Master of Science in Chemistry
(Analytical Chemistry)

Regulations 2020

For students admitted from academic year 2020-21 onwards
Under Choice Based Credit System

Department of Chemistry
Krishna University
Machilipatnam – 521 003
Andhra Pradesh

VISION

- To impart knowledge in the basic and advanced chemistry useful for the academics, industry and research.
- To Establish industry academia relations
- To establish multi-institutional, interdisciplinary and international collaborations in thrust areas of scientific research so as to acquire national and international recognition.
- To develop advanced characterization facilities for cutting edge research with a roadmap towards the establishment of Centre for multifunctional nano-crystalline materials.
- To thrive for transformation of laboratory research towards industrial scale so as to acquire support from the industry.

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 society.
- Attraction of grants from national and international funding agencies for scientific research in thrust areas.

PROGRAMME OBJECTIVES

- Develop the basic concepts in core areas of chemistry, in particular, synthesis, characterization and analysis along with experimental skills.
- Develop the critical and creative analysis and problem-solving skills of students
- Undertake small academic and/or research projects in the area of synthesis / analysis 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.
- To prepare self-motivated human resources towards the innovations.
- 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.

Course structure and syllabus for M.Sc., Analytical Chemistry(Regulation: R2020)

1	Title of the Course	M.Sc., (Analytical Chemistry)
2	Duration of the course	2 years (Four Semesters)
3	Eligibility criteria for admission	The candidate seeking admission in to M.Sc., (Analytical 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.
6	Objectives of the course	The Objective of M.Sc., Chemistry course is to impart knowledge and skill-oriented training in the recent advancements in chemistry with an aim to develop research and innovations.
7	Course Requirement	The course shall include Theory papers, Labs, Assignments, Tests, Seminars and Project Work.
8	Number of working days	In each semester at least ninety working days must be dedicated for theory classes, practical classes and seminars.

COURSE STRUCTURE

Semester – I

Course Code / Year/sub/paper	Name of the Course	Hours			Credits	
		L	T	P	Theory	Practicals
20 ACH 101	General Chemistry	4	-	-	4	-
20 ACH 102	Organic Chemistry -I	4	-	-	4	-
20 ACH 103	Inorganic Chemistry -I	4	-	-	4	-
20 ACH104	Physical Chemistry -I	4	-	-	4	-
20 ACH 105	Organic Chemistry Practical-I	-	-	8	-	4
20 ACH 106	Inorganic Chemistry Practical	-	-	8	-	4
	Sub-Total	**16**	**-**	**16**	**16**	**8**
	Total	**32 hours per week**			**24 Credits per semester**	

L - Lecture, T- Tutorial & P – Practicals

Semester – II

Course Code / Year/sub/paper	Name of the Course	Hours			Credits	
		L	T	P	Theory	Practicals
20 ACH 201	Organic Spectroscopy	4	-	-	4	-
20 ACH 202	Organic Chemistry – II	4	-	-	4	-
20 ACH 203	Inorganic Chemistry -II	4	-	-	4	-
20 ACH 204	Physical Chemistry -II	4	-	-	4	-
20 ACH 205	Organic Chemistry Practical-II	-	-	8	-	4
20 ACH 206	Physical Chemistry Practical	-	-	8	-	4
20 OEACH 207	Chemistry in Daily Life (Open Elective -I)	4	-	-	4	
	Sub-Total	**20**	**-**	**16**	**20**	**8**
	Total	**36 hours per week**			**28 Credits per semester**	

Open electives offered to the other departments

Course code	Name of the Course	Semester	Credits
20 OE ACH 207	Chemistry in Daily Life	II	4

upload into KKU Website

- **Total number of credits at the end of course:**

S.No	Semester	Credits
1	I Semester	24
2	II Semester	28
3	III Semester	28
4	IV Semester	28
	TOTAL	**108**

Note: * Open Elective/None-core 8 credits will not be considered for division / percentage.

- **Evaluation**

I Semester **Marks**
1. Four theory papers 4X100 =400
2. Title of the paper(s)Practical-1=100
3. Title of the paper(s)Practical-2 =100

Total = 600 M

II Semester **Marks**
1. Four theory papers 4X100 = 400
2. Title of the paper(s)Practical-1 = 100
3. Title of the paper(s)Practical-2 = 100

Total = 600 M

III Semester **Marks**
1. Four theory papers 4X100 = 400
2. Title of the paper(s)Practical-1 = 100
3. Title of the paper(s)Practical-2 = 100

Total = 600 M

IV Semester **Marks**
1. Four theory papers 4X100 = 400
2. Title of the paper(s) Total = 600M
3. Project work = 200

Grand total Marks = 600+600+600+600= **2400**
1. Open Elective / Non-core I of student choice from other departments 100M
2. Open Elective / Non-core II of student choice from other departments 100M

Total = 200M

Note: Open Elective/Non-core 200 marks will not be considered for division / percentage. The total marks will be 2500 only.

- **Procedure to evaluate midterm examinations:**
- **Theory:**

Midterm Examinations – I & II	30 marks

Note: Final mid semester marks shall be arrived at by considering the marks Secured by the student i.e., average of the two mid examinations.

For Example:

Marks obtained in first mid: 30
Marks obtained in second mid: 30
Final mid semester Marks: (30+30) = 60/2= 30

Practical:

*Continuous assessment / Day to Day Work	Semester End Exam	Total
30 marks	70 marks	100M

*****Continuous assessment sheet given below.

Note: For practical courses, there shall be a continuous evaluation during the semester for 30 marks and end examination shall be for 70 marks. Day-to-day work in the laboratory shall be evaluated for 30 marks by the concerned laboratory teacher based on the regularity/record/viva. The end examination shall be conducted by the concerned laboratory teacher and external examiner in the subject from other university.

