Davangere University
Department of Chemistry
B.Sc., V - Semester Chemistry, Syllabus (SEP)

PAPER - V: Modern Concepts of Chemistry - I

Total No of Lecture Hours: 56 hrs **4 hrs/Week**

UNIT-I: Inorganic Chemistry-14hrs

d- block elements :

Introduction- Oxidation state- minimum and maximum oxidation states, reason, anomalies, relative stabilities of various oxidation states, formation of ionic and covalent compounds on the basis of oxidation states, formation of interstitial and non-stoichiometric compounds, formation of alloys.

Magnetic Properties: Origin of paramagnetism, application of magnetic properties in recording tapes, magnetic susceptibility and its experimental determination using Gouy's method, calculation of magnetic moments of metal ion in complexes.

Colour of metal complexes on the basis of CFT, standard oxidation and reduction potentials explanation, differences between 3d, 4d and 5d series. **6 hrs**

Industrial Chemistry:

Electroplating: Purpose of electroplating, nature of deposit, principle of good electroplating, methods of cleaning of articles, electroplating of Ni, Cr and Au.

Electroless Plating- Definition, preparation of active surface, plating bath, electroless plating of Copper.

Alloys: Definition, Purpose of making alloys. Steel-Influence of carbon, manganese, nickel, chromimum, tungsten, silicon and cobalt on the properties of steel. Heat treatment of steel - Hardening, case harding, Annealing, Tempering of steel. Manufacture of ferrochrome alloy.

Refractories: - Definition, classification, pyrometric cone equivalent and its values, RUL test, properties of refractories, composition and uses of silica, fireclay and zirconia bricks. Silicon carbide- manufacture, structure and uses.

Abrasives:- Properties, Mohr's scale of hardeness, classification-examples, preparation and uses of Alundum. **8 hrs**

UNIT-II : Organic Chemistry-14hrs

Stereochemistry:

Concept of Isomerism: Introduction of optical isomerism, geometrical isomerism.

Molecular Chirality- Enantiomers, Diasteromers and their properties. Optical isomerism in lactic acid and Tartaric acid. Mesocompounds. Homotopic, enantiotopic and diasterotopic hydrogens. Optical activity without asymmetric carbons- Allene derivatives, Biphenyl derivatives, Chirality in

alkylidine cycloalkanes and spirins. Crams and Prelog's rule. R & S notation for molecules having one and two asymmetric carbons (Cahn-Ingold-prelog system).

Threo and erythro enantiomers. Recemisation, resolution of racemic mixture (mechanical, chemical, biochemical, & adsorpstion method). Walden inversion, asymmetric synthesis. Optical purity (problems to be solved)

Geometrical isomerism: Determination of configuration of geometrical isomers physical methods. method of cyclisation and method of conversion into compounds of known configuration. E and Z notations. geometrical isomerism of oximes- syn and anti- aldoxims and ketoximes determination of configuration of oximes, Beckmann rearrangement.

Conformational isomers: Factors affecting stability of conformations. Conformation analysis of Ethane, 1,2- dichloro ethane, propane, ethylene glycol and cyclohexane. Differences between conformation and configuration. **9 hrs**

Active methylene compounds:

Acidity of active methylene compounds. preparation and synthetic applications of Diethylmalonate (Mano Carboxylic acids, dicarboxylic acids, keto acids, amino acids, barbituric acid). preparation of Ethyl aceto acetate by Claisen condensation with mechanism. synthetic applications (monocarboxylic acid, α, β unsaturated acid, ketones and 4 methyl uracil). Keto-enol tautomerism.

5 hrs

UNIT-lll: Physical Chemistry-14 hrs

Thermodynamics - I

Definition - system, surroundings, process, extensive and intensive properties, first law of Thermodynamics statement and mathematical expression. kirchoff's equation a) derivation of effect of temperature on the enthalpy of reaction b) Derivation of effect of pressure on the enthalpy of reaction (problems to be solved). Concept of entropy, thermodynamics scale of temperature. Statement of second law of thermodynamics (clausius & kelvin). Spontaneous process, cyclic process. Heat engine. **5 hrs**

Carnot's cycle:- Derivation of efficiency of heat engine. statement of carnot's theorem -problems to be solved. Entropy- physical significance of entropy. Second law of thermodynamics in terms of entropy . Entropy change during reversible and irreversible process- Entropy change in phase transition (problems to be solved)- Derivation of Entropy change in reversible and isothermal expansion of an ideal gas a) T and V are variables b) P & T are variables- problems to be solved.

Helmoltz free energy or work function - significance- Derivation of variation of work function with tempreture and volume. Gibb's free energy - physical significance- Derivation of Gibb's Helmoltz equation and its applications. Derivation of Clausius- Clayperon equation and its applications-

problems based on integrated form of Clausius - Clayperon equation, Derive Maxwell's thermodynamic relations. **9 hrs**

UNIT-lV: Analytical Chemistry-14hrs

Electro Analytical Methods:

Coulomatric Methods:- principals of Coulometry, Coulomatric techniques, Coulometer-hydrogen - oxygen Coulometer, Coulomatric titrations, Coulomatric determination, Advantages of coulomatic titrometry, Instrumentation for Coulomatric titraters, applications of Coulomatric titrations, Determinations involving Coulomatric titrations at constant current (Chloride, Bromide and iodide).

Amperometry:- principal of Amperometric titrations, amperometric titration curves, amperometric indicators, Instrumentation, procedure for amperometric titrations, advantages and applications of amperometric titrations. **7 hrs**

Polarography: principle polarographic instruments, polarographic measurement, dropping Mercury electrode (DME), limitations of DME, Hanging Mercury electrode(HMDE), Polarogram, Half wave potential and its significance, Ilkovic equation, qualitative and quantitative estimation of metal ions.

