MASTER OF SCIENCE
(M.Sc.)

(TWO YEARS DEGREE COURSE)

SUBJECT

CHEMISTRY

DEPARTMENT OF CHEMISTRY

J S UNIVERSITY, SHIKOHABAD

ORDINANCES & RULES / REGULATIONS-2018

1. The Programme

MSc. is a two-year duration postgraduate degree course offered by J. S. university in various specialized Science fields such as Chemistry. A Master of Science degree provides scientific as well as professional entry-level competency to students. The course offers advanced theoretical as well as practical knowledge to students in their chosen specialization. The M.Sc. specialization opted for by students is usually the one studied by them during graduation.

2. Eligibility

(a) The candidate for admission to the 1st year of M.Sc. (Physics) course must have passed B.Sc. (Pass) with Physics as one of the subjects/B.Sc. (Hons.) Physics with 50% marks (45% marks in case of SC/ST candidates) in aggregate or equivalent grade from any university recognized by UGC

(b) The candidate for admission to the 1st year of M.Sc. (Chemistry) course must have passed B.Sc. (Pass) with Chemistry as one of the subjects/B.Sc. (Hons.) Chemistry with 50% marks (45% marks in case of SC/ST candidates) in aggregate or equivalent grade from any university recognized by UGC.

(c) The candidate for admission to the 1st year of M.Sc. (Mathematics) course must have passed B.Sc. (Pass) with Mathematics as one of the subjects/B.Sc. (Hons.) Mathematics /B.A (Pass) with Mathematics/ as one of the subjects/ B.A (Hons.) Mathematics with 50% marks (45% marks in case of SC/ST candidates) in aggregate or equivalent grade from any university recognized by UGC.

(d) The candidate for admission to the 1st year of M.Sc. (Zoology) course, the candidate must have passed B.Sc. (Pass) with Zoology as one of the subjects/B.Sc. (Hons.) Zoology with 50% marks (45%marks in case of SC/ST candidates) in aggregate or equivalent grade from any university recognized by UGC.

(e) The candidate for admission to the 1st year of M.Sc. (Botany) course, the candidate must have passed B.Sc. (Pass) with Botany as one of the subjects/B.Sc. (Hons.) Botany with 50% marks (45%marks in case of SC/ST candidates) in aggregate or equivalent grade from any university recognized by UGC.

(f) The candidate for admission to the 1st year of M.Sc. (CSC) course, the candidate must have passed B.Sc. (Pass) with CSC as one of the subjects/B.Sc. (Hons.) CSC. with 50% marks (45%marks in case of SC/ST candidates) in aggregate or equivalent grade from any university recognized by UGC.

(g) The reservation for the SC/ST/OBC/PWD and other category shall be as per the rules of the UP

government.

3. Admission

(a) Admission shall be made on the basis of merit prepared according to marks obtained in Bachelor of Science (BSc.) or equivalent thereto or in the entrance examination.

(b) At the time of admission to the programme, the student will need to indicate their selection of the subject to be pursued for the discipline options and the accompanying pedagogic specializations for which they are applying, and these may be assigned on the basis of order of merit and availability.

4. Duration / Working Days:

(a) The M.Sc. (Physics, Chemistry, Mathematics, Botany, Zoology or Computer Science) programme shall be of two academic years, however, student shall, be permitted to complete the programme within a maximum period of five years from the date of admission to the programme.

5. Attendance:

(a) Attendance shall be counted and shortage there of may be condoned for special reasons subject to the conditionthat if his actual attendance is less than 75% he/she shall not be eligible to appear in the examination.

(b) The minimum attendance of student shall have to be 75% for all courses. The remaining twenty five per cent (25%) of attendance shall account for illness and contingencies of serious and unavoidable nature.

6. Fees:

Every candidate shall pay such fee to the University under jurisdiction of the University as may be prescribed from time to time.

7. Evaluation and the Marking System:

(i) The External Examination shall be held at the end of each year on the date notified by the university and as per details of the scheme of examination and result announced thereafter.

(ii) The examination shall be conducted by means of written papers and shall include practical work and internal assessment.

(iii) The Theory Paper of examination divided into two parts as External Exam and InternalAssessment.

(iv) Before the External Examination, the internal assessment marks should be submitted to the University.

(v) The External Examiners shall be appointed by the Board of Studies.

(vi) Each theory course will carry a weightage of 20% for internal assessment and 80% for an external examination. The internal assessment also include written test to be conducted in mid of the year.

(vii) The Minimum Passing Marks in every year examination shall be 40% for each in Theory Paper and 50% in Practical Exam separately.

(viii) The Total aggregate of the each year is 40% Minimum Marks.

(ix) Division will be awarded to the successful candidates on the basis of marks obtained in all the courses in a year.

(x) Candidate will have to pass theory exam and practical exam separately.

(xi) A provision is there for grievance redressel and removal of biases in the internal assessment mechanism.

8. Provided that in respect of the students who have completed and passed all the two years of programme of the M.Sc. (Physics, Chemistry, Mathematics, Botany, Zoology or Computer Science) in the aforesaid manner, the division shall be declared as follows:

a) ***First Division***, where student secures 60% or above.

b) ***Second Division*** where student secures 45% or above but less than 60% marks.

c) ***Third Division*** where student secures 36% or above but less than 45% marks.

9. Promotion Rules:

(i) A student will be promoted to second year only if he passed all the courses of first year atleast with minimum requirement of 40% marks in Theory Courses and 50% in Practical Exam separately.

(ii) In case, a student fails to score 40% marks in Theory Courses and 50% in Practical Exam separately, he/she will not be promoted to second year and he/she has to repeat all the courses in subsequent year and pass with at least minimum percentage requirements.

10. Curriculum, Scheme of Examination and Distribution of Marks

The curriculum, scheme of examination and distribution of marks in various courses shall be as approved by Board of Studies/Academic Council from time to time.

Program Educational Objectives (PEOs)

1. Postgraduate will have significant opportunities in various service domains at national and international level, and can work as scientist, analyst, quality controller, academics, research organizations and set testing labs.

2. On the basis of specialized knowledge and experience, postgraduate students will be able to do divers synthesis, separation, analysis, computational, design and development of new products.