- Internal marks will be awarded by internal examiner only.

Template

Krishna University, Machilipatnam – 521003

Department of Chemistry

Day to day evaluation sheet / Continuous Evaluation of Practical's

Course: M.Sc., (AnalyticalChemistry)

Programme: Analytical Chemistry

Academic Year: 2020-21

Subject with Code: Semester: I/II/III/IV

Subject Title:

		Experiment & Marks										Total Marks (30)	Final Marks (30M)
Student Roll. No	**Student Name**	**1 (3M)**	**2 (3M)**	3 **(3M)**	4 **(3M)**	**5 (3M)**	**6 (3M)**	**7 (3M)**	**8 (3M)**	**9 (3M)**	**10 (3M)**		

- each experiment carries equal marks and Number of experiments varies from subject to subject. Each experiment carries 3M.
- **Note: If the final marks are in fraction, it shall be rounded off to the next number.**

Faculty/Lab In charge Signature with date

- **PROJECT:**

Project midterm review	50 marks
Project evaluation	100 marks
Project Viva	50 Marks

- **Procedure for Conduct and Evaluation of Project Midterm review:**

- **Procedure for Conduct and Evaluation of Project:**

After selecting the specific project topic, the student shall collect the information and prepare an abstract, showing his/her understanding of the proposed project topic as a summary and submit the same to the department before implementation of the project in the beginning of the IV Semester. The status of the project work will be reviewed and the presentation shall be evaluated by the departmental committee consisting of Head of the Department, Project supervisor and a senior faculty member after two months of the project. It shall be evaluated for 50 marks. A student shall acquire 2 credits assigned to the Project midterm review, when he/she secures 40% or more marks for the total of 50 marks. There shall be no external evaluation for Project midterm review.

In case, if a student fails in Project midterm review, a re-review shall be conducted within a month. In case if he/she fails in the re-review also, he/she shall not be permitted for Project Evaluation. Further, such students shall reappear as and when IV semester regular examinations are conducted.

Procedure for Conduct and Evaluation of Project Evaluation:

Out of a total of 200 marks, 50 marks for **Project Review** and for the **Project Evaluation**, 100 marks shall be for Project report/thesis/record and 50 marks for the End Semester Examination (Viva-voce). The Viva- Voce shall be conducted by a committee consisting of HOD, Project Supervisor and an Examiner nominated by the University.

Summary of Course Structure:

Semester – I

S.No	Paper No.	Title of the paper	Paper Code	Internal Marks	External Marks	Total Marks
1.	Paper-I	General Chemistry	20 ACH 101	30	70	100
2.	Paper-II	Organic Chemistry -I	20 ACH 102	30	70	100
3.	Paper-III	Inorganic Chemistry -I	20 ACH 103	30	70	100
4.	Paper-IV	Physical Chemistry -I	20 ACH 104	30	70	100
5.	Practical-I	Organic Chemistry Practical-I	20 ACH 105	30	70	100
6.	Practical-II	Inorganic Chemistry Practical	20 ACH 106	30	70	100

Semester – II

S.No	Paper No.	Title of the paper	Paper Code	Internal Marks	External Marks	Total Marks
1.	Paper-I	Organic Spectroscopy	20 ACH 201	30	70	100
2.	Paper-II	Organic Chemistry –II	20 ACH 202	30	70	100
3.	Paper-III	Inorganic Chemistry -II	20 ACH 203	30	70	100
4.	Paper-IV	Physical Chemistry -II	20 ACH 204	30	70	100
5.	Practical -I	Organic Chemistry Practical-II	20 ACH 205	30	70	100
6.	Practical-II	Physical Chemistry Practical	20 ACH 206	30	70	100
7	Open Elective-1	Chemistry in Daily Life	20 OEACH 207	30	70	100

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DEPARTMENT OF CHEMISTRY
M.Sc – CHEMISTRY (ANALYTICALCHEMISTRY)
I SEMESTER

Paper Code & Title: 20 ACH101: GENERAL CHEMISTRY-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 knowledge for students on Titrimetric Analysis, Treatmentofanalyticaldata, Adsorption, Partition, Gas Chromatography andHigh-PerformanceLiquidChromatography.

Unit-I: Titrimetric Analysis: Classificationofreactionsin titrimetric analysis-Primary andsecondarystandards- NeutralizationTitrations-Theory ofneutralizationindicators-Mixedindicators-Neutralisationcurves- Displacementtitrations. Precipitationtitrations-Indicatorsforprecipitationtitrations-Volhard'smethod-Mohr'smethod- Theoryofadsorptionindicators-Oxidationreductiontitrations-Changeofelectrode potentials during titrationofFe (II) withCe(IV)-Detectionofendpointin redoxtitrations-Complexometric titrations.

Unit-II: Treatmentofanalyticaldata: Accuracy andprecision-Classificationoferrors-DeterminateandIndeterminateerrors- Minimization of errors-Absolute andRelativeerrors, propagation of errors-Distribution of Indeterminateerrors-Gaussian distribution-Measuresofcentral tendency-Measuresofprecision-Standard deviation-Standarderrorofmean-student'st- test-Confidenceintervalof mean-Testingforsignificance-Comparison of twomeans-F-test-Criteriaof rejection of an observation-Significantfigures andcomputationrules.

