rights (IPR)

Definition and Nature and Features of Intellectual Property Rights (IPR) – Types of Intellectual Property Rights – Procedure for Grants of Patents – Rights of a Patent – Scope of a Patent Rights – Licensing and Transfer of Technology – Why protection of intellectual property is important? Enforcement of IPR – Infringement of IPR.

UNIT -V: Indian and International Scenario and New Developments in IPR

IPR Developments in India for the past Five Years – Development of IPR Laws in India – International Cooperation on IPR – New Developments in IPR – Administration of Patent System – International Patent protection – Case Studies in Indian and Global Contexts.

Course Learning Outcomes:

At the end of this course the students should be able to:

- ☐ Understand some basic concepts of research and its methodologies
- ☐ Identify appropriate research topics
- ☐ Select and define appropriate research problem and parameters
- ☐ Demonstrate the ability to choose methods appropriate to research aims and objectives
- ☐ Have adequate knowledge on measurement & scaling techniques

- ☐ Have basic awareness of data analysis-and hypothesis testing procedures
- ☐ Prepare a project proposal (to undertake a project)
- ☐ Write a research report and thesis
- ☐ File Patents, Trademarks and Copy Rights

Text and Reference Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002, An introduction to Research Methodology, RBSA Publishers.
2. Cohen, L. Lawrence, M., & Morrison, K. (2005), Research Methods in Education (5th edition). Oxford: Oxford University Press.
3. Kothari, C.R., 1990, Research Methodology: Methods and Techniques, New Age International.
4. Dornyei, Z. (2007). Research Methods in Applied Linguistics. Oxford: Oxford University Press.
5. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009, Research Methods: A Process of Inquiry, Allyn and Bacon.
6. Fink, A., 2009, Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications.
7. Day, R.A., 1992, How to Write and Publish a Scientific Paper, Cambridge University Press.
8. Wadehra, B.L. 2000, Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
9. Coley, S.M. and Scheinberg, C. A., 1990, Proposal Writing, Sage Publications.
10. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options, Zed Books, New York.
11. Leedy, P.D. and Ormrod, J.E., 2004, Practical Research: Planning and Design, Prentice Hall.
12. Satarkar, S.V., 2000. Intellectual property rights and Copy right. EssEss Publications.

Important Websites:

- www.ipindia.nic.in - Intellectual Property Office, India
- www.patentoffice.nic.in – Patent office, India
- <http://copyright.gov.in/> - Copyright Office, India
- ipr.icegate.gov.in – Automated Recordation & Targeting for IPR Protection
- <http://www.icegate.gov.in>- E- Commerce portal of Central Board of Excise and Customs
- www.ipab.tn.nic.in - Intellectual Property Appellate Board, India
- www.mit.gov.in – Department of Information Technology, India
- <http://www.mit.gov.in/content/office-semiconductorintegrated-circuits-layout-designregistry>
- Semiconductor Integrated Circuits Layout-Design Registry (SICLDR)
- www.plantauthority.gov.in – Plant Varieties and Farmers' Rights Authority, India
- <http://nbaindia.org/> - National Biodiversity Authority
- www.nipo.in – The Indian IPR Foundation
- www.wipo.int – World Intellectual Property Organisation
- <http://www.wto.org> – World Trade Organisation

KRISHNA UNIVERSITY, MACHILIPATNAM - 521003

DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)

II SEMESTER

**PAPER CODE & TITLE: ACH205:
CYCLIC CHEMISTRY**

HETERO

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on Heterocyclic Chemistry.

UNIT-I: Definition, Classification, and Nomenclature (Hantzsch-Widman System) of heterocycles.

Three membered Heterocyclic Compounds: Synthesis, reactivity, and importance of the following ring systems: Aziridines, Oxiranes and Thiiranes.

UNIT-II: Four membered Heterocyclic Compounds: Synthesis, reactivity, and importance of the following ring systems: Azetidines, oxetanes, Thietanes.

UNIT-III: Five membered Heterocyclic Compounds with two hetero atoms: Synthesis, reactivity and importance of the following heterocycles: Pyrazole, Imidazole, Oxazole, Isoxazole, Thiazole, isothiazole.

UNIT-IV: Six-membered Heterocyclic Compounds with two hetero atoms: Synthesis, reactivity and importance of the following heterocycles: Pyridazines, pyrimidine, Pyrazine, Oxazine, Thiazine.

UNIT-V: Fused heterocycles : Synthesis and reactivity of Indole, quinoline, isoquinoline, benimidazole, quinoxalines, isoxazoles

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Heterocyclic Chemistry.

Reference books:

1. Some Modern Methods of Organic Synthesis W. Caruthers, Cambridge University Press, Cambridge.
2. Organic Synthesis viz Boranes, Herbert C. Brown Gray, W. Kramer Alan B. Levy and M. Mark Midland John Wiley & Sons, New York.
3. Heterochemistry, T.L. Gilchrist, Longman science and tech.
4. An introduction to the Chemistry of Heterocyclic Compounds, R.M. Acheson, Interscience Publishers, New York
5. Principles of Organic Chemistry, R.C. Norman, J.M. Coxon, Nelson Thomas
6. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg. Plenum.
7. Heterocyclic chemistry by Jack Lie, Springer publications.

KRISHNA UNIVERSITY, MACHILIPATNAM - 521003 DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)

II SEMESTER

PAPER CODE & TITLE: ACH 206 : CHEMISTRY OF BIO-ORGANIC COMPOUNDS

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge of the student on Bio-Organic Chemistry.

UNIT-I: Carbohydrates: Introduction, Classification, Occurrence of Hexoses and Ketoses, Nomenclature, Mutarotation, anomeric effects and Stereochemistry and ring structures of Carbohydrates. Chemistry of Glucose, Fructose, and Sucrose.

UNIT-II: Amino Acids and Proteins: Classification of Amino acid and their general properties. General methods of synthesis of alpha-amino acids. Isoelectric point, Determination of C-Terminal and N-terminal Amino acid. Definition and Classification of Peptides and Proteins.

UNIT-III: Vitamins: Classification, Occurrence, Structural elucidation, synthesis and biogenesis of Vitamin-A, B1, C, D and B12 and its importance.

UNIT-IV: Nucleic acids: Basic concepts of the Structure of RNA, DNA, and their hydrolysis products. Base pairs and Watson and Crick model, Nucleotides, Nucleosides, reactions of nucleic acid bases, mutations, and Heterocyclic bases.

UNIT-V: Bio polymers: Introduction, Classification of bio-polymers, properties of biopolymers, Difference between bio polymers and synthetic polymers, production and processing of biopolymers. Applications of bio-polymers.

Course Learning Outcomes : This paper imparts knowledge on biological chemistry and aspects related to the biopolymers.

Reference Books:

1. Natural products: Chemistry and Biological significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrop and J.B. Harborne.
2. Organic Chemistry, vol-2, I.L. Finar.
3. Stereoselective synthesis: a practical approach, M. Nogrudi.
4. Rodd's Chemistry of carbon compounds, Ed. S. Coffey.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas By Ed. Kurt. Hostettmann, M.P. Gupta and A. Marston.
6. Introduction to Flavonoids by B.A. Bohm.
7. Natural products Chemistry by Ata-ur-Rahman and M.I. Choudhary.
8. Chemistry of natural products by S.V. Bhat, B.A. Naga Sampagi and M. Siva Kumar.
9. Biopolymers: Biomedical and Environmental applications by Susheel Kalia Scrivener, Wiley publication.

**KRISHNA UNIVERSITY, MACHILIPATNAM - 521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)**

II SEMESTER

PAPER CODE & TITLE: ACH 207 POLYMERS CHEMISTRY

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on Polymer chemistry.

UNIT – I: Polymers introduction: Introduction, Classification of polymers, Polymerization, chain polymerization, condensation polymerization, step polymerization, Copolymerization, Free radical chain polymerization, cationic polymerization, anionic polymerization, Polymerization Techniques, Graft and Block Copolymers.

UNIT–II: Polymer Synthesis
: Polymer Synthesis, Isolation and Purification of polymers, Polymer Fractionation, Molecular weight determination, Molecular weight determination curve, Processing Techniques.

UNIT–III: Polymer reactivity: Polymer Reactions–
Introduction, Hydrolysis, Acidolysis, Aminolysis, Hydrogenation, Addition and Substitution Reactions, Cyclisation reactions, Cross-linking Reactions.

UNIT – IV: Degradation of polymers: Polymer Degradation – Definition, Types of Degradation, Thermal Degradation, Mechanical Degradation, Degradation by Ultrasonic Waves, Photodegradation, Degradation by High-Energy Radiation, Oxidative Degradation, Hydrolytic Degradation.

UNIT–V: Applications of Polymers: Plastics, Fibres, Elastomers- Polyethylene, Polystyrene, Polyesters, Polyacrylonitrile, Polyurethanes, Polyvinyl Chloride, Polyisoprenes. Resins– Phenol Formaldehyde Resin, Urea Formaldehyde and Melamine– Formaldehyde Resins, Epoxy Polymers, Silicon Polymers, poly Carbonates and poly urethanes .

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge on Polymer chemistry.

Reference books:

1. Textbook of Polymer Science by Fred, W. Billmeyer,
2. An Introduction to Polymer Chemistry by Moore.
3. Polymer Chemistry- An Introduction by M.P. Stevens.
4. Polymer Science – VR Gowariker, NV Viswanathan, Jayadev Sreedhar.

KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)

II SEMESTER

PAPER CODE & TITLE: ACH 208 Organic Chemistry LAB-2

Total marks: 100

(Internal: 30M & External: 70M)

Course Objectives:

- To develop an insight into the identification of organic compounds by systematic analysis
- To understand the process of identification of organic compounds by systematic analysis
- To acquire skills in the identification of organic compounds by systematic analysis

COURSE CONTENT:

1. Preparation of organic compounds: Two stage preparations by reactions involving nitration, halogenation, oxidation, reduction, alkylation, acylation, condensation and rearrangement. (A student is expected to prepare at least 5 different organic compounds by making use of the reactions given above).