3. Post-graduate will have leadership quality to handle all kind of circumstances in diversities by providing interdisciplinary and multidisciplinary learning environment.

4. Postgraduate will be continuous learner to learn and adopt new skills and techniques to overcome the problem related with new technologies.

5. Postgraduate will be able to formulate, investigate and analyze scientifically real life problems along with ethical attitude which works in multidisciplinary team.

Programme Specific Outcomes (PSO)

Programme Name: Master of Science

- Sound knowledge about the fundamentals of theories concerning behind formation of new substances.
- To appropriately apply techniques for the qualitative and quantitative analysis of chemicals in laboratories and industries.
- To develop analytical skills and problem solving skills requiring application of chemical principles.
- To become familiar with the different branches of chemistry like analytical, organic, inorganic, physical, environmental, polymer, biochemistry etc.
- To acquire the ability to undertake independent research.
- To understand the different issues of environmental concern and sustainable solution.

After completing M.Sc. Chemistry program, students will be able to:

Programme Outcomes:

PO1: Exhibit and apply the fundamental knowledge of the basic principles in various fields of Chemistry

PO2: Identifying and analyzing complicated scientific problems in order to achieve the solution by utilising the principles of chemistry

PO3: Make consciousness and sense of responsibilities towards environmental sustainability

PO4: Develop small scale industry leading to entrepreneurship for developing endogenous product.

PO5: Develop team-oriented projects in the field of Chemical Science.

PO6: Link scientific information in a concise way both orally and in written document.

PO7: Develop the ecological and eco-friendly technology in Industrial Chemistry.

PO8: Ability to develop critical thinking, reasoning, enable to design experiments, analysis and interpretation of data and conclude the result.

PO9: Implement the ethical principles, embrace professional ethics, obligations, and standards of scientific practice.

PO10: Apply logical thinking within the research field and industrial domain knowledge to assist society in all spheres, including healthcare, the environment, and industry, with the most recent advancements in scientific and professional ways.

PO11: Recognize the importance of, and be prepared for, autonomous, lifelong learning in the context of technological development as a whole.

M.Sc. (Chemistry)
Course Structure

First Year

Course Code	Title	MM
Paper 101	Inorganic Chemistry	100
Paper 102	Organic Chemistry	100
Paper 103	Physical Chemistry	100
Paper 104	Spectroscopy and Diffraction Methods	100
Paper 105	Practical	200
Total		**600**

Second Year

Course Code	Title	MM
Paper 201	Inorganic Chemistry	100
Paper 202	Organic Chemistry	100
Paper 203	Physical Chemistry	100
Paper 204	Inorganic Chemistry (Special Paper)	100
Paper 205	Organic Chemistry (Special Paper)	100
Paper 206	Physical Chemistry (Special Paper)	100
Paper 207	Practical	200
Total		**800**

Paper 101 – Inorganic Chemistry

After completing this course, students will be able to:

CO1: Elaborate the detailed chemistry of Transition Metal Complexes

CO2: Explain the detailed mechanism of bonding in transition metal complexes

CO3: Illuminate the chemistry of Metal π complexes of various inorganic compounds

CO4: Elucidate the chemistry of boranes

CO5: Differentiate between Hetero poly Acids and salts

Unit I – Reaction Mechanism of Transition Metal Complexes: Energy profile of a reaction, reactivity of metal complexes, insert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factor affecting acid hydrolysis base hydrolysis, conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism, anation reactions, reactions without metal legend bond cleavage, substitution reactions in square planner complex the trans effect, mechanism of the substitution reactions.

Unit II –Metal Legend Bonding: Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and squire planner complex π - bonding and molecular orbital theory.Molecular Orbital theory-Homo-nuclear molecules (H_2 to F_2), Hetero-nuclear molecules (CO, NO) Polyatomic molecules (BF_3, B_2H_6, SF_6). Bond Properties- Bond Length, Bond strength, Electronegativity and bond enthalpy.

Unit III –Metal π- Complex: Metal carbonyl, structure and bonding, vibration spectra of metal carbonyls of bonding and structure elucidation, important reactions of metal carbonyls: preparation, bonding structure and important reactions of transition nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as legend.

Unit IV- Metal Clusters: Higher boranes, carboranes, metalloboranes and metallocarboranes metal carbonyl and halide clusters, compounds with metal multiple bonds.

Unit V-Spectroscopic terms, Racah parameters; d-d transitions in weak and strong field cases,

(Octahedral and Tetrahedral complexes) Orgel and Tanabe Sugano diagrams of transition metal complexes (d1-d9 states), Charge transfer spectra, Intensity of bands, Laporte and Spin selection rules and relaxation. splitting of f-orbitals in octahedral field.

Reference Books:

1. J. E. Huheey, E. A. Keiter, R. L. Keiter& O. K. Medhi. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education (2006).

2. F. A. Cotton, G. Wilkinson, C. A. Murillo & M. Bochmann. Advanced Inorganic Chemistry (6th edition), John Wiley (1999).

3. M. Weller,T. Overton, J. Rourke, & F. Armstrong, Inorganic Chemistry, Oxford University Press , 6th edition.

4. J. D. Lee, Concise Inorganic Chemistry, Elbs, Chapman and Hall, 2006.

5. G. L.Meissler and D. A. Tarr; Inorganic Chemistry, 3rd. Edition, Pearson.

6. B. Douglas, D. McDaniel and J. Alexander. Concepts and Models of Inorganic Chemistry (3rd edn.), John Wiley & Sons (1994).

7. B. R. Puri, L. R. Sharma and K. C. Kalia; Principles of Inorganic Chemistry. Vishal Pub. 2016.

Paper 102 – Organic Chemistry

After completing this course, students will be able to:

CO1: Enlighten the nature of electronic movements in various organic compounds.

CO2: Explain the chemistry of intermediate involved in organic synthesis.

CO3: Differentiate between reaction mechanism to maintain the inversion and retention in configuration.

CO4: Elucidate the stereo chemical aspect of different reaction intermediates.

CO5: Make clear the role of free radicals involved in various organic reactions.

Unit I –Nature of Bonding

(a) Delocalized Chemical Bonding Conjugation cross conjugation resonance, Hyberconjugation, tautomerson. Aromatic in benzenoid and non benzenoid compounds, alternant and non alternant hydrocarbon, huckle rule, annulenes.