Unit-III:Methodsof purification:1. Distillation: Basicprinciples, Distillationtypes-continuousdistillation,batchdistillation,fractional distillation, vacuum distillation and steam distillation. Industrial applications; **2.DryingTechniques**:DryingofHexane,Benzene,Toluene,Xylene,Tetrahydrofuran,DMF,DMSO, Methanol,Ethanol,Diethylether and Dioxane**;3. Solvent extraction:** Basic principles, Different types of extraction. Selection of solvents. Avoiding emulsion formation. Basic concepts on Soxhlet extraction.Industrial applications**;4. Recrystallization**:Basicprinciples,choiceofsolvent,seeding,filtrationandcentrifugationanddrying. Industrialapplications. Concepts of fractional crystallization.

Unit-IV: Adsorption andPartitionChromatography: Introductiontochromatography,DifferenttypesofChromatography:**Adsorptionchromatograph:** adsorbents,solvents,solutes,apparatus;
ColumnChromatography:stationaryphase,Mobilephase,packing of column, advantages and disadvantages.**Paperchromatography:**BasicPrinciples. Ascending anddescending types.Selectionofmobilephase,
Developmentofchromatograms,Visualizationmethods.Applicationofpaperchromatography inthe identification ofsugars and amino acids. One- and two-dimensionalpaper chromatography;

ThinLayerchromatography: BasicPrinciples.Commonstationary phases,MethodsofpreparingTLC plates,Developmentof TLCplates,Visualizationmethods, $R_f$value. Application of TLC in monitoringorganicreactions. identification and quantitative analysis.

Unit-V: Gas Chromatography andHigh-PerformanceLiquidChromatography:Gaschromatography: Basic Principles.Differenttypes of GCtechniques.Selectionof columnsandcarrier gases. Instrumentation.detectors; RTvalues.Applicationsinthe separation,identificationandquantitative analysisof organiccompounds; **HighPerformance liquidchromatography (HPLC):**Basic Principles.Normalandreversed Phases. Selection ofcolumn andmobile phase. Instrumentation. detectors; RT values. Applications inthe separation,identificationandquantitativeestimationoforganiccompounds. ConceptsonHPLCmethod development.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Titrimetric Analysis, Treatmentofanalyticaldata, Adsorption, Partition, Gas Chromatography andHigh-PerformanceLiquidChromatography.

Text books/ Reference books:

1. Vogel's text book of quantitative analysis. Addition Wesley Longmann 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. Helftnan, 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 Prakasan, Meerut.
10. Protein Purification-Principles and practice, III Edn- R. K. Scopes, Narosa Publishing House, Delhi.

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DEPARTMENT OF CHEMISTRY

M.Sc – CHEMISTRY (ANALYTICALCHEMISTRY)

I SEMESTER

Paper Code & Title: 20 ACH102: ORGANIC CHEMISTRY-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 for students on Nature ofbonding, Aromaticity and organic reaction mechanism.

Unit-I: Nature ofbonding and Aromaticity:Nature ofbonding: Inductive effect, Mesomeric effect (Resonance), localized and delocalized covalent bonds, conjugation, cross conjugation, Hyperconjugation, Stericeffect,Tautomerism and their applications.**Aromaticity:** Aromaticity in benzenoidnon-benzenoid compounds,Benzene,Cyclobutadiene, Tropyllium cation, 1,3,5,7-Cyclooctatetraene,aromaticity of Hetero-aromatic Systems,Annulenes:[10]Annulenes-[12], [14],[16]and[18]annulenes,azulenes,anti- aromaticity andhomo-aromaticity.

Unit-II: Reactiveintermediates &ReactiveSpecies:Reactiveintermediates: Generation, Structure,Stability,DetectionandReactivity ofCarbocations,Carbanions,Free radicals,Carbenes,NitrenesandArynes.
ReactiveSpecies: GenerationandreactivityofElectrophiles,Nucleophiles,Dienophiles, Ylids, Enophiles.

Unit-III: AdditionReactions: Mechanisticandstereochemicalaspectsofadditionreactionsinvolving electrophiles,nucleophilesandfreeradicals,regioandchemoselectivity,orientationandreactivity,Hydrogenationof double andtriplebonds,hydrogenation ofaromatic rings,Hydroboration.

Unit-IV: EliminationReactions: Typeofeliminationreactions,mechanisms,Stereochemistry andOrientation,Hofmannand Saytzeff rules,Syneliminationversusanti-elimination,competition betweeneliminationandsubstitution, dehydration, dehydrogenation,dehalogenation,decarboxylative eliminations andpyrolytic eliminations**.**

Unit-V: Substitution Reactions: Aliphatic Nucleophilic Substitution Reactions: The S_N2, S_N1,mixed $S_N1$and S_N2 reactions and their mechanisms,NeighboringGroupParticipation by NGPby O,S,N, sigma and pi bonds, Anchimericassistance. **Aromatic Nucleophilic substitution Reactions:** S_N2(Ar)(Addition–Elimination),S_N1(Ar)andbenzynemechanisms(Elimination-Addition);evidencefor the structureofbenzyne.VonRichter, Sommelet-Hauserrearrangements.