2. **Identification of the unknown organic compounds**

Systematic identification of organic compounds – preliminary tests, detection of extra elements, solubility, common functional group tests (determination of functional group/s in a single compound, if present), preparation of two rational derivatives

The given organic compound must be identified by comparing the melting point / Boiling point of the compound and melting points of its derivatives with the literature

List of suggested compounds

Glucose, fructose, benzaldehyde, p-anisaldehyde, p-chloro benzaldehyde, acetophenone, phenol, cresols, naphthols, esters, p-chloro benzoic acid, aniline, p-toluene, p-anisidine, p-chloroaniline, diphenyl amine, N,N-dimethylaniline, benzamide, naphthalene and anthracene.

Learning Outcomes:

At the end of the course, the learners should be able to:

Identify an organic compound by systematic analysis

Develop skill in identification of organic compounds by systematic analysis

Apply the skill in the identification of new organic compounds by systematic analysis

TEXT BOOKS

1. A Textbook of Practical Organic Chemistry by A. I. Vogel, ELBS and Longman group.
2. Practical Organic Chemistry by Mann and Saunders, ELBS and Longman group.
3. A.I. Vogel, "Elementary Practical Organic Chemistry", Longman
4. Reaction and Synthesis in Organic Laboratory, B.S. Furniss, A.J. Hannaford, Tatchell, University Science Books Mill Valley.
5. Purification of Laboratory chemicals, manual, W.L.F. Armarego EDD Perrin.
6. Reaction and Synthesis in Organic Chemistry Laboratory, Lutz-Friedjan-Tietze, Theophil Eicher, University Science Book.

KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
II SEMESTER

Paper Code & Title: ACH209: PHYSICAL CHEMISTRY LAB

Total marks: 100 (Internal: 30M & External: 70M)

Course Objectives: To teach laboratory ethics, safety and cleanliness, Preparation and standardization of solutions, develop hands-on experience/practical knowledge in performing Physical chemistry experiments, develop skills on handling instruments like conductometry and perform different types of acid- base titrations, train to plot accurate graphs of the desired scale for the calculations of Langmuir and Freundlich isotherms, train to Prepare the solution of the desired concentration and the desired volume in Cuprammonium cation. Over all objective of this paper is to give a practical knowledge for the students on Physical chemistry experiments.

1. Conductometry

- a) Conductometric titration of strong acid (HCl) vs strong base (NaOH)
- b) Conductometric titration of weak acid (CH₃COOH) vs strong base (NaOH)
- c) Conductometric titration of mixture of acids (HCl + CH₃COOH) vs strong base (NaOH)

2. Determination of Critical solution temperature of phenol-Water system

3. Potentiometric titration of Iron (II) using potassium dichromate

4. Determination of kinetics of Ester hydrolysis

5. Determination of Equilibrium constant of Potassium Iodide-Iodine system

6. Determination of effect of electrolyte (NaCl) on the miscibility temperature of Phenol-Water system

7. 0pH-metric determination of strong acid with strong base. Relative strengths of acids by studying the hydrolysis of ethylacetate /methylacetate.

7. Determination of equilibrium constant of KI_3 $\text{KI} + \text{I}_2$ by partition coefficient.

8. Determination of unknown concentration of potassium iodide by partition coefficient method.

9. Distribution coefficient of Benzoic acid between Benzene and water.

10. Verification of Beers Law using potassium permanganate/Potassium dichromate

Course Outcomes: At the end of the course, the learners should be able to: develop/practical skills to solve problems in chemistry, extend the principle of Conductometric titration to other kind of reactions, learn to use the concept of phase diagram for different systems, apply adsorption isotherms for other reactions.

Textbooks/Reference books:

1. Experimental Physical chemistry by V.D. Athawale, Parul Mathur, New Age International publishers.
2. Physical chemistry experiments by V.P. Kudesia, Pragati Prakasan publishers.
Advanced practical Physical chemistry by J.B. Yadav, Krishna's educational publishers

**KRISHNA UNIVERSITY,
MACHILIPATNAM DEPARTMENT OF
CHEMISTRY**

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY) III SEMESTER

PAPER CODE & TITLE: ACH 301: SEPARATION METHODS

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30 M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on various types of Chromatography, sampling of solids, liquids and gases and solvent extraction.

Unit-1: Importance of Analytical Chemistry to Industrial

Research: Importance of Qualitative and Quantitative analysis in research and development, industries and other branches of science. Development and validation of an analytical method, units, concentrations, calculations, standards, chemical reactions, expressions of concentrations, importance of separation methods with examples. **Chromatography:** retardation factor, retention time and volume, column capacity, temperature effects. Efficiency of chromatographic column, zone spreading, Height Equivalent Theoretical Plate (HETP), Van Demeter equation, resolution, choice of column, length and flow velocity, qualitative and quantitative analysis.

UNIT-II: Ion Exchange and Ion Chromatography: Ion Exchange chromatography: Principle, synthetic ion-exchange resins, properties of anion and cation exchange resins, ion-exchange mechanism, ion-exchange equilibria, selectivity, ion exchange capacity, applications. Ion chromatography: Principle, instrumentation, detectors, applications in the analysis of water and air pollutants.

UNIT-III: Gel Exclusion, Capillary electrophoresis, Ion exclusion and Affinity chromatography, Gel Exclusion chromatography: Principles, properties of xerogels, detectors, resolution of gel type, applications to organic compounds. Capillary Electrophoresis: Principle, Instrumentation, applications. Inorganic molecular sieves: Principle, structure of zeolites, crystals, application. Ion exclusion: principles and applications. Affinity chromatography: principles and applications.

UNIT-IV : Sampling of Solids, Liquids and Gases: Basis of sampling, Sampling procedure, homogeneous and heterogeneous samples, sampling statistics, sample size, sampling unit. Sampling of solids: Cone and Quartering method, Long pile and alternative shovel method, precautions in preservation of solid samples. Sampling of different types of liquids: different sampling techniques, sampling of drinking water, industrial effluents, precautions in preservation of collected liquid samples. Sampling of gases: Different types of gas samplers, precautions in preservation of gas samples.

UNIT-V

: Solvent

Extraction: Principles and processes of solvent extraction, Distribution Law and Partition coefficient, nature of partition forces, different types of solvent extraction systems – Batch extraction, Continuous extraction, Counter current extraction, solvent extraction systems, applications in metallurgy, general applications in analysis and pre-concentration, special extraction systems like crown ethers, super fluid and surfactant extractions-examples.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of on various chromatographic methods, sampling of solids, liquids and gases and solvent extraction.

Reference books:

1. Techniques and practice of Chromatography, R.P.W Scott, Marci Dekker Inc., New York.
2. Separation methods, M.N Sastri, Himalaya Publishing Company, Mumbai
3. Chromatography, E. Helftnan, Van Nostrand, Reinhold, New York.
4. Chromatography, E. Lederer and M. Lederer, Elsevier, Amsterdam.
5. Chemical separation methods, John A Dean, Von Nostrand Reinhold, New York.
6. Ion chromatography, James, G. Tartor.

KRISHNA UNIVERSITY, MACHILIPATNAM

DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)

III SEMESTER

PAPER CODE & TITLE: ACH 302: APPLIED ANALYSIS-I

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30 M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated

knowledge on analysis of ores like Manganese and Aluminium analysis of raw materials, analysis of soil, fertilizers, fuels and finished products.

Unit – I : Analysis of Ores – I(a) General techniques of analysis applied to complex materials - Scope of metallurgical analysis - General methods of dissolution of complex materials - Various chemical methods for the effective separation of the constituents in the complex materials.(b) Analysis of ores: Iron ore- Analysis of the Constituents – Moisture, loss of ignition, Total Iron, ferrous Iron, Ferric Iron, Alumina, Silica, Titania, Lime, Magnesia, Sulphur, Phosphorous, Manganese, Alkalies, combined water, Carbon in blast furnace, flue dust and sinter.(c) Manganese Ore- Analysis of the Constituents – Total Manganese, MnO_2 , SiO_2 , BaO , Fe_2O_3 , Al_2O_3 , CaO , P and S

Unit – II: Analysis of Ores – II:(a) Chromite Ore - Analysis of the Constituents – Chromium, SiO_2 , FeO , Al_2O_3 , CaO , & MgO .(b) Phosphate rock Ore - Analysis of the Constituents - CaO , P_2O_5 , F, SiO_2 , CO_2 , S, Na_2O , Al_2O_3 , Fe_2O_3 , MgO , K_2O , Cl , MnO . Organic carbon, Moisture, Loss of ignition.(c) Aluminium Ore (Bauxite) - Analysis of the Constituents – Silica, Alumina, Fe_2O_3 , Titania, MnO_2 , P_2O_5 , CaO , MgO , vanadium, zirconium, and alkalies.

Unit – III : Analysis of Finished Products – I: (a) Analysis of steel for C, Si, S, P, Mn, Ni, Cr; Mg and analysis of blast furnace slag .(b) Analysis of refractory materials: fire clay, flint spar, and magnesite(c) Analysis of fluxes - limestone and dolomite.