(b) Conformation analysis of cycloalkanesdicalines, conformation of sugars. Elements of Symmerty, chirality molecules with more then one chriral center, Threo &crythro isomers method of resolution enantiotropy &diastercotopic atoms, Groups sterio specific &sterio selective synthesis Asymmetric synthesis, optical activity in absence of chiral carbon (Biphenyls), sterio chemistry of compound containing Nitrogen.

Unit II – Reaction mechanism: Nucleophiles-definition, types-anionic, neutral, hard, soft, ambident. Reactivity effect of substrate structure, effect of attacking nucleophiles, leaving groups and reaction medium. Neighbouring group participation, Types of mechanism, types of reaction, methods of determining mechanism structure, Stability and reaction of Carbocation carbanions free radicals Carbene's, Nitrene, effect of structure on reactivity – resonances & field effect Steric effect.

Unit III – SN^2, SN^1 mechanism classical and nonclassical Carbo cation, Phenoumiom, Nucleophilic substitution at an allylic, vinyllic Carbon. SF^2, SE^1, Electrophilic Substitution

Accompanied by double bond shift. the arenium on mechanism,Nucleophilic substitutions at an allylic, aliphatic trigonal and vinylic carbons. Isotope labeling and kinetic isotope effects.

Unit IV –Nucleophiles-definition, types-anionic, neutral, hard, soft, ambident. Reactivity effect of substrate structure, effect of attacking nucleophiles, leaving groups and reaction medium. Neighbouring group participation.

Unit V –Chirality due to helical shape, a brief Study of dissymmetry of allenes, biphenyls and spiro compounds. Stereo specific and stereo selective reactions. Asymmetric synthesis, enantioselective and diastereoselective synthesis. Cram's and Prelog's rule, Cram model, FelkinAhn model.

Reference Books:

1. S. H. Pine. Organic Chemistry (5th edn.), McGraw-Hill Bool (2012).
2. Organic Chemistry by T.W. Graham Solomons and Craig B. Fryhle (10th Edition), Willy Student Edition (2012).
3. Advanced organic chemistry by J. March, (4th Ed) (2008) published by Wiley.
4. A guidebook to mechanism in organic chemistry – Peter Sykes (6th Ed) Orient Longman (2005).
5. Organic Reactions and their mechanisms (3rd revised edition) by P.S. Kalsi, New Age International (P) Ltd (2010).
6. Reaction Mechanism and Reagents in Organic Chemistry -Gurdeep R Chatwal, New Age International (P) Ltd (2010).
7. Organic Chemistry (VI edition) - R.T Morrison, R.N. Boyd. Prentice Hall of India Pvt Ltd, (2009).
8. Organic Chemistry - I.L. Finar, 6th Edition (Low price) Pearson Education, 2009.

Paper 103 – Physical chemistry

Through this course students should be able to

CO1: Explain the failure of classical mechanics for defining microscopical systems.

CO2: Account for theory of angular momentum theory for orbitals and electrons, and describe both coupled and uncoupled representation.

CO3: Describe the laws of classical thermodynamics and to explore the ideas of nonideal and microscopical system

CO4: Understand the mechanism behind the various surface phenomenons.

CO5: Define central parts of electrochemical cells and mechanism of various electrochemical processes.

Unit I – Quantum Chemistry

(a) Introduction to exact Quantum Mechanism Results

Review of the basic principles of quantum mechanics: Postulates, Schrödinger equation, normalization and orthogonalization of wave function. Expectation values, Quantum mechanical operators, Hamiltonian operator, Hermitian operators, angular momentum operator.

(b) Approximate Method: The variation theorem, linear variation principle, Perturbation theory (first order and non degenerate). Application of variation method and perturbation.

(c) Angular Momentum: Ordinary angular momentum, generalized angular momentum, eigen functions for angular momentum, eigen values of angular momentum, operator using ladder operators, additions of angular momenta spin, antisymmetry and Pauli exclusion principle.

Unit II –Thermodynamics :

(a) Brief review of thermodynamic functions and laws of thermodynamics. Temperature dependence of thermodynamic functions. Gibbs-Helmholtz equation, partial molar properties: partial molar Gibbs free energy, partial molar volume, partial molar heat

content and their significances. General methods of determination of partial molar properties–Gibbs-Duhem and Gibbs-Duhem-Margules equation, excess thermodynamic functions. Third law of thermodynamics, calculation of entropy, Residual entropy.

(b) Non-ideal system: thermodynamics of real gases and gas mixtures, fugacity and its determination, non-ideal solutions, activity and activity coefficient-different scales of activity coefficient, electronic activity coefficients.

Unit III–Statistical thermodynamics: Concept of distribution, Boltzmann distribution, Thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Kinetic theory of gases. Partition function - Translational, Rotational, Vibrational and Electronic partition functions, calculation of thermodynamic properties in terms of partition function, Applications of partition functions, Heat capacity behaviour of solid and Calculations for model systems.

Unit IV –Surface Chemistry

(a) Surface Phenomena, Gibbs adsorption isotherm, types of adsorption isotherms, solidliquid interfaces, contact angle and wetting, solid-gas interface, physisorption and chemisorption, Freundlich, derivation of Langmuir and BET isotherms, surface area determination. Kinetics of surface reactions involving adsorbed species, LangmuirHinshelwood mechanism, Langmuir-Rideal mechanism

(b) Surface Films, Langmuir-Blodgett films, self-assembled monolayers. Coordination polymer- gas storage, photoluminescence, drug delivery, gas separation and purification. Phase transfer catalysis, Zeolites. Chemical analysis of surfaces: Surface preparations- spectroscopic surface characterization methods, ion scattering spectrometry, secondary ion scattering microscopy (SIMS)-Auger electron spectroscopy.

Unit V- Definition of terms, Precision, deviation, mean deviation, standard deviation, accuracy, absolute errors, types of errors determinate, indeterminate and gross, sources of errors and their effect on final result, Methods of reporting analytical data. Statistical evaluation of data. Indeterminate errors, linear least squares methods, correlation coefficient. Significant figures, Problems.