Eelectro gravimetry: Introduction, important terms used in electrogravimetry, decomposition potential, over potential, factors affecting the magnitude of over potential, process of deposition, Electro gravimetric methods, procedure of electrolysis, electrolysis using a Mercury cathode, Internal electrolysis, determination of copper by constant current procedure. **7 hrs**

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V Semester Chemistry Practical **4 hrs/Week**

Paper - V : Modern Concepts of Chemistry Practicals

PART-A

Gravimetry

List of Experiments:

1. Estimation of Barium in Barium Chloride solution as Barium sulphate.
2. Estimation of sulphate as Barium sulphate.
3. Estimation of iron in iron ore solution as iron oxide.
4. Estimation of aluminium in Potash alum as Aluminium oxide.
5. Estimation of Nickel as Nickel dimethyl glyoximate.
6. Estimation of magnesium as magnesium oxinate using 8- hydroxy Quinoline.
7. Estimation of zinc as zinc oxide.
8. Estimation of lead as lead chromate.
9. Electro gravimatric estimation of copper or Nickel.
10. Estimation of Copper as cuprous thiocyanate.

PART-B

Organic Estimations and preparations

1. Estimation of Amino acid by formal titration method.
2. Estimation of Aspirin by base hydrolysis method.
3. Estimation of Aniline by bromination method.
4. Estimation of Phenol by bromination method.
5. Estimation of an ester by hydrolysis method.
6. Saponification value of coconut oil by hydrolysis method.
7. Preparation of acetanilide from aniline. (Acetylation).
8. Preparation of Aspirin from Salicylic acid. (Acetylation).
9. Preparation of p-bromoacetanilide from acetanilide.
10. Preparation of methyl orange from N,N-dimethylanaline (Diazotisation).
11. Oxidation of toluene or benzyl alcohol or benzaldehyde to benzoic acid by $KMnO_4$ oxidation.
12. Nitration of benzene or nitrobenzene to dinitrobenzene.
13. Preparation of Nylon-66.

Recommended Books:

Part-A

1. Advance in organic chemistry, 5th edition. F.A cotton and Wilkison, John Willey and sons 1988.
2. Inorganic chemistry 3rd ed. shriver and Atkins, Oxford University Press 1999.
3. Concepts and models in inorganic chemistry Second Ed, Douglas, McDanial and Alexander.
4. A concise inorganic chemistry, J.D. Lee, ELBS ed,1991. Edition

5. Modern Inorganic Chemistry, by R.D. Madan, S. Chand & Co.
6. Inorganic Chemistry by R.L. Madhan, Malik and G.R.Tuli.
7. Engineering Chemistry by Jain and Jain, Dhanpateai publishing Company(P) Limited.
8. Elements of statistical thermodynamics by E.K. Nash, Wesley, 1974.
9. Statistical thermodynamics –M.C. Gupta Willey Eastern, Limited 1990.
10. Organic chemistry Morrison, Boyd- PHI Publications.
11. Organic Chemistry by Ahluwalia.
12. Modern organic chemistry S.P. Shukla, G.L.Trivedi. S. Chand publications.
13. UG organic chemistry Jagadamba Singh, lds Yadav volume 1, 2 and 3.
14. Analytical chemistry, Grey D. Christian, 5th edition, John Willey and sons.
15. Concise coordination chemistry R.Gopalan and V. Ramalingam.
16. Vogel's Text book of quantitative Chemical analysis- GH. Jaffery,J. Bassell, et al. ELBS.
17. Instrumental methods of chemical analysis. Dr. H. Kaur, Pragati prakashana.
18. Principals of inorganic chemistry Puri, Sharma, Kalia- milestone publishers and distributors.
19. Text book of organic chemistry 3rd edition K.S Tiwari, N.K. Vaishnavi. Vikas publishing House Private Limited.
20. Instrumental methods of chemical analysis. B.K. Sharma, Goel Pub.house. Meerut.
21. Advanced Organic Chemistry by Arun bal and B.S. Madan. S. Chand Co. Pub.
22. Laboratory Techniques in Electro analytical chemistry. P.T. Kissingen & Heinman, Marcel Deckkerlnc,1984.
23. Stereochemistry: Conformation and Mechanism. By P.S. Kalasi.
24. Basic Stereochemistry of Organic Molecules. By Subrata Sen Gupta.
25. Stereochemistry of Organic Compounds, By D. Nasipuri.

Part B

1. Basic Inorganic Chemistry- F. A. Cotton, G. Wilkinson and P. L. Gaus; John Wiley and sons. Inc, 6th edition (1999).
2. Advanced Inorganic Chemistry, 6th edition; F. A. Cotton and G. Wilkinson.
3. Inorganic Chemistry IV edition; J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley (1993).
4. Inorganic Chemistry, II edition, D. F. Shriver, P. W. Atkins and C. H. Langford, ELBS; Oxford University Press, 1994.
5. Chemistry of elements; N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).
6. Concise Inorganic Chemistry, 5th edition; J. D. Lee (1996).
7. Inorganic Chemistry, 3rd edition; Gary. L. Miessler and Donald . A. Tarr (2007).
8. Advanced Organic Chemistry - Reactions, Mechanism and Structure, Jerry March, John Wiley (2008).
9. Advanced Organic Chemistry, F A Carey and R J Sundberg Plenum, (1990).
10. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman, (2000).