Unit – IV : Analysis of Finished Products – II: (a) Chemical Analysis of cement-silica, NH_4OH group, ferric oxide, alumina, lime, magnesia, Sulphide Sulphur, K_2O , Na_2O , free CaO in Cement and Clinker, SO_3 and loss on ignition.(b) Analysis of oils - saponification number, iodine number, and acid number.(c) Analysis of soaps - moisture, volatile matter, total alkali, total fatty matter, free caustic alkali or free fatty acids, sodium silicate, chloride. (d) Analysis of paints-vehicle and pigment, $BaSO_4$, total lead and lead chromate

UNIT-V : Analysis of raw materials – I : Analysis of non-ferrous alloys:(i) Brass – Analysis of the constituents – Cu, Zn, Sn, Pb and Fe.(ii) Bronze - Analysis of the constituents – Cu, Sn, Zn, Pb and Fe.(iii) Solder - Analysis of the constituents – Sn, Pb and Sb.

Learning outcome:

Student will acquire basic knowledge on applied analysis which is very much useful for having extensive idea on ores and finished products.

Text books

1. Handbook of Analytical Control of Iron and Steel Production, Harrison John, Wiley 1979
2. Standard methods of Chemical Analysis, Welcher
3. Technical Methods of Analysis, Griffin, McGraw Hill
4. Commercial Methods of Analysis, Foster Dee Sneel and Frank M. Griffin, McGraw Hill Book Co.
5. H. Wincciam and Bobbles (Henry J)- Instrumental methods of analysis of food additives.,
6. H. Edward-The Chemical analysis of foods; practical treatise on the examination of food stuffs and the detection of adulterants.

KRISHNA NIVERSITY, MACHILIPATNAM:
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
III SEMESTER

PAPER CODE & TITLE: ACH 303: CHEMICAL AND SPECTRAL METHODS OF ANALYSIS

No. of hours per week: 04
Total marks: 100

Total credits: 04
(Internal: 30 M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on nephelometry, turbidimetry, spectrofluorimetry, X-ray spectroscopy, radiochemical and kinetic methods of analysis, electron microscopy and Mossbauer spectroscopy.

UNIT-I :Nephelometry & Turbidimetry : Theory – Instrumentation – effect of concentration, particle size and wavelength on scattering, Difference between Nephelometry & Turbidimetric titrations – comparison of Colorimetry with Turbidimetry, comparison of Fluorimetry with Nephelometry -Applications.

UNIT-II :Spectrofluorimetry and X-ray Spectroscopy : Spectrofluorimetry: Theory of fluorescence, phosphorescence, quenching, relation between intensity of fluorescence and concentration, instrumentation, Application with reference to chromium salts, fluorescence, Thiamin(B1) and Riboflavin (B2) in drug samples. X-ray Spectroscopy: Chemical analysis by X-ray spectrometers, energy dispersive and wavelength dispersive techniques, evaluation methods, instrumentation, matrix effects applications.

UNIT-III:Radio chemical and kinetic methods of analysis : Detection and Measurement of radioactivity, introduction to radioactive tracers, applications of tracer technique, isotope dilution analysis - applications, activation analysis – application, advantages and disadvantages, radio carbon dating technique.

UNIT-IV:Electron microscopy: Principle, theory and classification of Electron microscopic methods, scanning electron microscopy(SEM), working of SEM instrument, applications. Scanning tunnelling microscopy (STM), basic principle and applications. Transmission electron microscopy, (TEM) basic principle and applications Atomic force microscope (AFM) basic principle and applications.

UNIT-V: Mossbauer Spectroscopy : Principle, theory of Mossbauer spectroscopy, Instrumentation, interpretation of spectra, applications with reference to analytical sciences, chemical sciences, physical and biological sciences.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge on nephelometry, turbidimetry, spectrofluorimetry, X-ray spectroscopy, radiochemical and kinetic methods of analysis, electron microscopy and Mossbauer spectroscopy.

Reference books:

1. Kinetic Methods of Analysis by K.B. Yarstimiskii.
2. Technical Methods of Analysis, Griffin, Mc. GrawHill.
3. Principles of instrumental analysis – Skoog and West, Saunders College publishing.
4. Instrumental methods of Analysis – Galen W. Ewing, (Mc. GrawHill).
5. Basic concepts of Analytical Chemistry S M Khopkar, New age International publisher

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M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
III SEMESTER

**PAPER CODE & TITLE: ACH 304: QUALITY CONTROL AND
STANDARD METHODS OF ANALYSIS**

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30 M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on Quality control in Analytical Chemistry, GLP, precipitation gravimetry, selected oxidant and reductant systems used in analysis.

UNIT-I :Quality control in Analytical Chemistry : Quality assurance and management systems: elements of quality assurance, quality assurance in design, development, meaning of quality and customer requirement of quality. Quality management system, ISO 9000 and ISO 14000 series- statistical process control, process control tools. Good laboratory practices (GLP): Need for GLP, GLP organization and management, Brief outline of ICH guidelines on drug substances and products.

UNIT-II :Precipitation methods: Nucleation and Crystal growth, homogeneous and heterogeneous nucleation, solubility and particle size, completeness of precipitation, effect of excess precipitant, pH, complex formation, temperature, purity of precipitates. Theory of co-precipitation, mixed crystal formation by occlusion and entrapment, re-precipitation with examples, theory of post-precipitation, examples of post-precipitation.

UNIT-III: PFHS and Gravimetric determination: Precipitation from Homogeneous Solution (PFHS), theory of PFHS, methods of PFHS - increase in pH, decrease in pH, cation release, anion release, reagent synthesis, change in oxidation state, photochemical reactions, precipitation from mixed solvents. Applications of PFHS methods. Gravimetric determinations: nature of species, preparation of solutions, Inorganic precipitants- chloride and sulphate. Organic precipitants: Dimethyl glyoxime (DMG), oxine, benzidine, salicylaldehyde, benzoin oxime, sodium tetraphenyl boron, tetraphenyl arsonium chloride.

UNIT-IV:Reductant systems: Principles and applications in analysis: Formal, standard and normal potentials in various media, stability of the solutions, species responsible for the reduction properties, standardization, selection of suitable indicators for various systems. Inorganic systems: Cr(II), V(II), Ti(III), Sn(II), Fe(II) in H₃PO₄. Organic Systems: Hydroquinone and Ascorbic acid.

UNIT-V: Oxidant systems : Principles and applications in analysis: Formal, standard and normal potentials in various media, stability of the solutions, species responsible for the reduction properties, standardization, selection of suitable indicators for various systems. **Inorganic Systems:** Mn (III), Mn (VII), Ce (IV), Cr (VI), V (V), Periodate, Iodate, **Organic Systems:** Chloramine-T.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Quality control in Analytical Chemistry, GLP, precipitation gravimetry, selected oxidant and reductant systems used in analysis.

References books:

1. Quality Assurance and Good Laboratory Practices, Prof. Y. Anjaneyulu, In Now Publication, New York.
2. Quality Assurance in Analytical Chemistry - G. Kateman and F. W. Pipers, John Wiley and Sons, New York.
3. Technical methods of analysis - Griffin, MC Graw Hill Book Co.
4. Chemical analysis - H.A Laitinan, Me Graw Hill Book Co.
5. Newer redox titrants - Berka, Zyka and Vulterin, Pergamon Press.
6. Volumetric Analysis, Vol III- I.M Kolthoff and R. Belcher, Interscience Public, New York.
7. Vogel's Text Book of Inorganic Quantitative Analysis - J. Bassett et al, ELBS.
8. Analytical Chemistry, An Introduction, D.A. Skoog, D.M West and F.J Holler, Sanders College Publishing, New York.
9. An Introduction ISO 9000, ISO 1400 Series, Environmental Management. K.V.S.G. Murali Krishna.

**KRISHNA UNIVERSITY, MACHILIPATNAM – 521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)**

III SEMESTER

**PAPER CODE & TITLE: ACH 305 : BIOINORGANIC, BIOORGANIC, BIOPHYSICAL
CHEMISTRY**

No. of hours per week: 04

Total marks: 100

Total credits: 04

(Internal: 30 M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to impart knowledge on basic and updated concepts of Bioinorganic, Bioorganic and Biophysical chemistry.

UNIT-I : BIO-INORGANIC CHEMISTRY- I: Metal complexes as oxygen carriers – Heme proteins – Hemoglobin and myoglobin – Non heme proteins – hemerythrin and hemocyanin – model synthetic complexes of iron, cobalt and copper. Co-enzymes Vitamin B12, carboxy peptidase and superoxide dismutase.

Electron Transfer in Biology: Structure and functions of metalloproteins in electron transfer processes – catalase – peroxidase – cytochromes and iron – sulphur proteins – synthetic models.

UNIT-II : BIOINORGANIC CHEMISTRY- II: Metal ion transport and storage in biological systems, Metal ions in Biology, Molecular mechanism of ion transport across membranes: ionophores, photosynthesis. Hydrolytic metalloenzymes: Carbonic anhydrase, carboxy peptidase, calcium in control processes, calcium and muscle contraction, calcium and secretion, calcium in blood clotting mechanisms. Therapeutic uses of enzymes. Importance of trace metals in biology: Metal ions as chelating agents in medicine, trace metal ions and metal and non-metal deficiency. Biological nitrogen fixation, in-vivo and in-vitro nitrogen fixation.

UNIT-III: BIOORGANIC CHEMISTRY: Carbohydrates: Structure and biological functions of mucopolysaccharides, glycoproteins, and glycolipids – Role of sugars in biological recognition – Blood group substances Lipids: Essential fatty acids – structure and function of triglycerols, Glycerophospholipids, cholesterol, bile acids prostaglandins – composition and functioning of lipoproteins Enzymes: Nomenclature and classification, properties, factors affecting enzyme catalysis, enzyme inhibition – reversible and irreversible inhibition. Uses of enzymes in food drink industry and clinical laboratories.

UNIT-IV BIOPHYSICAL CHEMISTRY-I: Standard free energy change in biochemical reactions, exergonic and endergonic reactions, hydrolysis of ATP, thermodynamics of biopolymer solutions, chain configuration of bio polymers, calculation of average dimensions.