Reference Books:

1. Atkins Physical Chemistry, Peter Atkins & Julio D Paula, Oxford University Press, 2006.
2. Principles of Physical Chemistry by B.R. Puri, L.R. Sharma, Madan S. Pathania, Vishal Publishing Company, 2008.
3. Text book of polymer science: F.W. Billmeyer, (John.Wiley), London, 1994.
4. Polymer science: V.R. Gowariker, N.V. Viswanathan& T. Sreedhar, (Wiley Eastern) New Delhi, 1990.
5. Introduction to Physical polymer science, L.H. Sperling, Wiley Interscience, New York, 1986.
6. Physical Chemistry (Vol. 1 & 2), K.L. Kapoor, Macmillan, 2001.
7. Physical Chemistry (Vol. 1 & 2), Ira N Levine, Macmillan, 2001.

Paper 104 – Spectroscopy and diffraction methods

Through this course students should be able to

CO1: Explain working principle, taking spectra and outline of spectroscopy involving IR radiation.
CO2: Define the electronic transition involved in electronic spectroscopy.
CO3: Determine the arrangement of hydrogen and electrons in various compounds to conclude the structure of various compounds.
CO4: Reveal the crystalline structure of any solid by X-Ray diffraction processes. **CO5:** Know how to utilize the wave nature of electron in studying the crystal structure of the sample of interest

Unit I – Vibrational Spectroscopy

Fundamental vibrational frequencies, selection rules and vibrational energy for harmonic and anharmonic oscillators, vibration-rotation spectroscopy, diatomic vibrating rotator, fundamental, overtone and P, Q, R branches, hot bands, group frequencies, normal modes of vibrations.

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Unit II – Rotational Spectroscopy

Classification of molecules according to moment of inertia. Rotational energy levels of HCl molecules. Spectra of linear, symmetric top and asymmetric top type molecules. Isotopic effect on pure rotational spectrum. Stark effect, estimation of molecular dipole moment. Spectra of asymmetric top and asymmetric top type molecules.

Molecular Spectroscopy: Energy levels, molecular orbitals, vibronic transitions, vibration progressions and geometry of the excited states Frank-Condon principle, electronic spectra of polyatomic molecules, Emission spectra, radiative and non-radiative decay, internal conversion spectra of transition metal complexes, charge transfer spectra.

Unit III – Magnetic Resonance Spectroscopy:

(A) Nuclear magnetic resonance spectroscopy: Nuclear spin, nuclear resonance, Saluration, Shielding of magnetic nuclear chemical shift and its measurements, factor influencing

chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant 'J' classification (ABX, AMX, ABC, A_2B_2, etc) Spin decoupling, basic ideas about instrument, NMR studies of nuclearother than proton 13c, $19_F$and 31p, FT NMR and advantages of FT NMR, use of MNR in medical diagnostics.

(B) Electronic spectroscopy: Introduction, Born-Oppenhiemer Approximation, FrankCondon Principle, Electronic spectra of diatomic molecules. Vibrational and rotational structure of electronic bands. P, Q and R branches of spectra, Fortrat parabola. Electronic orbitals in diatomic molecules, electronic states and term symbols for the ground state, Chemical Analysis by electronic spectroscopy. Photoelectron and Auger spectroscopy.

U**nit IV – X-ray diffraction:** Basic concepts, X-ray diffraction, Bragg's law of X-ray diffraction, crystal systems, point groups, Bravais lattices, space groups. Structure factor calculations. Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals. Difference between neutron and X-ray diffraction

Unit V –Electromagnetic Spectrum: Interaction of electromagnetic radiation with molecular systems. Spectroscopic transitions-adsorption, emission, reflection, polarization and scattering process. Natural line width and broadening - Intensity of spectral transitions, selection rules.

Reference Books:

1. Introductory Quantum Chemistry, A. K. Chandra. Tata McGraw Hill, 1994.

2. Quantum Chemistry, I. N. Levine, Prentice Hall India, 2001.

3. Quantum Chemistry, B K Sen
4. Fundamentals of Molecular Spectroscopy by Colin N. Banwell& Elaine M. McCash (4th Edition) 2009 Published by Tata McGraw-Hill Publishing Company Ltd.

5. Spectrometric Identification of Organic Compounds, Robert M Silverstein, Francis X

Webster, David J. Kiemle, 7th Ed, John Wiley & Sons

6. Spectroscopy of Organic Compounds, P S Kalsi, 7th Edition, New Age International Publishers

Paper - 105

Practical

Through this course students should be able to

CO1: Perform qualitative and quantitative analysis of various elements.

CO2: Synthesize various organic compound of industrial importance.

CO3: Understand the mechanism of various physical processes involved in chemical processes.

Inorganic chemistry:

A. Qualitative and Quantitative Analysis :

(a) Less common metal ions – TI, Mo, W, Ti, Zr, Th, V, U (two metal ions in Cationic/anionic forms).

(b) Separation and determination of two metal ions Cu-Ni,Ni-Zn, Cu-Fe, etc., involving volumetric & gravimetric methods. B. Chramatography :

Separation of Cations and Anions by Paper chromatography.

C. Preparations

Preparation of Selected inorganic Compounds like :

1. $K_3[Fe(C_2O_4)_6]$ 2. $[Ni(NH_3)_6]Cl_2$

3. Ni $(dmg)_2$ 4. $[Cu(NH_3)_4]SO_4.H_2O$

5 $[Co(NH_3)_6]$ $[CO(NO_2)_6]$ 6. Prussian Blue

Organic chemistry :

A. Qualitative Analysis :
Separation, Purification and identification of compounds of binary mixture (Two solids)

B. Organic Synthesis :

Acetylation : Acetylation of Salicyclic and with acetyl chloride, aromatic Electrophilic substitution – Synthesis of P-nitroniline and P-bromoaniline from aniline.

Aldol Condensation : Dibenzal acetone from benzaldehyde. Sandmeyer reaction : Pchlorotoluene from P-toludine. Cannizzaro reaction : Benzyl alcohol & Benzoic acid from Benzaldehyde.

Friendel Crafts recation : β-Benzoyl propionic acid from succinic anhydride and benzene.

Grignard reaction : Synthesis of triphenyl methanol from benzoic acid. **C.**

Quantitative Analysis :

(a) Determination of the percentage of number of hydroxyl groups in an organic compound by acctylation method.