11. Structure and mechanism of Organic Chemistry, C K Ingold, Cornell University Press (1999).
12. Organic Chemistry, R T Morrison and R N Boyd, Prentice-Hall, (1998).
13. Modern Organic Reactions, H O House, Benjamin, (1972).
14. Principles of Organic Synthesis, R O C Norman and J M Coxon, Blackie Academic and Professional, (1996).
15. Stereochemistry of Organic Compounds, D Nasipuri, New-Age International, (1999).
16. Organic Chemistry, Volumes I and II, I L Finar, Longman, (1999).
17. Physical Chemistry, P. W. Atkins, (2002).
18. Physical Chemistry: A Molecular Approach, McQuarie and Simon, Viva, New Delhi, (2001).
19. Principles of Physical Chemistry – B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co.1987
20. Molecular Spectroscopy, J. D. Graybeal, McGraw Hill (Int. Students EdiBon) (1990)..
21. Banwell, C. N. & Mc Cash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed.Tata McGraw-Hill:New Delhi (2006).
22. Photochemistry by Gurdeep Raj, 5th edition- 2008
23. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. BasseZ, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
24. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, New Delhi, (1996).
25. Practical Organic Chemistry - Mann and Saunders, (1980).
26. Textbook of Practical Organic Chemistry- A. I. Vogel, (1996).
27. Comprehensive practical organic chemistry: Preparation and quantitative Analysis,
28. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S. Dhingra, University Press (India), 2000.
29. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency, Calcutta, 2000.
30. Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
31. Practical organic chemistry (Quantitative analysis), B. B. Dey, M. V. Sitaraman and T. R. Govindachari, Allied Publishers, New Delhi, 1992.

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Paper VI: Applied Chemistry-I

Total No of Lecture Hours: 56 hrs **4 hrs/Week**

Unit-I : Inorganic Chemistry-14 hrs

Co-ordination Compounds:

Co-ordination compound, ligands and their classification (mono, bi, tri, tetra, penta and hexa-dentate ligands) and ambidentate ligands, co-ordination number, nomenclature of co-ordination comounds in detail. Theories of structure and bonding (Explanation for the formation of complexes by Werner's Theory in detail and its limitations). EAN rule, Valence bond theory-postulates, low spin and high spin complexes with examples, limitations of VBT. Crystal field theory (octahedral, tetrahedral and square planar complexes). Crystal field splitting and crystal field stabilization energies. Limitations of CFT. Magnetic properties of $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$, $[Fe(CN)_6]^{4-}$ and $[Fe(CN)_6]^{3-}$, Spectral properties of $[Ti(H_2O)_6]^{3+}$, $[Co(H_2O)_6]^{3+}$, $[CoCl_4]^{2-}$.

Isomerism-Structural, ionization, linkage, hydrate and co-ordination isomerism with examples. Stereoisomerism-geometrical and optical isomerism with examples. **10 hrs**

Nano materials:

Introduction, definition, preparation of nanoparticles from chemical vapor condensation and gas condensation process., carbon nanotubes – electrical, vibrational, thermal and mechanical properties. Applications of carbon nanotubes. General applications of nanomaterial in medicine, electronics and communications and catalysis. 4 **hrs**

Unit-II: Organic Chemistry-14hrs

Carbohydrates:

Classification and nomenclature of monosaccharides (aldotrioses, aldotetroses, aldopentoses and aldohexoses). Mechanism of osazone formation from D(+)-glucose. Conversion of glucose into fructose, conversion of aldopentose into aldohexose. Determination of configuration of D(+)-glucose and D(-)-fructose Epimerisation (conversion of glucose into mannose), difference between epimers and anomers. Formation of glycosides. Determination of ring size of D(+)-glucose & D(-)-fructose (six membered ring strutures). Conformational structures of glucose, sucrose, and maltose. Anomeric effect (glucose as an example). Concept of muta-rotation with mechanism.

Disaccharides: Structural elucidation of maltose and sucrose. Fischer and Haworth's structures of cellobiose and lactose. **Polysaccharides**: Partial structure of starch (amylose and amylopectin) and cellulose. **9 hrs**

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Amino acids and Peptides:

Defintion and classification of amino acids. Methods of synthesis of amino acids-Strecker's synthesis, phthalimide synthesis and malonic ester synthesis. Configuration of amino acids, acid-base properties of amino acids, isoelectric point of amino acids. Seperation of amino acids by electrophoresis. N-terminal and C terminal amino acids.

Peptides: Peptide bond. Carbobenzoxy method of synthesis of peptides. Use of di-tert-butyldicarbonate (t-BOC) and dicyclohexyl carbodiimide (DCC) in peptide synthesis. **5 hrs**

Unit-III : Physical Chemistry-14hrs

Photochemistry:

Photochemical and thermo chemical reaction: Definition, examples. Frank-Condon principle, Energy band gap.

Laws of Photochemistry: Grotthus-Draper's law and Einstein's law of photochemical equivalence (problems on Einstein law). Quantum yield, high and low quantum yield reasons for the deviation (problems on quantum efficiency). Primary and secondary process. Mechanism of Photolysis of hydrogen iodide, photolysis of hydrogen bromide and photolysis of acetone. Photophysical Process: Fluorescence, phosphorescence, Photoluminescence chemiluminescence, Bioluminescence, Photosensitization and Photo-inhibitors with examples, photochemical equilibrium. Distinguish between photo-physical and photo- chemical process. **8 hrs**

Polymer Chemistry

Introduction to polymers, definition, Nomenclature-Functionality. Types of polymerization. Mechanism of polymerisation: Free radical mechanism-cationic mechanism- Anionic mechanism, Determination of molar mass of polymers by Ostwald's Viscosity method. Number average, weight average, average molecular weights-Problems to be solved. Plastics: types-thermoplastics and thermosetting plastics. Properties: strength-crystalline and amorphous state-average molecular weight -polydispersity. Compounding of plastics. Moulding of plastics: Compression moulding-Injection moulding- Extrusion moulding. Introduction to conducting polymers. **6 hrs**

Unit-IV **14 hrs**

Molecular Spectroscopy:

Introduction, spectrum of electromagnetic radiations, interaction of EMR with molecules, absorption and emission spectrum, quantisation of different forms of energies (rotation, vibration and electronic) in molecules.