UNIT-V BIOPHYSICAL CHEMISTRY-II : Membrane equilibrium, ion transport through cell membrane . dialysis and its function. Structure and functions of proteins, enzymes, DNA and RNA in living systems, forces involved in bio polymer interactions, electrostatic forces, hydrophobic forces, molecular expansion, and dispersion forces.

Course Learning Objective(S): This paper enlightens the updated knowledge on basic and updated concepts of Bioinorganic, Bioorganic and Biophysical chemistry.

Books Suggested

1. M.N. Hughes, The Inorganic chemistry of Biological Processes, John Wiley and Sons, New York 2nd Edition, 1981.
2. A Text book of BioChemistry, A.V.S.S. Rama Rao
3. Physical chemistry by Atkins
4. Physical chemistry by Albertz.
5. Bio physical chemistry by Van Holde
6. Bio Physics by Narayanam
7. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
8. Chemistry of Natural Products, P.S. Kalsi, Kalyani Publishers.
9. Chemistry of Organic Natural Products, O. P. Agarwal, Vols., 1 & 2, Geol Pubs.

10. Natural products Chemistry K.B.G. Torssell, John Wiley, 1983.
11. Burger's Medicinal Chemistry, M.E. Wolff, John Wiley
12. Medicinal Chemistry, A. Kar, New Age International

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M.Sc., CHEMISTRY (ANALYTICAL
CHEMISTRY)
III SEMESTER**

PAPER CODE & TITLE: ACH 306 GREEN CHEMISTRY

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on Green chemistry.

Unit-I: Fundamentals and significance of Green Chemistry: Discussion of the current state of chemistry and the environment and the definition of green chemistry. Assessment of the impact of chemistry in the environment and definition of risk hazard. An introduction to the tools of green chemistry and its fundamental principles. e-factor.

Unit-II: Principles of Green Chemistry: Prevention of waste / by-products, Hazardous products - Designing of safer chemicals - Selection of appropriate solvents and starting materials - Use of protecting groups and catalysis - Designing of biodegradable products.

Unit-III: Microwave assisted reactions:

Introduction to Microwave organic synthesis, Applications: solvents (water and organic solvents), solvent free reactions (solid state reactions), Phase transfer catalysis - Principle, Types, advantages and applications, Crown ethers.

Unit-IV: Solvent Free Reactions: Solvent free techniques -

Reactions on solid mineral supports, Phase Transfer Catalysis - C-alkylation, N-alkylation, Darzen's reaction, Wittig reaction. Ultrasound assisted green synthesis - Oxidation, Reduction, Hydroboration, Strecker reaction.

Unit-V: Ionic liquids: Definition - Types of Ionic Liquids - Synthesis of Ionic Liquids - Selection of ionic liquids - physical properties - Application in organic synthesis - alkylation, allylation, oxidation, reduction, polymerization, hydrogenation, hydroformylation, alkoxycarbonylation, carbon-carbon bond forming reactions, alkenemetathesis.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Green chemistry.

Textbooks/Reference books:

1. New Trends in Green Chemistry by V.K. Ahluwalia, M. Kidwai.
2. Green Chemistry: Environment Friendly Alternatives by Rashmi Sanghi, M.M. Srivastava
3. Green Solvents for Organic Synthesis by V.K. Ahluwalia, Rajender S. Varma
4. Green Analytical Chemistry by Mihkel Koel and Mihkel Kaljurand

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DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)

III SEMESTER

PAPER CODE & TITLE: ACH 307 : CHEMISTRY OF NANO MATERIALS

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on Nano Chemistry.

Unit-I: Introduction to Nano chemistry: Definition of terms-nanoscale, nanomaterials, nanoscience, nanotechnology-scale of materials natural and manmade-nanoscience practiced during ancient and modern periods-contributors to the field of Nanochemistry.

Unit-II: Synthesis of Nanomaterials: Top down and bottom-up approaches-synthesis of carbon nanotubes, Nano spears, Nano rods, quantum dots, gold and silver nanoparticles.

Unit-III: Characterization of Nanomaterials: Powder XRD, XPS, Electron microscopy techniques-scanning electron microscopy, transmission electron microscopy and atomic force microscopy.

Unit-IV: Application of Nanomaterials: Solar cells-smart materials-molecular electronics-biosensors-drug delivery and therapy-detection of cancerous cells.

Unit-V: Nanochemistry in Nature: The science behind the nanotechnology in lotus effect-self-cleaning property of lotus-gecko foot climbing ability of geckos-water strider-anti wetting property of water striders-spider silk mechanical properties of the spider silk.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Nano Chemistry.

Textbooks/ Reference books:

1. Nano: The Essentials: Understanding Nanoscience and Nanotechnology, T. Pradeep, McGraw-Hill Professional Publishing, 2008.

1. Introduction to Nanoscience, J. Dutta, H. F. Tibbals and G. L. Hornyak, CRC Press, Boca Raton, 2008.

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DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)

III SEMESTER

PAPER CODE & TITLE: ACH 308: CLASSICAL METHODS OF ANALYSIS PRACTICAL

No. of hours per week: 06

Total credits: 03

Total marks: 100

(Internal: 30 M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on classical methods of analysis practical.

1. Analysis of water for total hardness (Ca^{+2} and Mg^{+2}).
2. Analysis of Water for Alkalinity (carbonates and bicarbonates).
3. Analysis of dissolved oxygen (DO) in drinking water and sewagewater.
4. Analysis of chemical oxygen demand (COD) in drinking water and sewagewater.
5. Analysis of iron ore (with special reference to percentages of Fe(II) and Fe(III) present in the sample).
6. Determination of Iron by photochemical reduction.
7. Analysis of Pyrolusite.
8. Analysis of fertilizer for ammonia, nitrate and phosphate.
9. Analysis of Zn in zinc ore by using EDTA.
10. Analysis of nickel by EDTA.
11. Analysis of limestone.
12. Determination of lead and tin in a mixture by using EDTA.
13. Analysis of oil for the determination of saponification value, acid value and iodine value.
14. Analysis of synthetic mixture of iron and zinc.
15. Analysis of solder.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of on classical methods of analysis practical.

Reference books:

1. Vogels Text Book of Quantitative analysis, revised. J. Bassett, R.C.Denny, G.H. Jeffery and J. Mendhan, ELBS.
2. Practical Inorganic Chemistry by. K. Somasekhara Rao and K.N.K. Vani. Kalyani publishers.

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III SEMESTER

PAPER CODE & TITLE: ACH 309: SPECTRALMETHODS OF ANALYSIS PRACTICAL

No. of hours perweek:06

Total credits:03

Totalmarks:100

(Internal: 30 M & External:70M)

Course Learnig Objective: To prepare students with hands on experience in analysing spectral data as required for the identification of compounds.

1. Characterization of organic compounds using IR, UV-Vis, $^1\text{H-NMR}$, $^{13}\text{C-NMR}$ and Mass spectral methods. (At least 10molecules).

CourseLearningOutcome(S):Afterstudyingthispaper,studentswillacquiretheknowledge of on instrumental methods of analysispractical.

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DEPARTMENT OF CHEMISTRY
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III SEMESTER

PAPER CODE & TITLE: ACH 310: CHEMISTRY IN DAILY LIFE

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on Chemistry Laboratory safety symbols – Meaning, Environmental Chemistry, Bioinorganic Chemistry, Biological functions of Hormones and Medicinal Chemistry.

Unit-I: Chemistry Laboratory safety symbols– Meaning: Corrosive, carcinogenic, Harmful, toxic, dangerous to environment, Explosive, flammable, Narcotic, Oxidizing, Lachrymatory, Radioactive, irritant, gases under pressure, general laboratory safety precautions.

Unit-II: Environmental Chemistry: Ambient air quality standards, Acid rain, Smog, Greenhouse effect, Bhopal gas tragedy, Vishakhapatnam polymer industry tragedy, Renewable and Non-renewable energy resources, Methods to convert temporary hard water into soft water, DO, COD, BOD, Toxicity of lead, mercury, arsenic and Cadmium.

Unit-III: Bioinorganic Chemistry: Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and Cl. Metalloporphyrin – Structure and functions of hemoglobin, Myoglobin and Chlorophyll.

Unit-IV: Biological functions of Hormones: Introduction, mechanism of action of Adrenaline, melatonin, noradrenaline, dopamine, prostacyclin, adrenocorticotropic hormone, antidiuretic hormone, Insulin.

Unit-V: Medicinal Chemistry: Disease-medicinal molecule-mode of action of the following diseases Malaria-Artesunate, Dengue-Acetaminophen, Asthma-Albuterol, Diabetes (type-II) (IDDM) – metformin, Diabetes (type-I) (IDDM) – Insulin, Arthritis-methotrexate, Glaucoma-brimonidine, Chickenpox-acyclovir, Anxiety – citalopram, Thyroid-Levithyroxine (L₄), Insomnia – estazolam, peptic ulcer, GERD (acid reflux) – Omeprazole, pantoprazole.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Chemistry Laboratory safety symbols – Meaning, Environmental Chemistry, Bioinorganic Chemistry, Biological functions of Hormones and Medicinal Chemistry.

Reference Books:

1. Medicinal Chemistry by Ashotosh Kar

2. Environmental Chemistry, B.K. Sharma, Goel Publishers, 2001.
3. Laboratory safety for Chemistry Students by Robert H. Hill and David Finster
4. Environmental Chemistry by Samir K. Banerji
5. Organic Chemistry by G. Mare Loudan, Purdue University
6. Unified Chemistry by O.P. Agarwal, Paper-III, JPNP Publications.
7. Hormones and Endocrine system—Kleine, Rossemanith.