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

Text books / Reference books:

1. Advanced organic chemistry- Reaction, mechanism and structure, Jerry March, John Wiley.
2. Advanced organic chemistry, F.A. Carey and R.J. Sundberg, Springer, New York.
3. A guide book to Mechanism in organic chemistry, Peter Sykes, Longman.
4. Organic chemistry, I.L. Finar, Vol. I, Fifth ed. ELBS.
5. Organic chemistry, Hendrickson, Cram and Hammond (McGraw – Hill).
6. Modern organic Reactions, H.O. House, Benjamin.
7. Structure and mechanism in organic chemistry, C.K. Ingold, Cornell University Press.
8. Principles of organic synthesis, R.O.C. Norman and J.M. Coxon, Blakie Academic &Professional.
9. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
10. Basic Principles of Organic Chemistry by J. B. Roberts and M. Caserio.

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

Paper Code & Title: 20 ACH 103: INORGANIC CHEMISTRY-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 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: Introduction to Exact Quantum Mechanical Results: Schrodinger equation, importanceof 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), three-dimensional box, Rigid rotator system and the Hydrogen atom. Variation theorem, linear variation principle, perturbation theory (first order and non-degenerate), Application of variation method to the Hydrogen atom.

Unit-II: Chemistry of non- transition elements: Inter halogen compounds, Halogen oxides andoxyfluorides, 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 andDioxygen complexes.

Unit-III:Structure and Bonding: pπ-dπ bonding, Bent's rule, Non-valence cohesive forces, VSEPR theory.Molecular Orbital theory, Symmetry of Molecular orbitals, Molecular orbitals in triatomic(BeH_2) molecules and ions (NO_2^-) and energy level diagrams. Walsh diagrams for linear (BeH_2) and bent (H_2O) molecules.

Unit-IV: 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. 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 Δo. Experimental evidence for π - bonding in complexes.

Unit-V: 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 - Irwing -William's series. Hard and soft acids and bases (HSAB), Acid-base strengths.

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.

Text books/ Reference books:

1. Inorganic Chemistry Huheey, Harper and Row.
2. Physical methods in inorganic chemistry, R.S. Drago. Affliated East-West Pvt. Ltd.
3. Concise inorganic chemistry, J. D. Lee, ELBS.
4. Modern Inorganic Chemistry,W. L. Jolly, Mc.GrawHill.
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. Introductory quantum Mechanics, A. K. Chandra.
8. Quantum Chemistry, R. K. Prasad.
9. Inorganic Chemistry, Atkins, ELBS**.**
10. Advanced Inorganic Chemistry,Cotton and Wilkinson, Wiley Eastern**.**
11. Text book of Coordination chemistry, K. SomaSekhara Rao and K.N.K. Vani, Kalyani Publishers.

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DEPARTMENT OF CHEMISTRY
M.Sc – CHEMISTRY (ANALYTICALCHEMISTRY)
I SEMESTER

Paper Code & Title: 20 ACH 104: PHYSICAL CHEMISTRY-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 for students onThermodynamics,Surface phenomena and phase equilibria, Electrochemistry, Chemical kinetics and Microwave Spectroscopy and Rotational Vibrational Spectroscopy.

Unit-I: Thermodynamics–I: 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 – Classiuss - 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-II: Surface phenomena and phase equilibria: Surface tension - capillary action – pressuredifference -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 – criticalMicelle concentration (CMC) - factors affecting the CMC of surfactants, Micro emulsions - Reverse micelles.

Unit-III: 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 lawand its verification. Effect of dilution on equivalent conductance of electrolytes - Anomalous behavior of strong electrolytes. Debye Huckel-Onsagar equation- verification and limitations - Bjerrum treatment of electrolytes.

Unit-IV: Chemical kinetics: Methods of deriving rate laws - complex reactions - Rate expressionsfor 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 - Hammet - Taft

equation - Chain reactions - Rate laws of H_2-Br_2, photochemical reaction of H_2 - Cl_2.Decomposition of acetaldehyde and ethane - Rice-Hertzfeld mechanism.

Unit-V: Microwave Spectroscopy and Rotational Vibrational Spectroscopy: Motion of molecules-Degrees of freedom –Energy associates with the degrees of freedom Type of spectra**. Microwave spectroscopy**: Classification molecules, rigid rotator model, effect of isotopicsubstitution on the transition frequencies, Intensities non-rigid rotator-Microwave spectra of polyatomic molecules.**Rotational Vibrational Spectroscopy**: Harmonic oscillator, vibrational energies ofdiatomic molecules, zero-point energy, force constant and bond strengths, anharmonicity Morse potential energy diagram. Vibration – rotation spectroscopy. PQR branches, Born–Openheimer approximation, selection rules, normal modes of vibration group frequencies, overtones, hot bands, applications.

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.

Text books / Reference books:

1. Physical Chemistry P.W. Atkins, ELBS**.**
2. Chemical Kinetics - K.J. Laidler, McGraw Hill Pub.
3. Text Book of Physical Chemistry. Samuel Glasstone, Mcmillan Pub.
4. Physical Chemistry, G.W. Castellan. Narosa Publishing House
5. Thermodynamic for Chemists. Samuel Glasstone.
6. Electrochemistry, Samuel Glasstone, Affiliated East West
7. Physical Chemistry, W.J. Moore, Prentice Hall
8. Atomic structure and chemical bond. Manaschanda. Tata McGraw Hill Company Limited.
9. Fundamentals of Molecular spectroscopy: by C.N. Banwell
10. Molecular spectroscopy by B.K. Sharma
11. Vibrational Spectroscopy by D.N. Satyanarayana New Age Int. Pub.
12. Spectroscopy by Aruldas.