Rotation spectroscopy: Selection rule, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, the amplitude of diatomic molecular vibration, anharmonicity, Morse potential, dissociation energies. Fundamental frequencies, overtones, hot bands, Vibration-rotation spectroscopy : diatomic vibrating rotator P, Q and R branches. **7 hrs**

UV Spectroscopy:

Types of electronic transitions, λ_{max}, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward-Feiser Rules for calculation of λ_{max} for the following systems: α, β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinctions between cis and trans isomers. **4 hrs**

IR Spectroscopy:

Fundamental and non-fundamental molecular vibrations; IR absorption positionsof O, N and Scontaining functional groups; Effect of H-bonding, conjugation, resonance, and ring sizeon IR absorptions; Fingerprint region and its significance; application in functional group analysis.

3 hrs

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SEP BSc-V Semester: Elementary Research Methodology

(for Biochemistry, Biotechnology, Botany, Chemistry, Electronics, Environmental Science, Food Technology, Microbiology, Zoology)

Subject	**Elementary Research Methodology**	Semester	V
Number hr/week	2 hours	Total hours	32
Duration of the exam	2 hours	Credits	2

Learning Outcomes:
After the completion of this course the learner will be able to:

- Describe the basic concepts of research and its methodologies.
- Identify the appropriate research topics and set up hypothesis.
- Perform literature survey using library (print) and internet (online) sources.
- Design experiments/surveys, collect data and and represent data in table and figure forms.
- Analyze data with appropriate software tools, internet results and draw conclusions.
- Write scientific report/ review and prepare seminar/ conference presentations oral or poster.
- Understand the methods of citations and referencing styles, check plagiarism.
- Identification of lacuna (finding gap-areas), hypothesis formulation, framing objectives, and preparation of questionnaire.

Unit-1	***Scientific Methods and Research:*** Concept, Definitions of research; Purpose, importance, steps levels and rigor of research; different paradigms of research. ***Types of Research:*** Fundamental/Applied research, Descriptive/Analytical research, Quantitative /Qualitative research, Conceptual/Empirical research, Diagnostic/Hypothesis testing research, Conclusion oriented/Decision oriented research, Theoretical / Action research, Longitudinal /Cross sectional research ***Research Question:*** Introduction, types and identification; ***Research Problem:*** Definition, identification of problem, ways of understanding problem, criteria of a good problem, guidelines for selecting meaningful problem; ***Research Objective:*** Definition, broad and specific objectives, goals; ***Research Hypothesis:*** Meaning of research hypothesis, sources of hypothesis, qualities of workable hypothesis, utilities of hypothesis;	8 h
Unit-2	***Introduction and review of sampling***: Definition, needs, steps; Definitions of population, sample, sampling unit, sampling frame, sampling error and non sampling error; Steps in sampling; Fundamentals, characteristics, advantages and disadvantages of sampling. ***Types of sampling***: Probability (simple, stratified, systematic , cluster and multistage –in brief), Process of selecting random sample; non probability sampling (convenience, purposive, quota, snowball, self selecting); Advantages and disadvantages (brief discuss only) ***Size of sample***: Factor affecting size of sample, Testing the reliability of sample, Methods of estimating sample size, Process of selecting random sample	8 h

Unit-3	***Designing of research work:*** Introduction, Purposes, Characteristics of a research design, Principles of designing a research, conceptual framework and its operationalization, Sectors of research design, Research methods as research designing, similarities and differences between Research design and research method. ***Conventional research method:*** Principle and Importance conventional methods, Scientific methods as conventional methods, Characteristic of a scientific method; Aspects of scientific Method, Evolution of scientific Studies Steps in scientific methods,	8 h
Unit-4	***Historical Research Method:*** Nature and Steps in Historical method, Importance and fundamentals of Historical method, Sources of Historical data, Limitations. ***Experimental Research Method:*** Introduction, Types of experiments, steps in experimental research, Problems in experimentation; Ex-post facto research: definition and technique. ***Survey Research Method:*** Introduction, and Importance of survey method, Comparison of survey method with other methods; Objectives of social and survey and technical survey, types of social and technical survey, Steps in social and technical surveys, Pilot survey ***Case study:*** Introduction, Types of case studies: Exploratory and Hypothesis testing; Steps in case studies, Sources of case data, limitations. **Analysis of data**- introduction, data analysis tools. Project time line, literature review and references, research report structure, plagiarism.	8 h

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Paper VII: Modern Concepts of Chemistry-II

Total No of Lecture Hours: 56 hrs **4 hrs/Week**

Unit -I : Inorganic Chemistry -14 hrs

Nuclear Chemistry: The atomic nucleus-elementary particles, quarks, classification of nucleides based on Z and N values, nuclear stability, nuclear potential, binding energy. Nuclear Models: Shell model-salient features, forms of the nuclear potential, filling of orbitals, nuclear configuration, Liquid drop model, Fermi gas model, Collective model and Optical model. Radioactivity, radioactive decay kinetics, Parent-daughter decay-growth relationship-secular and transient equilibria, theories of α, β^-, $\beta+$ and γ-decay, internal conversion, Auger effect. **12 hrs**

Inorganic Polymers: Silicons: Definition, types manufacture, physical properties and applications. Flourcarbons: Definition, properties and uses, manufacture of Teflon and its uses. **2 hrs**

Unit-II: Organic Chemistry-14hrs

Alkaloids: Definition, occurrence and extraction of alkaloids. Structural elucidation of nicotine, synthesis of Nicotine by Spath method. Elucidation of structure of Ephedrine. Nagai synthesis of Ephedrine. Structure and biological importance of Atropine, Cocaine, Quinine and Piperine.