KRISHNA UNIVERSITY, MACHILIPATNAM -

521003 DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)

III SEMESTER

PAPER CODE & TITLE: ACH311 : ENVIRONMENTAL CHEMISTRY

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on Environmental Chemistry.

Unit-I: Water Pollution: Types of water pollution, groundwater and surface water pollution- Sources and harmful effects- sources and effects of major water pollutants- Inorganic pollutants and toxic metals- Oxygen demanding wastes- Organic Pollutants- Plant nutrients- detergents- suspended matter- radioactive wastes- Sediments- Thermal pollutants - oil spills- oil spill removal methods- disease causing agents.

Unit-II: Air Pollution: Atmosphere- structure- functions and photochemical reactions- sources of air pollution- Natural and manmade- classification and effects of air pollutants -CO, CO₂, SO₂, SO₃, NO and NO₂- hydrocarbon as pollutant- reactions of hydrocarbons and effects - particulate pollutants- sources and effects of organic and Inorganic particulates -Greenhouse effect- impact on global climate- control measures- role of CFC's -ozone holes- effects of ozone depletion- smog- components of photochemical smog- effects of photochemical smog.

Unit-III: Metal Toxicology and Nuclear Pollution: Effects of metals and metallic compounds- sources, toxicology and health risks of iron, arsenic, cadmium, chromium, lead, mercury and nickel. Nuclear pollution- sources- effects of ionizing and non-ionizing radiation - genetic and somatic effects- effects of Cesium-137, Krypton-85, Iodine-131 and Strontium-90- storage of nuclear wastes- disposal of nuclear wastes- nuclear disasters and their management- some major nuclear accidents.

Unit-IV: Pesticides and Soil Pollution: Pesticides- classification, mode of action- toxic effects of chlorinated hydrocarbons, organophosphorous compounds and carbamates- alternatives to chemical pesticides- (pheromones, Juvenile hormones, chemosterilization). Soil pollutants- sources and effects of industrial wastes- urban wastes- radioactive pollutants- agricultural wastes- solid waste management in cities,

soil pollution control measures.

Unit-V: Analysis and Control: Sampling of polluted water- preservation- main quality characteristics of water- alkalinity, hardness, total solids- TDS - DO, BOD, COD, TOC, fluoride and chloride. Defluoridation techniques- Iron removal- sampling of gaseous

pollutants and particulates –adsorption - absorption - scrubbing – cold trapping – filtration - cycloneseparator-gravitysettling-electrostaticprecipitators-thermalprecipitators-analysisofCObygaschromatography,NObychemiluminescenceandSO₂by spectrophotometer.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge on chemistry related aspects of Environment.

Textbooks/ Referencebooks:

1. Environmental Chemistry, A.K. De, Wiley Eastern Ltd, 3rd Edn., 1994.
2. Environmental Chemistry, B.K. Sharma, Goel Publishers, 2001.
3. Environmental Chemistry, M.S. Sethi, Sri Sai Printographers, 1994.
4. Textbook of Environmental Chemistry, C.D. Tyagi and M. Mehra, Anmol Publishers, 1996.
5. Fundamentals of Environmental Pollution, K. Kannan, S. Chand & Co., 1997.
6. Laboratory safety for Chemistry Students by Robert H. Hill and David Finster
7. A Textbook of Environmental Chemistry by W. Moore and F.A. Moore
8. Environmental Chemistry by Samir K. Banerji
9. Organic Chemistry by G. Mare Loudan, Purdue University
10. Unified Chemistry by O.P. Agarwal, Paper-III, JPNP Publications.
11. Hormones and Endocrine system – Kleiner, Rossemanith.
12. Principles of Biochemistry - Leninger.
13. Essentials of Medical pharmacology - K. D. Tripathi.

**KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
III SEMESTER**

**PAPER CODE & TITLE: ACH 312 -
TECHNIQUES FOR MODERN INDUSTRIAL APPLICATIONS**

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on Recrystallization, Distillation, Solvent extraction, Adsorption and Partition Chromatography, Gas Chromatography and High-Performance Liquid Chromatography and Ion-Exchange Chromatography and Electrophoresis.

Unit-I: Classical Methods of purification: Recrystallization: Basic principles, choice of solvent, seeding, filtration and centrifugation and drying. Industrial applications. Concepts of fractional crystallization. **Distillation: Basic principles.** Distillation types- continuous distillation, batch distillation, fractional distillation, vacuum distillation and steam distillation. Industrial applications. **Solvent extraction:** Basic principles, Different types of extraction. Selection of solvents. Avoiding emulsion formation. Basic concepts on Soxhlet extraction. Industrial applications.

Unit-II: Adsorption and Partition Chromatography: Introduction to chromatography. Different types of Chromatography. Adsorption chromatography- adsorbents, solvents, solutes, apparatus. Column Chromatography- stationary phase, Mobile phase, packing of column, advantages and disadvantages. **Thin Layer chromatography:** Basic Principles. Common stationary phases, Methods of preparing TLC plates, Selection of mobile phase, Development of TLC plates, Visualization methods, R_f value. Application of TLC in monitoring organic reactions. Identification and quantitative analysis. **Paper chromatography:** Basic Principles. Ascending and descending types. Selection of mobile phase, Development of chromatograms, Visualization methods. Application of paper chromatography in the identification of sugars and amino acids. One- and two-dimensional paper chromatography.

Unit-III: Gas Chromatography and High-Performance Liquid Chromatography: Gas chromatography: Basic Principles. Different types of GC techniques. Selection of columns and carrier gases. Instrumentation. detectors; RT values. Applications in the separation, identification and quantitative analysis of organic compounds. **High Performance liquid chromatography (HPLC):** Basic Principles. Normal and reversed Phases. Selection of column and mobile phase. Instrumentation. detectors; RT values. Applications in the separation, identification and quantitative estimation of organic compounds. Concepts on HPLC method development.

Unit-IV: Ion-

Exchange Chromatography and Electrophoresis: Ion exchange chromatography: Basic Principles. Preparation of cross-linked polystyrene resins. Different types of cation and anion exchange resins. Application in the purification of carboxylic acids and amines. **Electrophoresis:** Basic Principles. Capillary electrophoresis. Instrumentation, applications, zone-electrophoresis, gel-electrophoresis.

Unit-V: GC-MS – Introduction: Instrumentation – GC – MS interface – Mass spectrometer (MS) Instrument operation, processing GC-MS data – ion chromatogram Library searching – Quantitative measurement – sample preparation Selected ion monitoring – Application of GC-MS for Trace constituents. Drug analysis, Environmental analysis and others.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Recrystallization, Distillation, Solvent extraction, Adsorption and Partition Chromatography, Gas Chromatography and High-Performance Liquid Chromatography and Ion-Exchange Chromatography and Electrophoresis.

Textbooks/ Reference books:

1. Principles of Instrumental Analysis by D.A. Skoog, F.J. Holler and T.A. Nieman, Harcourt College Pub.
2. Separation Techniques by M.N. Sastri, Himalaya Publishing House (HPH), Mumbai.
3. Introduction to Organic Laboratory Techniques - D.L. Pavia, G.M. Lampman, G.S. Kriz and R.G. Engel, Saunders College Pub (NY).
4. Instrumental Methods of Chemical Analysis by H. Kaur, Pragati Prakashan, Meerut.
5. Protein Purification - Principles and practice, III Edn - R.K. Scopes, Narosa Publishing House, Delhi.

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)

IV SEMESTER

PAPER CODE & TITLE: ACH 401: INSTRUMENTAL METHODS OF ANALYSIS

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30 M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on spectro-analytical methods of analysis like flame photometry, AAS, ICP-AES, ICP-MS, thermogravimetry and electroanalytical methods like polarography, anode stripping voltametry, electrogravimetry, coulometry, amperometry, biamperometry and cyclic voltametry methods.

UNIT-I :Spectro-analytical methods of analysis: Flame photometry: Theory, instrumentation, combustion flames, detectors, and analysis of Na, K, Ca, Mg. **Atomic Absorption Spectrometer:** theory, instrumentation, flame and non-flame techniques, resonance line sources, hollow cathode lamp, chemical and spectral interferences, applications with special reference to analysis of trace metals in oils, alloys and toxic metals in drinking water and effluents. **Inductively coupled plasma spectrometer (ICP-AES, ICP-MS):** principles, instrumentation, plasma, AES detectors, quadrupole mass spectrometers, difference between the two detectors, applications.

UNIT-II :Thermal methods of Analysis: Thermo gravimetry: Theory, instrumentation, applications with special reference to $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, $\text{CaC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$, CaCO_3 , $(\text{COOH})_2 \cdot 2\text{H}_2\text{O}$. **Differential thermal analysis:** Principle, instrumentation, difference between TG and DTA - applications with special reference to the clays and minerals, coals (fuels). **Differential scanning calorimetry:** Principle, instrumentation, applications to inorganic materials like chlorates and perchlorates, ammonium nitrate, organic compounds and drugs.

UNIT-III Electro analytical Methods-1: Polarographic analysis: Principle and Instrumentation, Dropping mercury electrode (DME), advantages and disadvantages of DME, qualitative and quantitative analysis of inorganic ions - Cu, Bi, Pb, Cd, Zn, AC polarography, pulse polarography. **Anode stripping voltametry:** Principle, instrumentation, Hanging mercury drop electrode, application in the analysis of Pb and Cd in environmental samples, principle of cathode stripping voltametry.

UNIT-IV :Electro analytical methods -2 Electro gravimetric analysis: Principle, important terms in electrogravimetry, decomposition voltage or decomposition potential, over voltage and their importance, instrumentation, electrolysis at constant current, determination of Cu^{2+} by constant current electrolysis, electrolysis at controlled potentials, determination of Cu, Pb, Sn in brass and bronze by controlled potential electrolysis. **Coulometric analysis:** Principles of coulometric analysis with constant current and controlled potential, coulometric analysis with controlled potential, applications of coulometric methods for the analysis of cations - As(III) , Fe(II) and I^- and S^{2-} by using I_2 liberations and Ce^{4+} liberation in solutions.