(b) Estimation of amines/Phenols using bromated bromide solution/or acetylation method.

Physical Chemistry:

Each experiment will be of 3 – 4 hours duration.

1. To study surface tension – concentration relationship for solution (Gibbs equation)
2. Determination of the effect of (a) change of temperature (b) change of concentration of reactant & catalyst on the velocity constant of hydrolysis of an ester/ionic reaction.
3. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
4. Determination of molecular weight of non – variable and non electrolyte/electrolyte by cryscopic method & to determine the activity coefficients of an electrolyte.
5. Determination of Solubility & Solubility product of sparing soluble salts (e.g. $PhSO_4$, $BaSO_4$) conductometrically.
6. Determination of the strength of strong and weak acid in a given mixture conductometrically.
7. Determination of the strength of strong and weak acid in a given mixture using a potentiometer/pH meter.
8. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.
9. Acid-base Titration in a non-aqueous media using a pH meter.

Reference Books:

1. Vogels Text book of Quantitative Analysis revised, J. Bessett, R.C. Denney, G.H. Jellery and J. Mendhan ELBS.
2. Experimental Inorganic Chemistry by Mounir A, Malati, Horwood series in Chemical Science (Horwood publishing Chichester) 1999.
3. The systematic Indentification of Organic Compounds, R.L. Shringer and D.Y. Curlin.
4. Basic concept of Analysis chemistry, S.M. Chopkar, Wiley Bastern.
5. Handbook of Organic Analysis Qualitative and Quantitative, H. Clark, Adward Ar.
6. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
7. Practical Physical Chemistry, A.M. James and F.E. Prichand, Longman.
8. Experimental Physical Chemistry, V.D. Athawale, ParulMathur, New Age International (P)Limited.
9. Systematic Experiment in chemistry, ArunSethi, New Age International (P) Limited.
10. Advanced Practical Physical Chemistry, JB Yadav.
11. Practical Organic Chemistry, Mann and Saunders.

M.Sc, Chemistry

IInd Year

Paper 201 – Inorganic General

At the end of course student will be able to
CO1: Interpret spectroscopic data of different inorganic compounds to elucidate their structure.
CO2: Determine the structure of organic molecules in solution and study molecular physics and crystals as well as non-crystalline materials.
CO3: Explain the transport system of metal ions in biological system.
CO4: Explicate the energetic of various enzymatical reactions.
CO5: Define the properties and mechanism of various environmental components.

Unit I

Absorption excitation, photochemical laws, quantum yield, electronically excited states-life times. Flash photolysis, Frank-Condon principle, photochemical stages-primary and secondary processes. Structure, dipole moment, acid-base strengths, reactivity, photochemical kineticscalculation of rates of radiative process, bimolecular deactivation-quenching.

Unit II

Vibrational Spectroscopy : Symmetry and shapes of AB2, AB3, AB4, AB5 and AB6 mode of bonding of ambidentate ligands, ethlenediamine and diketonato complexes, application of resonance Raman Spectroscopy particularly for the study of active sites mellalloproteine. Nuclear Magnetic Resonance of Paramagnetic Substances in Solution: The contact and pseudo contact

shifts. Rectors affecting nuclear relaxation, some application including biochemical system overview of NMR of metal nuclear with emphasis on Sn^{159} NMR

Unit III

Metal ions in Biological Systems: Bulk and trace metals with special reference to Na, K Mg, Ca, Fe, Cu, Zn and Na+/K+ Pump Role of metal ions in biological process. Bioenergetics and ATP Cycle: DNA Polymerisation, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water process, transport and storage of dioxygen. Heme Proteins and oxygen uptake, structure and function of Hemoglobin, myoglobin's, Hemocyanins and hemerythrin, model synthetic complexes of irons Cobalt Copper. **Unit IV**

Electron transfer in Biology: Structure and function in metalloproteins in electron transport processes-cytochromes and ion-sulphur proteins, synthetic models.
Nitrogenase: Biological nitrogen fixation, molybdenum infrogenase, spectroscopic and other evidence, other nitrogenases model systems.

Metal nucleic acid complexes: Metal ions and metal complex interaction, metal complex-nucleic acid interaction.

Unit V

(i) Soils: Composition, micro and macro nutrients Pollution-Fertilizers, pesticides, plastics and metals.

(ii) Hydrosphere: Chemical composition of water bodies - lakes, streams, rivers and wet land etc, Hydrological cycle Aquatic pollution-inorganic, organic Pesticide, agricultural, industrial and sewage detergents, oil spills and oil pollutants. Water quality parameters-dissolved oxygen, biochemical Oxygen demand, solids, metals, content of chloride, sulphate, Phosphate, nitrate and micro organisms, water quality standards. Purification and treatment of water.

Books/References:

1. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McClevert, Pergamon

2. Magnetochemstry, R.L. Carlin, Springer Verlag.

3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.

4. Inorganic Chemistry, J.E. Huhey, Harpes& Row.

5. Advanced Inorganic Chemistry, F.A. Cotton and G. Wilkinson, John Wiley

6. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.

7. Advanced Inorganic Chemistry by J.D. Lee.

Paper 202 - Organic General

Through this course students should be able to

CO1: Interpretate the structure of organic compound by fragmentation method (Mass Spectrometry).
CO2: Determine the structure of various aromatic and aliphatic compounds by NMR spectroscopy.
CO3: Describe the mechanism of various photochemical organic reactions.
CO4: Understand the enzymatic processes involved in organic reactions.
CO5: Apply enzymatic reactions in medical and environmental processes.

Unit I

Optical Rotatory Dispersion (ORD) and circular Dichroism (CD) Definition, deductionof absolute configuration octat rule for ketone. Mass Spectrometry-IntroductionFragmentation, Molecular ion peak, metastable peak, Nitrogen rule. High resolution mass spectral fragmentation of organic compound with respect to their structure determination.

Unit II

Electromagnetic radiation, interaction of electromagnetic radiation with matter-absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering, uncertainty relation and natural line width and natural line broadening, transition probability, selection rule, intensity of spectral lines.