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DEPARTMENT OF CHEMISTRY

M.Sc – CHEMISTRY (ANALYTICALCHEMISTRY)

I SEMESTER

Paper Code & Title: 20 ACH/105:ORGANIC CHEMISTRY PRACTICAL-I

No. of hours per week:04 **Total credits:04**

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

List of experiments:

1. Separation of Binary mixtures of Carboxylic acid + Neutral organic compounds (Solvent extraction method).
2. Separation of Binary mixtures of Basic nature + Neutral organic compounds (Solvent extraction method).
3. Separation of Binary mixtures of Phenolic compounds + Neutral organic compounds (Solvent extraction method).
4. Preparation of Phthalimide from Phthalic anhydride – High Temperature.
5. Preparation of p-nitro acetanilide – Low temperature.
6. Preparation of Iodoform – Room temperature.
7. Column chromatography - separate the given mixture of o-and p-nitro aniline.
8. Paper chromatography - separate the given mixture of sugars or amino acids.
9. Thin layer chromatography - separate the given mixture of phenols or 2,4-DNP derivatives of carbonyls compounds.
10. Preparation of Sodium wire - to make Sodium Wire for solvent drying.
11. Preparation of Sodium Granules.
12. Preparation of Sodium t-butoxide.
13. Preparation of Grignard Reagent and its usage one reaction.
14. Preparation of Wittig reagent.
15. Preparation of Butyl Lithium.

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

Text books/ Reference books:

1. A.I.Vogel,"ATextBookof PracticalOrganicChemistry", Longman

2.A.I.Vogel,"ElementaryPracticalOrganicChemistry", Longman

3. F.G.MannandB.C.Saunders,"Practical OrganicChemistry",Longman

4.ReactionandSynthesisinOrganicLaboratory,B.S.Furniss,A.J.Hannaford, Tatchell,UniversityScienceBooks millsvalley.

5.PurificationofLaboratorychemicals,manual,W.L.F.ArmaregoEDD Perrin

6.ReactionandSynthesisinOrganicChemistryLaboratory,Lutz-Friedjan- Tietze, TheophilEicher,UniversityScienceBook.

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DEPARTMENT OF CHEMISTRY

M.Sc – CHEMISTRY(ANALYTICAL CHEMISTRY)

I SEMESTER

Paper Code & Title: 20 ACH106: INORGANICCHEMISTRY PRACTICAL

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 practical knowledge for students on Inorganicexperiments.

List of experiments:

1. Preparation of Potassium trisoxalato ferrate (III).
2. Preparation of Tris thiourea copper (1) sulphate.
3. Preparation of Cis and trans potassium diaquodioxalato chromium (III).
4. Preparation of Hexa ammine cobalt (III) chloride.
5. Determination of Zn^{2+} with potassium Ferro cyanide.
6. Determination of Mg^{2+}using EDTA.
7. Determination of Ni^{2+}using EDTA.
8. Determination of hardness of water using EDTA.
9. Gravimetric determination of nickel using dimethyl glyoxime.
10. Gravimetric determination of Copper using ammonium thio cyanate.
11. Gravimetric determination of Zn using diammonium hydrogen phosphate.
12. Semi micro qualitative analysis of six radical mixtures.

(One interfering anion and one less familiar cation for each mixture)
(minimum three mixtures).

Anions: S^{2-} , SO_4^{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-}, BO_3^{3-}

·**Cations**: Ammonium (NH_4^+)

1st group: Hg^+, Ag^+, Pb^{+2}, Tl^+, W^{+6}.

2nd group: Hg^{+2}, Pb^{+2}, Bi^{+3}, Cu^{+2}, Cd^{+2}, Sn^{+2}, Sn^{+4} , Mo^{+6}.

3rd group: Fe^{+2}, Fe^{+3}, Al^{+3}, Cr^{+3}, Ce^{+4}, Th^{+4}, Ti^{+4}, Zr^{+4}, VO^{+2}, UO_2^{+2}, $Be^{+2.}$

4th group: Zn^{+2}, Mn^{+2}, Co^{+2}, Ni^{+2}.

5th group: Ca^{+2}, Ba^{+2}, Sr^{+2}.

6th group: Mg^{+2}, K^+, Li^+.

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

Text books/ Reference books:

1. Vogels Text Book of Quantitative analysis, revised. J. Bassett, R.C. Denny, G.H. Jeffery and J.Mendhan, ELBS.

2. Synthesis and Characterisation of Inorganic Compounds, W.L. Jolly. Prentice Hall.
3. Practical Inorganic chemistry by G. Pass and H. Sutcliffe Chapman and Hall.
4. Practical Inorganic Chemistry by. K. Somasekhara 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: 20 ACH201:ORGANIC SPECTROSCOPY

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 UV-Visible spectroscopy, Infraredspectroscopy, ^{1}HNMR Spectroscopy and Massspectrometry.

Unit-I: UV-Visible spectroscopy: Beer-Lambert'slaw-DeviationsfromBeerslaw-Instrumentation-Mechanicsofmeasurement-Energytransitions– Simple chromophores-Auxochrome,Absorptionshifts(Bathochromic,Hypsochromic,Hyperchromicand Hypochromic shifts) UVabsorptionofAlkenes-Polyenes unsaturatedcyclic systems. UVabsorption of carbonylcompounds: α,β-unsaturatedcarbonylsystems-UVabsorption of aromaticsystems-solvent effects-geometricalisomerism-acidand baseeffects-typicalexamples-calculation of λmaxvaluesusingWoodward-Fieser rules,applications.