UNIT-V :Electro analytical methods -3Amperometry: Introduction, principle, conditions for performing amperometric titrations, advantages, titrations with rotating platinum electrode, applications.**Biamperometry:** Principle, biamperometric titrations and its curves, applications.**Cyclic voltametry:** Basic principles, applications.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge on spectro-analytical methods of analysis like flame photometry, AAS, ICP-AES, ICP-MS, thermogravimetry and electroanalytical methods like plorography, anode stripping voltametry, electrogravimetry, coulometry, amperometry, biamperometry and cyclic voltametry methods.

Reference books:

1. Instrumental methods of analysis - H.H Willard, Meritt Jr. and J.A Dean.
2. Principles of instrumental analysis - Skoog and West.
3. Vogel's Textbook of Quantitative Inorganic analysis - J. Basset, R.C. Denney, G.H. Jefferey and J. Madhan.
4. Instrumental methods of analysis - B.K Sarma, Goel Publishing House, Meerut.
5. Instrumental methods of Analysis - Chatwal and Anand.
6. Instrumental methods of Analysis - Ewing W. Wendtland.
7. Thermal Analysis, John Wiley Sons, New York.

KRISHNA UNIVERSITY, MACHILIPATNAM :
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
IV SEMESTER

PAPER CODE & TITLE: ACH 402:TRADITIONAL AND ENVIRONMENTAL
METHODS OF ANALYSIS

No. of hours per week:04

Total credits:04

Total marks:100

(Internal: 30 M & External:70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on decomposition techniques, organic functional group analysis, drug analysis, analysis of water and air.

UNIT-I: Decomposition techniques in analysis: Principle of decomposition and Dissolution. Difference between dissolution and decomposition. Decomposition of samples with acids-HCl, HF, HNO₃, H₂SO₄ and HClO₄. Decomposition of samples by fusion, Alkali Fusion- Na₂CO₃, NaOH, Acidic Fusion- Sodium Hydro Sulphate, Sodium Pyrosulphate, Oxidation Fusion-Na₂O₂, Sodium Chlorate, Reductive Fusion Na₂CO₃+Na₄BO₄. Sintering, difference between sintering and fusion. Decomposition of samples by sintering with sodium peroxide, sodium carbonate.

UNIT-II: Organic functional group analysis: Classification of functional groups with suitable examples. Determination of: 1. Functional groups imparting acidic nature – thiol, enediol, phenolichydroxyl. 2. Functional groups imparting basic nature – Aliphatic and Aromatic primary, secondary and tertiary amines – hydrazinederivatives. 3. Functional groups which impart neither acidic nor basic nature – Aldehydes, Ketones, Nitro, Methoxy and Olefinic.

UNIT-III: Analysis of some selected drugs: Basic considerations of drugs, Classification, Determination of the following Drugs:

- 1) Acetyl salicylic acid (Antipyretic –Analgesic)
- 2) Testosterone, progesterone and cortisone (Steroids and corticoids)
- 3) Sulphadiazine (Sulphadrugs)
- 4) Phenobarbitone (Barbituric acid derivatives)
- 5) Chloramphenicol, Benzyl penicillin and Tetracycline (Antibiotics)
- 6) Thiamine (B1), Riboflavin (B2) and ascorbic acid (C) (Vitamins)
- 7) Isoniazid (Antimicrobial agents)
- 8) Methyl Dopa (Antihypertensive agents)
- 9) Metronidazole (Antiamoebic agents).

UNIT-IV :Analysis of Water :

Types of water pollutants and their effects, Analytical methods for the determination of the following ions in water, anions like CO²⁻, HCO⁻, F⁻, Cl⁻, SO²⁻, PO³⁻, NO⁻, NO⁻, CN⁻, and S²⁻. Determination of Cations in water: Fe²⁺, Fe³⁺, Ca²⁺, Mg²⁺, Cr³⁺, As⁵⁺, Pb²⁺, Hg²⁺, Cu²⁺, Zn²⁺, Cd²⁺, Co²⁺. Determination of Dissolved oxygen (D.O), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), standards for drinking water.

UNIT-V :Analysis of Air : Composition of pure air, classification of air pollutants, chemical analysis for the following. Primary pollutants: Carbon compounds -Carbon monoxide and Carbon dioxide. Sulphur compounds- sulphur dioxide, Sulphur trioxide, Nitrogen compounds -nitric oxide and nitrogen dioxide. Hydrocarbons - Aliphatic hydrocarbons and polycyclic aromatic hydrocarbons, Inorganic and Organic particulates. Secondary pollutants – ozone, peroxy acetyl

nitrate (PAN), peroxybenzyl nitrate (PBN). Standards for ambient air quality.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of on decomposition techniques, organic functional group analysis, drug analysis, analysis of water and air.

Reference books:

1. Quantitative Chemical Analysis - I.M Kolthoff, F.B Sandal, F.J. Meehan, S. Bruckenstein, Macmillan Company, London.
2. Decomposition Techniques in Inorganic Analysis - J.Dolezal, P.Ponondra, Z.Sulcek.
3. Chemical Separation and measurements - D.G. Peterseti, John M.Haves SandersCo.
4. Analytical Chemistry, An Introduction, D.A.Skoog, D.MWestand F.J.Holler, Sanders College Publishing, New York.
5. Environmental Chemistry, Anil Kumar De Wiley Eastern Ltd.
6. Environmental Analysis, S.M Khopkar (IIT Bombay).
7. Environmental Air Analysis, Trivedi and Kudesia, Akashdeep Pub.
8. Organic functional groups - S.Siggia.

KRISHNA UNIVERSITY, MACHILIPATNAM - 521003

DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)

IV SEMESTER

PAPER CODE & TITLE: ACH 403 APPLIED ANALYSIS-

II

Course Learning objectives: This course is designed to impart skills in titrimetric methods, analysis of ferro alloys, soil and fertilizer, fuel, milk and milk products.

Unit – I Analysis of raw materials Analysis of Ferro alloys :(i) Ferro silicon - Analysis of the constituents – Si, C, P, S(ii) Ferro vanadium - Analysis of the constituents – V, C, P, S, Si, Al.(iii) Ferro manganese - Analysis of the constituents – Mn, S, C, P, Si(iv) Silico manganese -Analysis of the constituents – Mn, S, C, P, Si(v) Ferro chromium - Analysis of the constituents – Cr, C, Si.

Unit – II :Analysis of Soil, Fertilizer and Fuel:(a) Analysis of soils: sampling, determination of moisture, total N, P, Si, lime, humus nitrogen,alkali salts, soil absorption ratio.(b) Analysis of fertilizers: ammonical fertilizers, Phosphate fertilizers, Nitrate fertilizers.(c) Analysis of fuels: solid fuels-coal, proximate analysis, ultimate analysis, heating value,grading of coal based on Ultimate Heat Value(UHV).

Unit- III Kinetic Methods of Analysis & Non aqueous Titrimetry: (a) Kinetic methods of analysis:introduction, slow reactions, catalysed reactions, methods of determination of catalyst concentration, extrapolation method for the determination ofcatalyst, variable time method, fixed time method, examples for the determination of toxicmetals and anions using some typical kinetic reactions.(b)Non aqueous titrimetry :Classification of solvents and titrations for non-aqueoustitrimetry-Types of reactions - Indicators .(i) Determination of acids(ii) Determination of bases(iii) Karl-Fisher reagent for the determination of moisture content in drugs and othersamples.

UNIT- IVAnalysis of Milk and milk products:Acidity, total solids, fat, total nitrogen, proteo amines,lactose, phosphate activity, casein, chlorideAnalysis of food materials- Preservatives: Sodium carbonate, sodium benzoate sorbic acid, Flavoring agents - Vanilla, diacetyl, isoamyl acetate, limonene, ethylpropionate,allyl hexanoate andAdulterants in rice and wheat, wheat floor, coffee powder, tea powder, milk.

UNIT-V: Clinical analysis of blood:Composition of blood,clinical analysis,trace elements in the body.Estimation of bloodcholesterol,glucose,enzymes,RBC & WBC ,Blood gas analyser

Course outcomes: Students will have through knowledge and skill in analysis and analytical aspects .

Text books

1. Chemical analysis – H.A Laitinan, McGraw Hill Book Co
2. Standard methods of Chemical Analysis, Welcher
2. Technical Methods of Analysis, Griffin, McGraw Hill
3. Commercial Methods of Analysis, Foster Dee Sneel and Frank M. Griffin, McGraw Hill Book Co.
- 4.H.Wincciam and Bobbles (Henry J)- Instrumental methods of analysis of food additives.,
- 5.H.Edward-The Chemical analysis of foods;practical treatise on the examination of food stuffs and the detectionof adulterants,
- 6.Comprehensive medicinal chemistry-Ed Corwin Hansch Vol 5,Pergamon Press.

KRISHNA UNIVERSITY, MACHILIPATNAM

DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)

IV SEMESTER

PAPER CODE & TITLE: ACH 404: SPECTROSCOPIC METHODS

No. of hours per week: 04

Total credits: 04

Total marks: 100

(Internal: 30 M & External: 70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on mass spectrometry, GC-MS and LC-MS, advanced magnetic Resonance spectroscopy, ^{13}C -NMR and combined spectral problems.

UNIT-I :Mass Spectrometry: Basic principle-instrumentation-Isotopic abundance- molecular ion-isotopic peaks- base peak- multicharged ions-RetroDielsAlderFragmentation-Mass spectral fragmentation modes, Mass spectral fragmentation of typical compounds with respect of their structure determination of metal carbonyls, heteroaromatic compounds, nitrogen and sulfur compounds.