Terpenoids: Definition, classification and isolation of terpenes. Isoprene rule. Structure of Geraniol, Limonene and Zingerbene. Structural elucidation of Citral. Synthesis of Citral from methyl heptenone. Structural elucidation of Menthol. Kotz and Hessel synthesis of Menthol. Synthesis of Camphor (Haller process). **8 hrs**

Vitamins : Classification and biological importance of vitamins. Synthesis of vitamin C from D(+)-Glucose, synthesis of vitamin A. Synthesis of vitamin B_1 (Williams et.al). Structure of vitamin B_2 and vitamin-D. **2 hrs**

Hormones: Biological importance of hormones.Synthesis of adrenaline and thyroxin.

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Nucleic Acids: Definition of nucleosides and nucleotides. Purine and Pyrimidine bases. Structures of Purine and pyrimidine bases.Synthesis of nucleosides (synthesis of adenosine) and nucleotides (synthesis of adenosine-5^1-phosphate). **4 hrs**

Unit-III: Physical Chemistry-14hrs

Thermodynamics II: Nernst heat theorem, standard entropy, absolute entropy, Third law of thermodynamics-statement and its limitations. Partial molar quantities, Partial molar free energy (Chemical potential), variation of Chemical potential with temperature and pressure. Gibb's Duhem equation (derivation). Duhem Margules equation, definition of fugacity, activity and activity coefficient (problems). **7 hrs**

Statistical Thermodynamics: Concept of distribution, Maxwell-Boltzmann statistics, Most probable distribution law, concept of bosons and fermions. Derivation of distribution laws for Fermi-Dirac and Bose- Einstein statistics. **3 hrs**

Advanced Chemical Kinetics: Theories of reaction rate, Collision theory, Activated complex theory- derivation of expression for rate constant based on partition function. Chain reactions- steps, chain length and chain inhibition. Derivation of rate constant for thermal and photo chemical reaction of Hydrogen- bromine, pyrolysis of acetaldehyde. **4 hrs**

Unit -IV: Analytical Chemistry-14 hrs

Instrumental Methods of Analysis

Thermo gravimetric analysis: Instrumentation, TG curves, factors affecting TGA, Applications-drying temperature, Curie point, analysis of alloys and absorbed gases. Atomic absorption spectroscopy (AAS): Principle, instrumentation, hallow cathode lamp, and total consumption burner. Applications-determination of Lead in petrol and Mg in tap water.**7 hrs**

Group Theory: Definition of groups, subgroups, cyclic groups, simple theorems in group theory. Symmetry elements and symmetry operations, point group, Schoenflies notations, representations of groups by matrices, reducible and irreducible representations, characteristics of irreducible representations. Great Orthogonality theorem (without proof) and its importance. Character tables for C_{2v}, C_{3v} and D_{3h} point groups. Mullikan symbols for irreducible representations. **7 hrs**

VI Semester Chemistry Practical

Paper-VII : Applied Chemistry - II Practicals

4 hrs/Week

Part-A

Qualitative Analysis

Systematic Qualitative Analysis of a binary organic mixture of bifunctional organic compounds

Note: Small scale Separation and identification of type of solid mixture (Water insoluble organic compounds)

1. Acid+ Base (Benzoic acid + p-Chloro aniline, Nitro aniline)
2. Acid + Neutral (Salicylic acid, Cinnamic acid, Phathalic acid + Anilides, Amides, halogenated or nitro derivatives)
3. Base + Phenol (p-Toluidine, nitro aniline + Alpha or Beta Napthahol)
4. Phenol + Neutral (Alpha or Beta Napthahol, p- Chloro phenol +Di notro benzene + anilides, amides, halogenated hydrocarbons or nitro derivatives. Benzophenone).
5. Base + Neutral (p-Toluidine, Nitro aniline + Di notro benzene + Anilides, Amides, halogenated hydrocarbons or nitro derivatives and Benzophenone).

Part-B

Physical Chemistry Experiments (Electrical and Instrumental)

1. Potentiometric titrations:
   (a) Mohr's salt solution against dichromate solution.
   (b) Hydrochloric acid against sodium hydroxide using quinhydrone electrode.
2. Conductometric titration:
   (a) Hydrochloric acid against sodium hydroxide.
   (b) Mixture of acetic acid and hydrochloric acid against sodium hydroxide.
3. Colorimetric titration:
   (a) Copper (II) using ammonia.
   (b) Iron (III) using thiocyanate.
4. Determination of rate constant for the inversion of cane sugar using polarimeter.
5. Estimation of Protein by colorimetric method.
6. Estimation of Cholesterol by colorimetric method.
7. Determination of pKa value of acetic acid by Conductometric method.

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8. Determination of pKa value of dibasic acid by Potentiometric metho.
9. Determination of percentage composition of binary mixture using Abbe's refractometer.
10. Determination of cell constant (0.1 N solution of KCl to be provided) and determination of equivalent conductance at infinite dilution for a strong electrolyte.