Unit-II: Infraredspectroscopy: Mechanics ofmeasurement-Fundamental modes ofvibrations-stretching andbending vibrations-Factors effecting Vibrationalfrequency-hydrogen bonding. Fingerprintregionanditsimportance,typicalgroupfrequenciesfor–CH, -OH,-NH,-CC, -COandaromaticsystems- Applicationinstructuraldetermination–Examples-simple problems.

Unit-III: ^{1}H-NMR Spectroscopy-I: Introduction:Basic principle of NMR, Nuclearspin, nuclearresonance, saturation, Relaxation, Instrumentation. Shieldinganddeshieldingofmagneticnuclei, chemicalshiftanditsmeasurements,factorsinfluencingchemicalshift, spin-spininteractions, factors influencing –coupling constantJ andfactors effectingJ value.

Unit-IV: ^{1}H-NMR Spectroscopy-II:Improvingthe PMR spectrum: Chemicaland Magnetic Equvalence.Chemical exchange, FirstandNon-FirstOrder Spectra andanalysis ofAB,AMXandABXsystems. **Simplificationofcomplexspectra:**NuclearMagneticdouble resonance,Lanthanideshiftreagents,Deuterium Exchange,spectraathigherfields,solventeffects, Fouriertransformstechnique,NuclearOverhauserEffect(NOE).Hindered Rotations andRateprocesses.

Unit-V: Massspectrometry: Introduction, Ionproduction-E1,C1,ES,MALDIandFAB-determinationofMolecularweightandformulae-Behavior oforganic compoundsinmassspectrometer-factors affectingfragmentation. Massspectralfragmentationof organiccompounds,Commonfunctionalgroups,molecularionpeak,metastablepeak, McLafferty

rearrangement,Nitrogenrule.Examplesofmassspectralfragmentationof organiccompoundswithrespect of theirstructure determination.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of UV-Visible spectroscopy, Infraredspectroscopy, ^{1}H-NMR Spectroscopy, ^{13}C-NMRSpectroscopy, and Massspectrometry.

Text books/ Reference books:

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, 6thEd. John Wiley and Sons.
3. Spectroscopic methods in organic chemistry - D. H. Williams and I. Flemming 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.

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

Paper Code & Title: 20 ACH202:ORGANIC CHEMISTRY-II

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 onNamed reactions, StereoChemistry, Green chemistry & Phase transfer catalysisand Chemistry of Nanomaterials.

Unit-I: Named reactions: Definition, mechanism, stereochemistry and synthetic applications of Aldol condensation, Benzoin condensation, Cannizzaro condensation, Dieckmann condensation, Perkin condensation, Stobbe condensation, Mannich reaction, Reimer-Tiemann reaction,Vilsmeier-Haack reaction, Shapiro reaction,McMurray reaction, Michael addition reaction, Oppenaur oxidation reaction, Clemmensen reduction reaction, Wolff-Kishner reduction reaction, Meerwein–Ponndorf–Veriey reduction reaction, Birch reduction reaction, Robinson ringannulation reaction and Simmon-Smithreaction.

Unit-II: StereoChemistry-I: Concept and Recognition of MolecularSymmetryandChirality. Definitionandclassificationof Stereoisomers,Enantiomer, Diastereomer,Homomer,Epimer,Anomer,ConfigurationandConformation,Configurationalnomenclature:D,LandR,S nomenclature.Molecularrepresentation oforganicmolecules:Fischer, Newman and Sawhorse projections and their inter-conversions.GeometricalIsomerism. Cis-trans,E,Z-andSynand antinomenclature,Methods ofdetermining configuration ofGeometricalisomers usingphysical,spectralandchemicalmethods, Stability,Cis-trans inter conversion.

Unit-III: StereoChemistry-II: Definition of Conformation and factors influencing on stability of Conformations; Conformational analysis and energyprofilediagram ofacyclicmolecules; Conformational analysis ofcyclicmolecules - cyclobutane, cyclopentane, cyclohexane - mono and disubstituted cyclohaxanes and carbonheteroatombondshavingC–O&C–N.

Unit-IV: Green chemistry & Phase transfer catalysis: Introduction to Green chemistry, Principles and concepts of Green chemistry, Green Catalysis,Biocatalysis, renewable resources, Green Reagents, examples of green reactions-synthesis of Ibuprofen, Clean Fischer-Indole synthesis comparison of the above with conventional methods.Introduction to Microwave organic synthesis-introduction, advantages and disadvantages, solvents (water and organic solvents), solvent free reactions, Phase transfer catalysis-Principle, Types, advantages, Crown ethers.

Unit-V: Chemistry of Nanomaterials: Introduction, carbon nanotubes: structure of single and multi-walled carbon nanotubes, synthesis-solid and gaseous carbon source-based production techniques, synthesis with controlled orientation.Growth mechanism of carbon nano tubes-catalyst

free growth, catalyst activated growth, properties-general, adsorption, electronic and optical, Mechanical and reactivity. Applications.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of Named reactions, StereoChemistry, Green chemistry & Phase transfer catalysisand Chemistry of Nanomaterials.