UNIT-II GC-MS and LC-MS techniques
GC-MS: Introduction, Instrumentation - GC - MS interface - Mass spectrometer (MS), ion chromatogram, application of GC-MS for trace constituents, drugs analysis, environmental analysis and others.
LC-MS: Introduction, Instrumentation, liquid chromatography-Mass spectrometer, ion chromatograms, Application of LC-MS for drug analysis, environmental samples and others.

UNIT-III Advanced Magnetic Resonance Spectroscopy: High resolution NMR, Spin system, Nomenclature of spin system, spin system of simple and complex PMR spectrum (Study of $A_2 - AB - AX - AB_2, AX_2, ABX - ABC - AMX$ interactions). Fourier Transform (FT) - NMR, NMR of other nuclei (^{19}F and ^{31}P).

UNIT-IV ^{13}C -NMR Spectroscopy: Differences between PMR and CMR, Chemical shift and factor effecting Chemical shift in CMR, NMR shift reagents, double resonance, Off resonance, Broad band decoupling, Nuclear Overhauser Effect (NOE).

UNIT-V Structural elucidation of organic compounds Using UV, IR, ^1H -NMR, ^{13}C -NMR and Mass spectrometry.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge on mass spectrometry, GC-MS and LC-MS, advanced magnetic Resonance spectroscopy, ^{13}C NMR and combined spectral problems.

Referene books:

1. Separation methods, M.N Sastri, Himalaya Publishing Company, Mumbai.
2. Chemical separation methods, John A Dean, Von Nostrand Reinhold, New York.
3. Vogel's Text Book of Inorganic Quantitative Analysis – J. Bassett et al, ELBS.
4. Analytical Chemistry, An Introduction, D.A. Skoog, D.M West and F.J Holler, Sanders College Publishing, New York.
5. Introduction to Spectroscopy by D. L. Pavia, G.M. Lampman, G. S. Kriz, 3rd Ed. (Harcourt college publishers).
6. Spectrometric identification of organic compounds R.M. Silverstein, F.X. Webster, 6th Ed. John Wiley and Sons.
7. Spectroscopic methods in organic chemistry - D.H. Williams and I Fleming McGraw Hill.

KRISHNA UNIVERSITY, MACHILIPATNAM

DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)

IV SEMESTER

PAPER CODE & TITLE: ACH 405:Nuclear and Photo Chemistry

No. of hours perweek:04

Total credits:04

Totalmarks:100

(Internal: 30 M & External:70M)

Course objective: This course will impart basic knowledge on photochemistry, nuclear reactions, nuclear reactors, activation analysis and Inorganic photochemistry.

UNIT-I :Photochemistry.: Nuclear transition and activity , Orbital electron capture: nuclear isomerism, internal conversion, detection and determination of activity by cloud chamber, nuclear emulsion, bubble chamber, G.M., Scintillation and Cherenkov counters.

UNIT-II :Nuclear reactions:Nuclear fission and fusion reactions as energy sources: direct reactions, photonuclear and thermo nuclear reactions

UNIT-III: Nuclear reactors :Components of nuclear reactors – the breeder reactor – nuclear reactors in India.

UNIT-IV: ActivationAnalyses :Applications of tracer in study of reaction mechanism and in analytical chemistry –neutron activation analysis – isotope dilution analysis –Carbon dating-radioactive tracer in the diagnosis and treatment in field of medicine.

UNIT-V: Inorganic photochemistry : Photo redox reactions and photo substitution reactions in coordination chemistry -photovoltaic and photo galvanic cells. Photo electro chemistry, Aspects of solar energy conversion.

Course Outcomes: This course gives basic knowledge on photochemistry, Nuclear reactors , Nuclear reactions, activation analysis and inorganic photochemistry.

Reference Books:

1. H.J. Arnikaar, Nuclear Chemistry, Wiley Eastern Co. II Edition, 1987.
2. N.N. Greenwood and Earnshaw, Chemistry of the Elements,Pergamon Press NewYork, 198

KRISHNA UNIVERSITY, MACHILIPATNAM –

521003

DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)

IV SEMESTER

PAPER CODE & TITLE: ACH 406 FOOD CHEMISTRY

No. of hours per week:04

Total credits:04

Total marks:100

(Internal: 30 M & External:70M)

Course objectives: This course is designed to impart knowledge on food chemistry, constituents of foods, proteins, amino acids, minerals, vitamins, food additives, pesticides control, food adulteration.

UNIT-I: Introduction :Source, functions of food – food groups – food guide – basic five food groups, usage of the food guide – food in relation to health – objectives of cooking. Water: Purification processes – Ion exchangers, reverse osmosis, activated charcoal treatment - Use of chlorination, ozone, and UV light disinfection. Specification of drinking water.

UNIT-II: Constituents of Foods:Carbohydrates: Classification, Principles involved in the analysis of carbohydrates – estimation of carbohydrates. Proteins: amino acids – peptides - Analysis of proteins – Separation of amino acids by paper chromatography. Minerals and vitamins: Sources, functions, deficiency of the following minerals (calcium, iron, iodine, fluorine, sodium and potassium (elementary treatment). Vitamins -classification, sources, Vitamins – A, D, E and K, C, B Complex - B6 & B12.

UNIT-III: Food Additives:Artificial sweeteners – saccharin, cyclamate, aspartame – food flavours – esters, aldehydes and heterocyclic compounds. Antioxidants. Food colours – Spurious colours. Emulsifying agents, preservatives – leavening agents. Baking powder–Yeast. Taste enhancers – MSG-vinegar.

UNIT-IV: Pesticides Control:Spoilage of foods by insects and pests, loss in food quantity and quality Various pesticides used in agriculture and post-harvest storage, uses of pesticides for food grain application.

UNIT-V: Food Adulteration:Common adulterants in different foods – milk and milk products, vegetable oils, and fats,spices and condiments, cereals, pulses, sweetening agents and beverages. Contamination withtoxic chemicals – pesticides and insecticides.

Course Outcomes: Students having this course will have complete knowledge on food adulteration, pesticide control which are very important to serve the society.

Reference Books:

1. Owen R Fennema, "Food Chemistry", Marcel Decker Inc., New York. 1996.
2. M. Swaminathan "Text Book on Food chemistry", Printing and Publishing CO., Ltd.1993.
3. B. Siva Sankar, "Food Processing and Preservatio", Prentice – Hall of India Pvt. Ltd., New Delhi. 2002.
4. S. Ramakrishnan, K. G. Prasannam, R. Rajan, "Principles - Text book of medical biochemistry", Orient Longman Ltd. Third Edition, 2001.

KRISHNA UNIVERSITY, MACHILIPATNAM
DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
IV SEMESTER

PAPER CODE & TITLE: ACH 407DRUG CHEMISTRY

No. of hours perweek:04

Total credits:04

Totalmarks:100

(Internal: 30 M &

External:70M)

Course Objectives: This course is to impart basic knowledge on drug chemistry which include classification of drugs, Antibiotics, enzymes, vitamins and phase transfer catalysis.

UNIT-I :Classification of drugs:Classification of drugs, general and local anaesthetics, Sedatives and hypnotics. Narcotics and analgesics.

UNIT-IIAntibiotics:Antibiotics – structure and analysis; Chloromphenicol, pencillins and streptomycine, tetracyclines

UNIT-III :Enzyme and related concepts: Enzymes, co-enzymes, theory. Michaelis-Menten's equation and verification by graphical methods-Eadieplot and Lineweaver-Burk plot. Enzyme catalysis, Enzyme specificity, Enzyme mechanism. Enzyme Inhibition- Competitive inhibition, Uncompetitive inhibition and Non-competitive inhibition.

UNIT-IVPhase transfer catalysis:Phase transfer catalysis, ionic liquids. Miscellaneous catalysis. Use of crown ethers.

UNIT-VVitamins: Introduction , water soluble and fat soluble vitamins. Details of vitamin A, C, B1, B2,B6,B12 and their analysis.

Course outcomes: This course will be useful for the students to learn classification of Drugs, preparation and utility of antibiotics, vitamins.

Text Books:

1. William Foye, Medicinal Chemistry, 4th Edition, 1995.
2. Wilson & Gisvold, Medicinal Chemistry, 10th Edition, 1998.
3. Burger, Medicinal Chemistry, 5th Edition, 199

**KRISHNA UNIVERSITY, MACHILIPATNAM -
521003 DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)**

IV SEMESTER

**PAPER CODE & TITLE: ACH 408 :INSTRUMENTAL AND
SPECTRALMETHODS OF ANALYSIS PRACTICAL**

No. of hours per week:06

Total credits:03

Total marks:100

(Internal: 30 M & External:70M)

Course Learning Objective(S): The main objective of this paper is to give a basic and updated knowledge for the students on instrumental methods of analysis practical.

1. pH-metric determination of strong acid + Weak acid with strong base.
2. pH-metric determination of strong base + weak base with strong acid.
3. Determination of alkalinity in industrial samples using pH metric method.
4. Assay of commercial acids by pH metric titration.
5. Potentiometric determination of mixture of Mn(VII)+V(V) with Fe(II).
6. Potentiometric determination of mixture of Ce(IV)+V(V) with Fe(II).
7. Spectrophotometric determination of Fe(III) with KSCN.
8. Spectrophotometric determination of nitrite with NEDA.
9. Spectrophotometric determination of phosphate with ammonium molybdate.
10. Determination of Na, K, and Li by flame photometry.

Course Outcomes: Student will have practical skills in handling instrumental techniques and will have hands on experience in analysis.

Reference books:

1. Vogel's Text Book of Quantitative analysis, revised. J. Bassett, R.C. Denny, G.H. Jeffery and J. Mendham, ELBS.
2. Practical Inorganic Chemistry by K. Somasekhara Rao and K.N.K. Vani. Kalyani publishers.