N.M.R.: Introduction, definition, Chemical Shift, Spin-Spin Interaction, Shielding Mechanisin. Mechanism ofmeasurement Chemical shift value and correlation for proton bonded to Carbon (Alphatic, Aromatic) and other nuclear (Alcohol Phenol), Carbolic acid, amine, effect of deuferation complex spin spin interaction between two three nuclei. Carbon 13 NMR Spectroscopy-introduction, cosy, Noesy-Technique chemical shift aliphatic, obfinic, alkyne, Aromatic, Carbonyl Carbon.

Unit III

Photo-chemistry: Type of excitation, fate of excited mole, types of Photo Chemical reaction Photo dission gas Photolysis, Intermolecular reactions of Olefinic bond intra molecular reaction of Carbonyl Compounds-Saturated Cyclic, a ß Unsaturated compounds. Intra molecular cyclo addition reactiondinerisahanIsomerization addition and Substitution.Photo-chemical reactions: Interaction of Electromagnetic radiation with matter, types of excitation of molecule,quantum yield, transfer of excitation energy. Photochemistry of alkenes: intermolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 21,5dienes.

Unit IV

Enzyme: Introduction, Nomenclature& Classification. Fischer lock and key; Koshland's and Induced hypothesis; Transition State theory, acid base catalysis, covalent catalysis, Nucleophilic displacement on Phosphorus atom, multiple displacement reaction and the coupling of ATP, cleave to endergonic Processes, Addition and Elimination reaction Enzyme Catalyzed Carboxylation & Decarboxylation.Natural products and biopolymers: Acetogenins and shikimates, Terpenes and steroids, Alkaloids. Nucleic acids: Basic concepts of the structure of RNA and DNA and their hydrolysis products nucleotides, nucleosides and heterocyclic bases.

Unit V

Coenzymes, Apoenzyne, Structure & Biological Function of coenzymes, production, Purification of enzyme, method of Immobilization of enzyme effect of immobilization on enzyme activity. Application of Immobilized Engyme, Clinical use of Enzyme, Disposal of Wastes and their management, Biodegradability, Chemical Solution to environmental Problem.Protein, amino acid and lipids: classification and its role. Basic consideration of drugs: Classification, nomenclature, metabolism.

Books/References:

1. Advanced Orgnaic Chemistry-Reactions, Mechanism and Structure, Jerry March, 6th Edition John Wiley.

2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.

3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.

4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.

5. Organic Chemistry, J.clayden, N.Greevs, S. Wawen, P. Wothers, Oxford Press.

6. Modern Organic Reactions, H.O. House, Benjamin.

7. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.

8. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.

Paper 203 - Physical General

Through this course students should be able to

CO1: Perform a mechanochemical reaction that occurs between powders in the solid state.

CO2: Explain various properties of material based on band gap. .

CO3: Understand thermodynamics and thermochemistry of various polymers

CO4: Explain the mechanism of energy distribution in biological systems.

CO5: Elucidate various types of forces involved in organic solids and biopolymers

Unit I

Electronic Properties and Band Theory: Metals, insulators and semiconductors, electronic structure of solids, bandstructure of metals, band theory, intrinsic and extrinsic semiconductors, doping semiconductor, p-n junction, super conductors Optical properties. Optical reflectance. Photoconduction-photoelectric effects, Magnetic Properties - Classification of materials, Quantum theory of Paramagnetics - cooperative phenomena. Magnetic domains, hysterisins.Approximate Methods The variation theorem, linear variation principle. Perturbation theory (first order and non-degenerate). Applications of variation method and pertubationtheory of the Hydrogen atom. Molecular Orbital Theory Huckel theory of conjugated systems, Bond order and charge density calculations, Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc.

Unit II

Solid State Reactions:

Production of x-rays, x-ray spectra, absorption of x-rays, analysis by absorption, absorption edge analysis, absorption apparatus, determination of molecular structure by X-ray diffraction, crystal morphology, lattice and unit cells, kinds, space lattice, planes or faces of cubic systems, labelling the planes, the Miller indices, spacing of the planes, X-ray crystallography, the powder method, the rotating crystal methods, Problems.

General Principles, experimental procedures, co-precipitation as a precussor to solid state reactions, kinetics of solid state reactions. Biological Cell and its Constituents: Biological cells structure and functions of proteins, enzymes, DNA and RNA in living systems, Helix Coil

Transitions. Ordinary angular momentum, generalized angular momentum, eigenfunctions, for angular momentum, eigenvalues of angular momentum, operator using ladder operators, addition of angular momenta, spin, anti-symmetry and Pauli exclusion principle.

Unit III

Mechanism of Absorption and Emission of Radiation of Photochemical Interest Electronic energy states of atoms; The selection rule, spectroscopic terms for electronic states. Notation for excited state of organic molocules, Einstein's treatment of absorption & emission phenomena, Time dependent Schrodinger equation, Intensity of electronic transition, Rules governing the transition between two energy states, d-d transition, charge transfer transition

Unit IV

Bioenergetics: Standard tree energy change in biochemical reactions, exergonic endergonic, Hydrolysis of ATP, Synthesis of ATP from ADP. Statistical Mechanics in Biopolymers: Chain configuration of macromolecules, statistical distribution end to end dimension, calculation of average dimension for various chain structures, Polypeptide and protein structures, introduction to protein folding problem. Cell Membrane and Transport of Ions: Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport, Nerve conduction.

Unit V

Organic Solids: Electrically conducting solids, organic charge transfer complex, organic metals, new super conductors.

Biopolymer Interactions: Forces involved in biopolymer interactions, electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interaction. Multiple equilibriums and various types of building processes in biological systems. Hydrogen ion titration curves.

References:

1. Physical Chemistry, P.W. Atkins, Oxford Press. 7th Edn.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall. 4. Coulson's Valence, R. McWeeny, ELBS.

Paper 204 - Inorganic Chemistry (Special)

Through this course students should be able to

CO1: Describe the compounds and reactivities of transition metals and trends in their physical and chemical properties.

CO2: Explain the role of metal transport system in biological system. .

CO3: Illuminate the role of metal in biochemical reactions.