Text books:

1. Advanced organic chemistry –Reaction, mechanism and structure, Jerry March, John Wiley.
2. A guide book to Mechanism in organic chemistry, Peter Sykes, Longman.
3. Organic chemistry, I.L. Finar, Vol. I & II, Fifth ed. ELBS, 1975.
4. Stereo Chemistry of carbon compounds – E.L. Eliel.
5. Nano, The Essentials: T. Pradeep, The Mc. Graw Hill & Co.
6. Principles of organic synthesis, R.O.C.Norman and J.M.Coxon, Blakie Academic & Professional.
7. Reaction Mechanism in organic chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
8. Green chemistry Theory and Practice by Paul T. Anastas and John C. Warner, Oxford University press.
9. Methods and reagents for Green chemistry, PietroTundo, AlvisePerosa, FulvioZecchini, John Willey& sons Inc.

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DEPARTMENT OF CHEMISTRY
M.Sc – CHEMISTRY(ANALYTICAL CHEMISTRY)
II SEMESTER

Paper Code & Title: 20 ACH 203:INORGANIC CHEMISTRY-II

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 onNon-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 B12 icosahedra). Carboranes, metalloboranes, metallocarboranes.Classification- LNCs and HNCs**,** Isoelectronic and Isolobal relationships, electron counting rules: Wade's and Lauher's rules. M-M multiple bonding; preparation, structure and bonding in dinuclear $[Re_2Cl_8]^{2-}$ ion, trinuclear $[Re_3Cl_9]$, tetra nuclear $W_4(OR)_{16}$, hexa nuclear $[Mo_6Cl_8]^{4+}$ and $[Nb_6Cl_{12}]^{2-}$.

Unit-II: Organometallic chemistry of transition metals: Classification and electron counting rules, hapticity, synthesis, structure and bonding of Olefinic complexes, Acetylene complexes, 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, Hunds rules to predict ground terms and ground states. List of ground energy and higher energy terms from d^1 to d^9 configurations; **Electronic spectra of transition metal complexes** Spectroscopic terms. Selection rules, Slator–Condon parameters, Racah parameters, Term separation energies for d^n configurations Correlation diagrams and Orgel diagrams. Tanabe-Sugano diagrams for d1 to d^9 configurations. Calculations of Dq, B and β parameters. Chargetransfer spectra.

Unit-V:Bio-inorganic chemistry and Magnetic properties of complexes: Storage and transport of dioxygen by Hemoglobin and Myoglobin, Chlorophyll, Vitamin $B_{12}$and itsimportance.**Magnetic properties of transition metal complexes** Types of magnetism, factorsaffecting Para magnetism,

anomalous magnetic moments - Orbital and spin contribution, spin-orbit coupling and magnetic moments.

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

Text books/ 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.Addiso, W. R. Cullen, D.Dorphin and G. J. James. Weliey Interscience.
9. Photochemistry of coordination compounds by V. Balzaniand V.Carassiti. Academic Press.
10. Text book of Coordination chemistry by K. Soma Sekhara Rao and K.N.K. Vani, Kalyani Publishers.

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DEPARTMENT OF CHEMISTRY
M.Sc – CHEMISTRY(ANALYTICAL CHEMISTRY)
II SEMESTER

Paper Code & Title: 20 ACH 204:PHYSICALCHEMISTRY-II

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 Third law of Thermodynamics and Statistical thermodynamics, Polymer chemistry and Raman Spectroscopy, Electro Chemistry, Chemical kinetics and Photo chemistry, 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-Plank equation. Ensembles, Maxwell-Boltzmann distribution, Fermi-Dirac statistics, Bose Einstein statistics. Partition function - calculation of thermodynamic properties in terms of partition function - Chemical equilibrium and partition function - Translational, rotational and electronic partition function - Entropy of Monoatomic gases (Sackur-Tetrode equation).

Unit-II: Polymer chemistry and Raman Spectroscopy: Classification of polymers - Free radical, ionic and Zeigler -Natta Polymerization - kinetics of free radical polymerization -Techniques of polymerization -Glass transition temperature - Factors influencing the glass transition temperature. Number average and Weight average, Molecular weights –molecular weights determinations – Membrane Osmometry, Light scattering phenomenon.Classical and quantum theories ofRaman effects,pure rotational, vibrational and Vibrational- rotational Raman spectra, selection rules, mutual exclusion principle.

Unit-III: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, advantages of 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 - electro chemical potential.

Unit-IV: Chemical kinetics and Photo chemistry: 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 - Michelis-Mentenkinetics.**Photochemistry:**Quantum yield and its determination, Actinometry, Reactions with low and high quantum yields, Photo sensitization, Exciplexes and Excimers, Photochemical equilibrium, Kinetics of collisional quenching - Stern-Volmer equation.

Unit-V: 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. GMT tables Abelian and non-abelian groups. Point group. Schonfiles symbols, Find out Point group of a molecule (yes or no Method).Representation of groups by Matrices (representation for the Cn, Cnv, Cnh, Dn 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.

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

Text books/ Reference books:

1. Physical chemistry, G.K. Vemulapalli (Prentice Hall of India).
2. Physical chemistry, P.W. Atkins. ELBS.
3. Chemical kinetics - K.J. Laidler, Mc.Graw Hill Pub.
4. Text book of Physical Chemistry, Samuel Glasstone, Macmillan pub.
5. Statistical Thermodynamics - M.C.Gupta.
6. Polymer Sceince, Gowriker,Viswanadham, Sreedhar.
7. Quantitative Analysis, A.I. Vogel, Addison Wesley Longmann 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 Billmayer.
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.
18. Spectroscopy by Aruldas.

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DEPARTMENT OF CHEMISTRY

M.Sc – CHEMISTRY(ANALYTICAL CHEMISTRY)

II SEMESTER

Paper Code & Title: 20 ACH205:ORGANIC CHEMISTRY PRACTICAL-II

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 practical knowledge for the students on Organic chemistry practical.