Recommended Books: Part-A

1. Basic Inorganic Chemistry- F. A. Cotton, G. Wilkinson and P. L. Gaus; John Wiley and sons. Inc, 6th edition (1999).
2. Advanced Inorganic Chemistry, 6th edition; F. A. Cotton and G. Wilkinson.
3. Inorganic Chemistry IV edition; J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley (1993).
4. Inorganic Chemistry, II edition, D. F. Shriver, P. W. Atkins and C. H. Langford, ELBS; Oxford UniversityPress, 1994.
5. Chemistry of elements; N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).
6. Concise Inorganic Chemistry, 5th edition; J. D. Lee (1996).
7. Essentials of nuclear chemistry, 4th edition; H. J. Arniker, NAIL publishers (1995); Chapters 1, 3 and 4.
8. Inorganic Chemistry, 3rd edition; Gary. L. Miessler and Donald . A. Tarr (2007).
9. Advanced Organic Chemistry - Reactions, Mechanism and Structure, Jerry March, John Wiley (2008).
10. Advanced Organic Chemistry, F A Carey and R J Sundberg Plenum, (1990).
11. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman, (2000).
12. Organic Chemistry, R T Morrison and R N Boyd, Prentice-Hall, (1998).
13. Organic Chemistry, Volumes I and II, I L Finar, Longman, (1999).
14. Thermodynamics for Chemists, by S. Glasstone, East-West Press, New Delhi, (1960).
15. Thermodynamics, by Rajaraman and Kuriacose, East-West Press, (1986).
16. Physical Chemistry, P. W. Atkins, (2002).
17. Physical Chemistry: A Molecular Approach, Mc Quarie and Simon, Viva, New Delhi, (2001).
18. Principles of Physical Chemistry – B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co.1987
19. Vogel's Text book of Qualitative Chemical Analysis, J. Basse Z, G. H. Jeffery and J. Mendham, ELBS (1986).
20. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. BasseZ, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
21. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, New Delhi, (1996).
22. Practical Organic Chemistry - Mann and Saunders, (1980).
23. Textbook of Practical Organic Chemistry- A. I. Vogel, (1996).
24. Textbook of Quantitative Organic Analysis- A. I. Vogel, (1996).
25. A Handbook of Organic Analysis - Clarke and Hayes, (1964).
26. Comprehensive practical organic chemistry: Preparation and quantitative Analysis,

V. K. Ahluwalia, R. Aggarwal, University Press (India), 2000.
27. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S. Dhingra, University Press (India), 2000.
28. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency, Calcutta, 2000.
29. Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
30. Practical organic chemistry (Quantitative analysis), B. B. Dey, M. V. Sita raman and T. R. Govinda chari, Allied Publishers, New Delhi, 1992.

Part - B

Recommended Books:

1. Basic Inorganic Chemistry- F. A. Cotton, G. Wilkinson and P. L. Gaus; John Wiley and sons. Inc, 6th Edition (1999).
2. Advanced Inorganic Chemistry, 6th Edition; F. A. Cotton and G. Wilkinson.
3. Inorganic Chemistry IV Edition; J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley (1993).
4. Inorganic Chemistry, II edition, D. F. Shriver, P. W. Atkins and C. H. Langford, ELBS; Oxford University Press, 1994.
5. Chemistry of elements; N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).
6. Concise Inorganic Chemistry, 5th Edition; J. D. Lee (1996).
7. Inorganic Chemistry, 3rd Edition; Gary. L. Miessler and Donald . A. Tarr (2007).
8. Advanced Organic Chemistry - Reactions, Mechanism and Structure, Jerry March, John Wiley (2008).
9. Advanced Organic Chemistry, F A Carey and R J Sundberg Plenum Press, (1990).
10. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman, (2000).
11. Organic Chemistry, R T Morrison and R N Boyd, Prentice-Hall, (1998).
12. Organic Chemistry, Volumes I and II, I L Finar, ELBS Longman, (1999).
13. Organic Name Reactions and Molecular Rearrangements, Gurudeep Raj, Krishna Prakashan Media (P) Ltd, 3rd Edition, 2008.
14. Advanced Organic Chemistry, N. Tewari, Books and Allied (P) Ltd., 2013.
15. Heterocyclic Chemistry, Raj K Bansal, New Age International Publishers Ltd., 4th Edition. 2005.
16. Thermodynamics for Chemists, by S. Glasstone, East-West Press, New Delhi, (1960).
17. Thermodynamics, by Rajaraman and Kuriacose, East-West Press, (1986).
18. Physical Chemistry, P. W. Atkins, (2002).
19. Physical Chemistry: A Molecular Approach, McQuarie and Simon, Viva, New Delhi, (2001).
20. Principles of Physical Chemistry – B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co.1987
21. Vogel's Text book of Qualitative Chemical Analysis, J. Basse Z, G. H. Jeffery and J. Mendham, ELBS (1986).
22. Vogel's text book of Quantitative Chemical Analysis, 5thEdition, J. BasseZ, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).

23. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, New Delhi, (1996).
24. Practical Organic Chemistry - Mann and Saunders, (1980).
25. Textbook of Quantitative Organic Analysis- A. I. Vogel, (1996).
26. A Handbook of Organic Analysis - Clarke and Hayes, (1964).
27. Comprehensive practical organic chemistry: Preparation and quantitative Analysis,
28. V. K. Ahluwalia, R. Aggarwal, University Press (India), 2000.
29. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S. Dhingra, University Press (India), 2000.
30. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency, Calcutta, 2000.
31. Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
32. Practical organic chemistry (Quantitative analysis), B. B. Dey, M. V. Sitaraman and T. R. Govindachari, Allied Publishers, New Delhi, 1992.
33. Physical Chemistry, P. W. Atkins, Julio de Paula, ELBS, 7th Edition., (2002).
34. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
35. Organic Spectroscopy, William Kemp, Bloomsbury Publishing, 2022.
36. Organic spectroscopy by Pavia, Lampman, Kriz and Vyvyan, Cengage Publishers, 2009.
37. Spectroscopy by H. Kaur, A pragati edition-9th edition 2014.
38. Molecular structure and spectroscopy by G. Aruldhas, 2nd edition-2014
39. Quantum Chemistry, R. K. Prasad, New Age International, 2nd Ed. (2000).
40. Chemical Kinetic Methods, C. Kalidas, New Age International Publisher, New Delhi (1995)
41. Physical Chemistry, P. Atkins and J. D. Paula, 9thEdition., Oxford University Press (2010).
42. Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publications Meerut (1988).
43. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
31. Experimental Physical Chemistry by Wilson, New combe& others, Pergamon Press, (1962).
32. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983).
33. Practical in Physical Chemistry A. Modern Approach, P.S Sindhu, Mac. Millan Publishers Delhi
34. Introduction to Quantum Chemistry, A. K. Chandra, Tata McGraw Hill, (1988).
35. Spectroscopy by GurudeepChatwal, Sham K Anand (2002)
36. A text book of Physical Chemistry- A. S. Negi& S C Anand, 3rd edition 2022
37. Advanced Practical Chemistry, Jagadamba Singh, Pragathi, Publications (2017).
38. College Practical Chemistry: V K Ahluwalia, SunithaDhingra and AdarshGulati. University Press-2011.

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Davangere University
Department of Chemistry
B.Sc VI Semester Chemistry, Syllabus (SEP)

Paper VIII: Applied Chemistry – II

Total No of Lecture Hours: 56 hrs **4 hrs/Week**

Unit-I: Inorganic Chemistry-14 hrs

Bio-Inorganic Chemistry

Essential, non essential and trace elements in biological processes.Macro and Micro nutrients.Role of metal ions in biological system.Iron-function of haeme and globin, co-ordination environment of haemoglobin. Zinc-role of carbonic unhydrase, carboxy peptidase. Magnesium in chlorophyll. Molybdenum-role of nitrogenase. **5 hrs**

Metal Carbonyls:

$Cr(CO)_6$, $Co_2(CO)_8$, $Mn_2(CO)_{10}$: Eighteen electron rule and its deviations with examples. Applications of co-ordination / organometallic compounds: Cis-platin in cancer therapy, Na_2Ca EDTA in the treatment of heavy metals (Pb, Hg) poisoning, Wilkinson's catalyst in alkene hydrogenation, Monsanto acetic acid process. **4 hrs**

Organic reagents in inorganic quantitative analysis:

Advantages and disadvantages of organic reagents in inorganic analysis, use of Nitron, Rhodamine-B, Oxine, DMG and EDTA. **2 hrs**

Acids and Bases:

Lux-Flood theory, Cady-Elsey theory and Usanovich concept of acids and bases. Hard and soft acids and bases: Definition, classification, characteristics, Pearson's HSAB principle, limitations and applications. **3 hrs**

Unit-II: Organic Chemistry-4 hrs

Rearrangements:

Wagner-Meerwein, Fries, Wolff, Beckmann, Hofmann, Curtius, Lossen and Schmidt rearrangement. Benzil-benzilic acid rearrangement, Arndt-Eistert reaction, Demjanov reaction. Stevens, Wittig and Favorskii rearrangements, Dienone-phenol, Baker-Venkatraman rearrangement, Baeyer-Villiger oxidation, Neber rearrangement, Benzidine rearrangement (Mechanism and synthetic applications also needs to be discussed) **9 hrs**

Heterocyclic compounds:

Classification and nomenclature, structure, synthesis (any three methods each) and reactions (any four) of pyrrole, furan, thiophene, pyridine and indole, Comparison of basicity and aromaticity of pyrrole and pyridine. **5 hrs**

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Unit-III: Physical Chemistry-14 hrs

Quantum Mechanics:

Classical mechanics-limitation, black body radiation, Plank's radiation law derivation. Postulates of quantum mechanics, derivation of Schrodinger wave equation based on the postulates of quantum mechanics. Eigen values and Eigen functions and their significance, Hamiltonian, Linear and Laplacian operators. Application of Schrodinger wave equation to simple systems: i) a free particle ii) a particle in one-dimensional box iii) a particle in three-dimensional box iv) Simple Harmonic oscillator. Definition of system, assembly and ensemble-types of ensemble, occupation number, macro and micro state, statistical weight factor, configuration probability. Distinguish between classical and quantum statistical mechanics. Postulates of statistical mechanics.Partition function- definition, derivation for rotational and vibrational partition function.Expression for thermodynamic functions in terms of partition function (no derivation), internal energy, enthalpy, entropy, Helmholtz free energy, Gibb's free energy (problems). **14 hrs**

Unit IV: Spectroscopy: 14hrs

NMR Spectroscopy:

Basic principles of nuclear magnetic resonance spectroscopy, position of signals, internal standards. Chemical shift. Factors influencing the chemical shift- Inductive effect (CH_3F, CH_3Cl & CH_3Br to be considered), hydrogen bonding effect, anisotropic effects (De-shielding of aldehyde proton & ethylene protons, Shielding of acetylene protons). Number of signals.Splitting of the signals. Application in structural identification of simple organic molecules-1,1,2-trichloroethane, 1,1- dichloroethane, p-xylene, ethanol, acetaldehyde and Benzoic acid. The ^1H NMR spectra of propionaldehyde, isopropyl bromide 1,3-dichoropropane, ethyl bromide and toluene), spin-spin coupling and high-resolution NMR spectra, interpretation of PMR spectra of simple organic molecules. Combined applications of IR, UV, MS and NMR techniques for structural determination of simple organic molecules (Ethanol, Benzaldehyde, acetophenone, 1,4-dichloro benzene, cinnamic acid, benzamide, p-nitro aniline). **9 hrs**