CO4: Understand the role of metal in medical science

CO5: Elucidate the mechanism of charge transfer complexes

Unit I

(i) Transition metal complexes: Transition metal-complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and trienyl complexes, preparations, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis. Transition metal compounds with Bonds to Hydrogen. (ii)Inorganic Polymers: Introduction, Properties and classification of Inorganic Polymers. Phosphorous, Sulphur, Boren and Silicon based polymers. Polyphosphaszenes, polycarboanes, polyboron, nitride and silicones. Natural, Chain, 2D and 3D coordination polymers.

Unit II

(i) Metal storage Transport and Bio-mineralization Ferritin, Transferrin and siderophores. Calcium in Biology: Calcium in living cells, Transport and regulation, molecular aspects of intramolecular processes, extracellular binding proteins.

(ii) Isopoly and heteropoly acids and anions. Polymerization of chromate, and vanadates, Keggin structure. Reactions of iso and heteropoly anions.

Unit III

Métalloenzymes: Zinc enzymes-Carboxypeptidase and carbonic anhydrase, Iron enzymes-catalase, peroxidase and cytochrome P-450. Copper enzymes-superoxide dismutase molybdenum oxatransferase enzymes-xanthine oxidase. Coenzyme vitamin B12.

Biopolymer interactions and Thermodynamics of Macromolecular solutions: Non-covalent interaction, Electrostatic: dipole-dipole interaction, Dispersion force interaction, Hydrophobic interaction. Multiple Equilibria and various types of binding processes in biological systems. Thermodynamics of biopolymer solutions, Flory-Huggins model of macromolecular solvation, Osmotic pressure and Donnan membrane equilibrium.

Unit IV

(i) Meal Nucleic Acid Interactions: Metal ions and metal complex interaction metal complexesnucleic acids.

(ii) Metal in Medicine: Metal deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs.

Unit V

Excited states of Metal Complexes: Excited states of metal complexes: comparison with organic compounds, electronically excited states of metal complexes, charge-transfer spectra, change transfer excitations, methods for obtaining charge transfer spectra.

References:

1. Advanced Inorganic Chemistry, F.A. Cotton and G. Wilkinson, John Wiley
2. Inorganic Chemistry, J.E. Huhey, Harpes& Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magnetochemsitry, R.L. Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.

Paper – 205

Organic Chemistry (Special) : Terpenoid & Carotenoid

Through this course students should be able to

CO1: Classify various types of Natural Products.

CO2: Explain the chemistry of heterocyclic alkaloid compounds..

CO3: Perform the structural determination of Steroids.

CO4: Elucidate the structure and properties of natural pigments.

CO5: Synthesize the antibiotics of medical use.

Unit I

Classification, nomenclature occurance, Isolation, Isoprene rule structure defermination of citral, atepeneol, zingiverene, B-carotene, Biosynthesis of terpene.

Unit II

Alkaloid: Definition, nomenclature and physio logical action, occurrence Isolation; classification based on Nitrogen hetrocyclic ring structure of Nicotine, Atropine, Quinine and Morphine. Biosynthesis of Alkaloid.

Unit III

Steroids:Occurence, nomenclature, diels hydrocarbon structure determination of cholesterol, Androsterone. Testosterone. Progestrone, Biosynthesis of steroid.

Unit IV

Plant Pigment:Occurence nomenclature. Isolation structure determination of quercetin, Cyanidin; Hirsutidin, Aureusin, Bio synthesis of flavonoid. Structure of Haemoglobin and Chlorophyll.

Unit V

Antibiotics: ß-lactamring, structure & synthesis of Penicillin G. Penicillin V, Ampicillin, amoxycillinChloramphenicoal, Tetracyclin and Streptomycin. Paper IV (is)-Physical Chemistry (Special)

References:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.

2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.

4. Modern Organic Reactions, H.O. House, Benjamin.

5. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.

6. Pericyclic Reactions, S.M. Mukherji, Macmillan, India.

7. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.

8. Organic Chemistry J.Clayden, N Greavs, S. Warren, P.Wothers.

Paper 206 - Physical Chemistry (Special)

Through this course students should be able to

CO1: Develop various kinds of thin films of metal oxides.
CO2: Explain the stereochemistry and application of polymers.
CO3: Elucidate the properties of material based on quantum mechanical approach
CO4: Elaborate the bonding and application of liquid material **CO5:**
Understand the development various kind of polymeric materials.

Unit I

Thin Films and Langmuir-Blodgett Films: Preparation techniques, evaporation/sputtering, chemical processes, MOCVD, Sol-gel, etc. Langmuir-Blodgett (LB) films, growth techniques, Photolithography, properties and application of thin & LB films.

Liquid Crystals : Mesmorphicbehaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smeticmesophates, smetic-nematic, transition and clearing temperature, homeotropic, planar and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smetic A and smetic C phases, Optical properties of liquid crystals, Dielectric susceptibility and dielectric constants. Lyotropic Phases and their description of ordering in liquid crystals.

Unit II

Polymeric Materials: Molecular shape, structure and configuration, crystalinity, stress-strain behaviour, thermal behaviour, polymer types and their application, conducting and feno-electric polymers. Ionic Conductors: Types of ionic conductors, mechanism of ionic, conduction, interstitial jumps (Frenkel); Vacancy, mechanism, diffusion superionic conductor, phase transitions and mechanism of conduction in super ionic conductors, examples and application of ionic conductors.

Unit III

Theoretical and computational treatment of atoms and molecules, Hartree-Fock theory. Review of the principles of quantum mechanics, Born-openhemmer approximation, Staler Condon rules. HartreeFock equation, Koopmans and Brilloning theories, roothan equation, Gaussian basis sets.

Unit IV

General Properties of Liquids:

(a) Liquids as dense gases, liquids as disordered solids, some thermodynamic relation, internal pressures and its significance in liquids. Equation of state, critical constants. Different types of intermolecular forces in liquids, different potential function for liquids, and additivity of pair potential approximation

(b) A classical partition function for liquids, correspondence principle, and configuration integral. Configuration properties.

Unit V

Concepts and language of supramolecular chemistry. Molecular recognition, Non-covalent interactions, self-assembly, Molecular receptors for different types of molecules, cationic and anionic substrates. Transport processes and carrier design. Synthetic strategy for design of supramolecular assemblies.