List of experiments:

1. Preparation of organic compounds: Single 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. 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).

3. Systematic qualitative analysis of organic compounds with different functional groups (5 different compounds)

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

Text books/ Reference books:

1. A.I.Vogel, “A Text Book of Practical Organic Chemistry”, Longman.
2. A.I.Vogel, “Elementary Practical Organic Chemistry”, Longman.
3. Practical Organic Chemistry, F.G.Mann and B.C.Saunders, Longman.
4. Reaction and Synthesis in Organic Laboratory, B.S.Furniss, A.J.Hannaford, Tatchell, University Science Books Mills valley.
5. Purification of Laboratory chemicals, manual, W.L.F. Armarego EDD Perrin.
6. Reaction and Synthesis in Organic Chemistry Laboratory, Lutz-Friedjan-Tietze, TheophilEicher, University Science Book.

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DEPARTMENT OF CHEMISTRY

M.Sc – CHEMISTRY (ANALYTICAL CHEMISTRY)

II SEMESTER

Paper Code & Title: 20 ACH206:PHYSICAL CHEMISTRY PRACTIAL

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 practical knowledge for the students on Physical chemistry experiments.

List of experiments:

1. Relative strengths of acids by studying the hydrolysis of ethyl acetate / methyl acetate.
2. Determination of equilibrium constant of $KI_3 \longrightarrow KI + I_2$ by partition coefficient.
3. Determination of unknown concentration of potassium iodide by partition coefficient method.
4. Distribution coefficient of Benzoic acid between Benzene and water.
5. Determination of critical solution temperature of phenol-water system.
6. Study of the effect of electrolyte on the miscibility of phenol-water system.
7. Determination of Coordination number of cuprammoniumcation.
8. Potentiometric determination of Fe(II) with Cr (VI).
9. Potentiometric determination of Fe(II) with Ce (IV).
10. pH-metric determination of strong acid with strong base.
11. Conductometric titration of strong acid with strong base.
12. Conductometric titration of strong acid + Weak acid with strong base.
13. Dissociation constant of weak acid (CH_3COOH) by conductometric method.
14. Determination of cell constant.
15. Verification of Beers Law using potassium permanganate/Potassium dichromate.

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

Text books/ 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.
3. Advanced practical Physical chemistry by J.B. Yadav, Krishna's educational publishers.

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DEPARTMENT OF CHEMISTRY

M.Sc – CHEMISTRY(ANALYTICAL CHEMISTRY)

II SEMESTER

Paper Code & Title: 20 OEACH207:(OPEN ELECTIVE-I)

CHEMISTRYINDAILYLIFE

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 onChemistryLaboratorysafetysymbols– Meaning, EnvironmentalChemistry, BioinorganicChemistry, Biological functionsofHormones and Medicinal Chemistry.

Unit-I:ChemistryLaboratorysafetysymbols– Meaning: Corrosive,carcinogenic,Harmful,toxic, dangeroustoenvironment,Explosive,flammable,Narcotic,Oxidizing,Lachrymatory,Radioactive,irritant,gases under pressure,general laboratorysafetyprecautions.

Unit-II:EnvironmentalChemistry: Ambient air quality standards, Acid rain,Smog,Greenhouseeffect,Bhopalgastragedy, Vishakhapatnam polymer industry tragedy, Renewableand Non- renewable energyresources,Methodsto convert temporaryhard water intosoft water, DO, COD, BOD, Toxicityof lead,mercury,arsenic and Cadmium.

Unit-III: BioinorganicChemistry: Essential elements,biological significanceofNa,K, Mg, Ca,Fe, Co, Ni, Cu, Zn andCl. Metalloporphyrin–Structure andfunctions of hemoglobin, Myoglobin and Chlorophyll.

Unit-IV: Biological functionsofHormones: Introduction, mechanism of action of Adrenaline, melatonin, noradrenaline, dopamine,prostacyclin, adrenocarticotropichormone, antidiuretichormone,Insulin.

Unit-V: Medicinal Chemistry: Disease -medicinal molecule-mode ofactionofthe followingdiseasesMalaria-Artesunate, Dengue-Acetaminophen,Asthma-Albuterol,Diabetes(type-II)(iiddm)– metformin,Diabetes(type-I)(iddm)–Insulin,Arthritis-methotrexate,Glaucoma-brimonidine,Chickenpox-acyclovir,Anxiety– citalopram,Thyroid- Levithyroxine(lt4),Insomnia-estazolam,pepticulcer,GERD(acid reflux)– Omeprazole,pantoprazole.

Course Learning Outcome(S): After studying this paper, students will acquire the knowledge of ChemistryLaboratorysafetysymbols– Meaning, EnvironmentalChemistry, BioinorganicChemistry, Biological functionsofHormones and Medicinal Chemistry.

Text books/ Reference books:

1. LaboratorysafetyforChemistryStudents byRobert H. Hill andDavidFinster.
2. ATextbook ofEnvironmental chemistryby W.MooreandF.A.Moore.

3. EnvironmentalChemistry by SamirK. Banerji.
4. OrganicChemistrybyG. MareLoudan, PurdueUniversity.
5. UnifiedChemistrybyO.P. Agarwal,Paper-III,JPNP Publications.
6. HormonesandEndocrinesystem–Kleine,Rossemanith.
7. PrinciplesofBiochemistry, Leninger.
8. Essentialsof Medical pharmacology-K.D.Tripathi.