Mass Spectrometry:

Basic principles, instrumentation, base peaks, molecular ion, Mclafferty rearrangement (butanal to considered). The nitrogen rule.Application mass spectrometry-the mass spectra of 1-bromopropane, toluene, 1-butanol &benazaldehyde. **3 hrs**

Electron Spin Resonance (ESR) Spectroscopy:

Principle, hyperfine splitting splitting, g-factor, ESR of simple free radicals and transition metal ions. **2 hrs**

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DavangereUniversity

Bachelor of Science (B.Sc.) CHEMISTRY

Curriculum Structure for Undergraduate Programme for 2024-25

Sl. No.	Course/Paper Code	Title of the Paper	Subject Category	Teaching Hours/ week	Semester End Exam.	Internal Assessment	Total Marks	Credits	Examination Duration
1	2	3	4	5	6	7	8	9	10
Semester-I									
1	24SEP-CHET-I	FUNDAMENTALS OF CHEMISTRY	**MC-T**	04	80	20	**100**	03	3 Hrs.
	24SEP- CHEP -I	FUNDAMENTALS OF CHEMISTRY PRACTICALS	**MC-P**	04	40	10	**50**	02	3 Hrs.
	Total			**08**	**120**	**30**	**150**	**05**	---
Semester-II									
2	24SEP-CHET-II	CONCEPTS OF CHEMISTRY	**MC-T**	04	80	20	**100**	03	3 Hrs.
	24SEP-CHEP-II	CONCEPTS OF CHEMISTRY PRACTICALS	**MC-P**	04	40	10	**50**	02	3 Hrs.
	Total			**08**	**120**	**30**	**150**	**05**	---
Semester-III									
3	24SEP-CHET-III	SELECTED TOPICS IN CHEMISTRY - I	**MC-T**	04	80	20	**100**	03	3 Hrs.
	24SEP-CHEP-III	SELECTED TOPICS IN CHEMISTRY - I PRACTICALS	**MC-P**	04	40	10	**50**	02	3 Hrs.
	Open Elective (Optional)		**EL/OP-I**	02	40	10	**50**	02	2 Hrs.
	Total			**10**	**160**	**40**	**200**	**07**	---
Semester-IV									
4	24SEP-CHET-IV	SELECTED TOPICS IN CHEMISTRY - II	**MC-T**	04	80	20	**100**	03	3 Hrs.
	24SEP-CHEP-IV	SELECTED TOPICS IN CHEMISTRY - II PRACTICALS	**MC-P**	04	40	10	**50**	02	3 Hrs.
	Open Elective (Optional)		**EL/OP-II**	02	40	10	**50**	02	2 Hrs.
	Total			**10**	**160**	**40**	**200**	**07**	---
Semester-V									
5	24SEP-CHET-V	MODREN CONCEPTS OF CHEMISTRY-I	**MC-T**	04	80	20	**100**	03	3 Hrs.
	24SEP-CHET-VI	APPLIED CHEMISTRY-I	**MC-T**	04	80	20	**100**	03	3 Hrs.
	24SEP-CHEP-V	MODREN CONCEPTS OF CHEMISTRY PRACTICALS	**MC-P**	04	40	10	**50**	02	3 Hrs.
		ELEMENTARY RESEACH METHODOLOGY		04	40	10	**50**	02	2 Hrs.
	Total			**16**	**240**	**60**	**300**	**10**	---

Semester-VI									
6	24SEP-CHET-VII	MODERN CONCEPTS OF CHEMISTRY-II	**MC-T**	04	80	20	**100**	03	3 Hrs.
	24SEP-CHET-VIII	APPLIED CHEMISTRY-II	**MC-T**	04	80	20	**100**	03	3 Hrs.
	24SEP-CHEP-VI	APPLIED CHEMISTRY-PRACTICALS	**MC-P**	04	40	10	**50**	02	3 Hrs.
	24 SEP-CHEP-VII	Project	**MC-P**	04	40	10	**50**	02	2 Hrs.
	Total			**16**	**240**	**60**	**300**	**10**	---
	Grand Total			**68**	**1040**	**260**	**1300**	**44**	---

MC: *Major Course*;**MC-T:***Major Course Theory*;***MC*-P:***Major Course Practical*;

El/Op:*Elective/Optional*;***AEDP*:** *Apprenticeship Embedded Degree Programme.*

*In Semester-III and Semester-IV open elective papers are offered. There shall be 02 elective papers offered during each semester (Semester-III and Semester-IV) by every major subject offering Department, where a student shall choose/select/opt 01 elective paper out of two to study in each semester (Semester-III and Semester-IV).

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B.Sc., Question Paper Pattern

Chemistry- V Sem and VI Sem

Time: 3 Hrs **PART-A** **Max Marks. 80**

I Answer All of the following questions. **10x2=20**

1. a
   b
   c
   d
   e
   f
   g
   h
   i
   j

PART-B

II Answer any SIX of the following questions. **6x5=30**

2.
3.
4.
5.
6.
7.
8.
9.

Note: Two questions from each unit.

PART-C

Answer any Three of the following questions. **3x10=30M**

10. **(5+5)M or (6+4)M**
11. **(5+5)M or (6+4)M**
12. **(5+5)M or (6+4M**
13. **(5+5)M or (6+4M**

Note: Minimum One question from each unit.

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