Department of Chemistry
M.Sc., ANALYTICAL CHEMISTRY IV SEMESTER
ACH 409-DRUG DESIGN AND DRUG CHEMISTRY

No. of hours per week: 04
Total marks: 100
External: 70M)

Total credits: 04
(Internal: 30 M &

Course objectives: This course will impart knowledge on drug classification, antineoplastic agents, cardiovascular drugs, oral hypoglycaemic drugs, anti-infective and antiviral drugs.

UNIT I: Introduction to Drugs :

General Classification, nomenclature, drug metabolism. Development of drugs: Procedure followed in drug design, concepts of lead compound lead modification, concept of prodrugs, Structure Activity Relationship (SAR)-factors affecting bio-activity-resonance, inductive effect, isosterism, bio-isosterism, spatial considerations, Quantitative Structure Activity Relationships (QSAR)-Concepts of drug receptors. Elementary treatment of drug receptor interactions. Physico-chemical parameters: lipophilicity, partition coefficient, electronic ionization constants, steric, Shelton and surface activity parameters and redox potentials.

UNIT II: Antineoplastic Agents:

Introduction, classification-alkylating agents- mechanism and mode of action, nitrogen mustards-synthesis, properties, uses and dosage - Chlorambucil, cyclophosphamide and melphalan. Antimetabolites- synthesis, properties, uses and dosage-pyrimidine analogues-5-fluorouracil, purine analogues-6-mercaptopurine, folic acid analogues-Methotrexate. Antibiotics-structure, properties and dosage-Doxorubicin, Mitomycin.

UNIT III: Cardiovascular Drugs:

Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output. Direct acting arteriolar dilators. Synthesis of amyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolol, oxyprenolol.

UNIT IV: Oral Hypoglycemic Drugs:

Introduction, Classification, Sulphonylureas- synthesis, mode of action, properties, uses and dosage- tolbutamide, glipizide. Biguanides- synthesis, mode of action, properties, uses and dosage-Metformin. α -glucosidase inhibitors-synthesis, mode of action, properties, uses and dosage- Miglitol. Dipeptidyl Peptidase-4 (DPP-4) inhibitors- synthesis, mode of action, properties, uses and dosage-saxagliptin and sitagliptin

UNIT V: Local Anti-infective & Antiviral drugs

Local Anti-infective Drugs: Introduction and general mode of action. Synthesis of sulphonamides, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, isoniazid, fluconazole, econazole and chloroquin. Antiviral Drugs: Introduction, classification based on mechanism of action, Nucleoside or Nucleotide Reverse Transcriptase Inhibitors (NRTIs)-Synthesis, metabolism, properties and uses and dosage-Acyclovir, Zidovudine (Anti-HIV agent). Non-Nucleoside or Nucleotide Reverse Transcriptase Inhibitors (NNRTIs)-Synthesis, metabolism, properties and uses and dosage-Nevirapine, Efavirenz. Protease Inhibitors (PIs)-Synthesis, metabolism, properties and uses and dosage-Indinavir. CCR5-Inhibitors- Synthesis, metabolism, properties and uses and dosage-Maraviroc

Course outcomes: Students will have knowledge on antineoplastic agents, cardiovascular

drugs, oral hypoglycaemic drugs , anti infective and antiviral drugs.

TextBooks:

1. Textbookofmedicinalchemistry,Volume1& II,Thirdedition by V Alagarsamy, CBS-publishers
2. IntroductiontoMedicinalChemistry,AGranguage,Wiley-VCH.
3. WilsonandGisvold'sTextBookofOrganicMedicinalandPharmaceutical Chemistry,Ed Robert F. Dorge.
4. AnIntroductiontoDrugDesign,S.S.PandeyaandJ.R.Dimmock,NewAge International.
5. Burger'sMedicinalChemistryandDrugDiscovery,Vol-1(Chapter.-9andCh-14), Ed. M. E. Wolff, John Wiley.
6. GoodmanandGilman'sPharmacologicalBasisofTherapeutics,McGraw-Hill.
7. The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press.
8. StrategiesforOrganicDrugSynthesisandDesign,D.Lednicer,JohnWiley.

KRISHNA UNIVERSITY, MACHILIPATNAM - 521003
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY (ANALYTICAL CHEMISTRY)
IV SEMESTER

PAPER CODE & TITLE: ACH 410 ENERGY, ENVIRONMENT AND SOIL CHEMISTRY

No. of hours per week: 04

Total marks: 100

External: 70M

Total credits: 04

(Internal: 30 M &

Course objectives: This course will impart knowledge on sources of energy, Environment and soil Chemistry.

UNIT-I Sources of Energy : Fossil fuels- Nuclear fission and fusion- Solar energy-use of solar energy in space heating and water heating- production of electricity using solar energy- solar trough collectors- power tower- solar pond- solar energy for driving vehicles- power from indirect solar energy – Hydropower- wind power- Biomass energy-production of ethanol from biomass- production of methane from biomass- photosynthesis- photo electrochemistry- Geothermal energy.

UNIT-II Water Resources Hydrological cycle- physical and chemical properties of water- complexation in natural and waste water, Anomalous properties-water pollutants-Types- Sources- Heavy metals- metalloids- organic –Inorganic –Biological and Radioactive-Types of reactions in various water bodies including marine environment-Eutrophication- Ground water- Potable water standards. Treatment for portable water.

UNIT-III Air: Chemical reactions in the atmosphere – Aerosols types- Production and distribution – Aerosols and Radiation – structure and composition of atmosphere- temperature inversion – Global warming- Ozone depletion– Green house effect, “CFC”s- Acid rain.

UNIT-IV Soil : Composition of soil- lithosphere- inorganic and organic contaminants in the soil- Biodegradation-Nondegradable waste and its effect on the environment- Bioremediation –of surface soils- Fate and transport of contaminants on soil system– Bioindicators- Soil parameters- soil destruction- Erosion- Soil conservation –Nitrogen pathways and NPK in soil .

UNIT-V Soil pollution: Introduction – soil pollution by industrial wastes. soil pollution by urban wastes, Radioactive pollutants and Agricultural waste- chemical and metallic pollutants- Biological agents – mining - Detrimental effects of soil pollutants – Effects of industrial pollutants- Effects of sewage and domestic wastes- Effects of heavy metals-Effects of radioactive pollutants- Effects of modern agro- technology – Diseases caused by soil pollution – solid waste management – sources and classification -public Health Aspects – methods of collection- Disposal methods – potential methods of disposal.

Course outcomes: Students opting this paper will acquire through knowledge on sources of energy, Environment and soil Chemistry.

Reference Books:

1. Daniel D. Chiras (1994), Environmental Science, 4th Ed.
2. Environmental Chemistry by W. Moore and J. Moore
3. Environmental chemistry by J.O.M. Bockariss
4. Environmental by BK Sharma
5. Environmental chemistry by SS Dara
6. Environmental chemistry by Mahajan

Department of Chemistry

M.Sc., ANALYTICAL CHEMISTRY IV SEMESTER

ACH 411- Catalysis

No. of hours per week: 04

Total marks: 100

External: 70M)

Total credits: 04

(Internal: 30 M &

Course objectives: This course will impart knowledge on catalysis and advance level of catalysis, recent development of catalytic reagents and their applications.

Unit 1 :Introduction to Catalysis: types of catalysis , terminologies, used in catalysis (TON, TOF, Precatalysts, induction time, resting state, catalytic loop)., distinguish homogeneous and heterogeneous catalysis.

Unit II: Ligand Substitution Reactions, Oxidative Addition [1. Concerted Mechanism], Oxidative Addition [2. SN₂ Mechanism], Oxidative Addition [3. Radical Mechanism], Reductive Elimination, Insertion, elimination and transmetalation

Unit III : Metal mediated organic synthesis : oxidative couplings using iron, copper, cobalt, ruthenium. Hydrogenation of Alkenes, Hydrosilylation reaction, Hydroformylation reaction, Alkene dimerization, Alkene polymerization, Monsanto acetic acid process, Wacker process, I: Metal complexes mediated organic synthesis, Metathesis of olefins and alkynes , Buchwald-Hartwig coupling reaction , Kulinkovich Reaction and its mechanism, Pauson-Khand.

Unit IV Organo catalysis: Proline , chinchona alkaloids, thiourea catalyzed reactions

Unit V: Enzymes as catalysts: lock and key mechanism, yeast as catalyst, protolytic enzymes , prototypic enzymes, lipases as catalysts. Trans amylases as catalysts.

Course outcomes: Students opting this course will have thorough knowledge of catalysis and catalytic reactions.

Reference books:

1. Organo transition metal chemistry by Crabtree
2. Organometallic Chemistry – R C Mehrotra and A Singh, New Age Publications
3. Inorganic Chemistry- Principles of Structure and Reactivity, James E Huheey, Ellen A. Keiter, Richard L. Keiter, Pearson Education
4. Advanced Inorganic Chemistry- F A Cotton, G Wilkinson, Carlos A. Murillo, Manfred Bochman- John Wiley and Sons.
5. Inorganic Chemistry – Allan G Sharpe, Addison Wesley
6. Organic Synthesis – Michael B. Smith (2nd Edition – McGraw Hill
7. Name Reactions – Jie Jack Li – (2nd Edition – Springer)
8. Organic Chemistry – Clayden, Greeves, Warren and Wothers (Oxford University Press)
9. Advanced Organic Chemistry – Francis A. Carey and Richard J. Sundberg – Part B – Reactions and Synthesis. Kluwer Academic / Plenum Publishers.
10. Advanced Organic Chemistry – Francis A. Carey and Richard J. Sundberg – Part A – Structure and Mechanisms – Kluwer Academic / Plenum Publishers.