Polymer Processing:

Polymer and Polymerization: Addition polymerization, condensation polymerization, copolymerization, Ring opening polymerization, sterioselective polymerization, electro chemicals polymerization, solid state polymer and kinetic length. Characterization of polymers: End group analysis, colligative property measurement, solution viscosity and molecular size. Rheology of polymers: Viscous flow, kinetic theory of rubber elasticity, Viscoelasticity, The mechanical properties of polymer. Morphology of polymers: Configuration of polymer chaincrystal structure, Morphology ofcrystalline polymers, Strain induced morphology. Polymer processing by molding and other processing methods, plasticizers and other additives, fibersmanufacture technology.

References:

1. Chemical Kinetics, K.J. Laidler, McGraw-Hill.
2. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
3. Modern Electrochemistry, Vol. I and Vol II, J.O.M. Bockris and A.K.N. Reddy, Plenum.
4. The Colloidal Domain: Where Physics, Chemistry, Biology and Technology Meet, D.F. Evans and H. Wennerstrom, VCH, Weinheim (Germany), 1994.
5. Introduction to polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
6. Supramolecular Chemistry - Fundamentals and Applications, Advanced Textbook Ariga, Katsuhiko, Kunitake, Toyoki. Springer.
7. Supramolecular Chemistry: Concepts and perspectives, J.M. Lehn, VCH.
8. Bioinorganic Chemistry, Bertini,Gray, Lippard and Valentine

Paper – 207 – Practical

Through this course students should be able to

CO1: Determine metal ions concentration and their separation.

CO2: Synthesize various compounds of Industrial significance.

CO3: Synthesize different organic compound of Industrial importance.

CO4: Determine the concentration of metal ions by electrochemical methods

Inorganic Chemistry Practical

1. Flame Photometric Determinations.

(a) Sodium and Potassium when present together.

(b) Li/Cata/Sr

(c) Cd and Mg in tap water.

2. Spectrophotometric Determinations.

(a) Fluoride/Nitrite/Phosphate

(b) Copper-Ethylene diamine complex; slope ration method.

3. Chromatographic Separations.

(a) Cd and Zn

(b) Zn and Mg

(c) Thin-layer chromatography

Separation of Ni, Mn, Co & Zn Determination of Rf values.

Organic Chemistry Practical

PRACTICAL

1. Separation and indentification of Components of mixture of three organic compounds.

2. Multi step Synthesis of organic compounds.

(1) Benzene-Buzophenone-Benzophen one oxime Benzilide.

(ii) Benzaldehyde-Benzoin-Benzil-Benzilic Acid..

(iii) Skramp Synthesis-Beparation of quinoline from anilene.

(iv) Fischer-Indole Synthesis-Preparation of 2 Phenylindole from Phenylhydrozine.

(v) Reduction of Ethyl Acctoacetate using Baker yeast to Yield enantiomeric excen of ethyl -3 hydroxy butanoate.

3. Extraction of organic compounds, from natural sources, (i) Isolation of caffeine from tea leaves.

(ii) Isolation of casein from milk.

(iii) Isolation of Lactose from milk.

(iv) Isolation of Nicotine-Di-Picrate from Tobacco.

(v) Isolation of Lycopene from tomatoes.

(vi) Isolation of Bcarotene from carrot.

4. Paper Chromatography : Separation and identification of sugars Present in mixture of glucose, Fructose, Sucrose by Paper chromatography and determination of RF values.

5. Spectro Photometric estimation :

(i) Amino acid (ii) Carbohydrate (iii) Ascorbic Acid (iv) Aspirin (v) Caffeine.

Physical Chemistry Practical

Number of hours for each experiment 3-4 hours.

A list of experiment under different headings are given below. Typical experiments are to be selected from each type,

Thermodynamics

1. Determination of partial molar volume of solute (e.g.,KCI) and solvent in a binary mixture.
2. Determination of the temperature dependence of the solubility of a compound in two solvents having similar intermolecular interaction (benzoic acid in water & in DMSO water mixture) and calculate the partial molar heat of solution.

Spectroscopy:

(i) Determination of pka of an indicator (e.g. Methyl red) in (a) aqueous and (b) micellar media.

(ii) Determination of stoichiometry and Stability constant of inorganic (e.g. ferric- salicylin acid) and organic (eg. amine iodine) complexes.

(iii) Characterisation of the complexes by electronic and IR Spectral Data.

Polarography:

(i) Estimation of Pb^{2}+ and Cd^{2}+/ Zn^{2}+ and Ni^{2}+ ions in a mixture of Pb2+ and Cd2+/Zn 2+ and Ni2+ by Polarography.

(ii) Determination of dissolved oxygen in aqueous solution of organic solvents.

Electronics :

(i) Measurements of resistance with multimeter.

(ii) To measure the resistance of the given ammeter.

(iii) Use of a wheatstone bridge for accurate measurement of resistance.

(iv) Capacitor as a charge storage device.

(v) Verification of Kirchoff's (vi) Laws.

(vii) Measurement of e.m.f. with thermocouples.

(viii) To plot the characteristie curve of a diode.

(ix) Setting up of a thermostat : Constant temperature both.

Operational Amplifiers :

Ideal characteristics, inverter, summerintegrator, differentiater. Voltage followres illustrative use of operational amplifiers. Introduction to fourier transform in instrumentation.

Active Components :

Introduction to ordinary diodes & Zener diodes with some emphasis on p-n junction as a solid state property, use of diodes as rectifiers, clipping and clamping circuits, power supplies Transistors. An extension of p- junction to p-n-p and n-p-n Transistors. Charcteristics of transistors, hybrid parameter, transistor circuits as amplifiers, high impedance (pre amplifier) circuits, Darlinction pairs, differential amplifiers,

Basic Electronics :

Notation used in an electric circuit, study of electronic components & colour codes, conversion of chemical quantities into electrical quantities, Transducer, illustration with electrodes, thermocouples & thermistors.

Passive components, Resistors, Capacitors & inductors with some emphasis on solid state properties of materials. Net works of resistors. Thevenin's theorem, superposition theorem, loop anlaysis, R.C. circuits, L.R. circuits, LCR circuits. Illustration of the use of the circuits, in NOR spectroscopy, Mosbauer spectroscopy, cyclic Voltametry and in power supplies as filter circuits.