A Documentary Support

for

Matric No. – 1.1.2

employability/ entrepreneurship/ skill development

under the

Criteria – I

(Curriculum Design and Development)

Key Indicator - 1.1

in

Matric No. – 1.1.2

MASTER OF SCIENCE (CHEMISTRY)

2003

Registrar
Dr. B.R.A. University, Agra

Mapping of course to:

Employability | Entrepreneurship | Skills Development

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Programme Outcomes

Ensures the students to understand, acquire knowledge in Quantum Chemistry, Group Theory Symmetry, Photochemistry, Advanced Concepts in Spectroscopy, Polymer Science, Green Chemistry, Solid State, Natural Products, disconnection approach as well as role of Modern Synthetic Reagents in Organic Transformations, Nanotechnology, Thermodynamics, Advanced Chemical Kinetics, Surface Analytical Techniques to measure Surface Properties of materials and the Advanced Principles of various Electrochemical Techniques and all branches of Chemistry. This syllabus also ensures the students to understand acquire knowledge and have hands on experience in multistep Inorganic/ Organic Compound Synthesis and Analysis by using Spectroscopic Techniques and have hands on experience in multistep Organic Synthesis and Analysis by using Spectroscopic Techniques.

PROGRAME SPECIFIC OUTCOME (PSO)

PSO 1- Students will understand the basic concepts, fundamental principles and the scientific theories related to various scientific phenomena and their relevancies in the day to day life. They will also be able to acquire knowledge about the fundamentals and applications of chemical and scientific theories.

PSO 2- Students will find that every branch of science and technology is related to science subjects but also in all aspects related to life.

PSO 3-Student will become familiar with different branches of chemistry like analytical, organic, inorganic, physical, environmental, polymer, medicinal. They will also learn to apply appropriate techniques for the qualitative and quantitative analysis of chemicals in the laboratories in industries.

PSO 4- The student will acquire knowledge of chemical thermodynamics, kinetics, electrochemistry, organic, inorganic, bio-organic, bio-inorganic, spectroscopy and skill in industrial chemistry.

PSO 5- Viewing chemistry as a tool developing mind and critical attitude and thinking of logical reasoning that is prepared to serve in diverse fields.

PSO 6- Student will gain a thorough knowledge in the subject to be able to work in projects at different research as well as academic institution.

C-1 **COMPUTERS FOR CHEMISTS** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- acquire knowledge about the history and development of computer.

CO2-aquint will the different softwares and the operating systems used in computer.

CO3- provide basic knowledge about the internet, networking.

CO4- aware about the tool used in chemistry.

CO5- acquire knowledge about the use of MS office, multimedia tool for presentation in chemistry.

C-2 **INORGANIC CHEMISTRY** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1-understand the principle of various bonding theories and identify the structure and bonding of metal cluster and complex molecules.

CO2- have a firm foundation in the fundamental techniques and scientific theories in nuclear chemistry.

CO3- understand the bonding and structure in metal clusters and also the spatial arrangements of molecules with different oxidation state of metals.

CO4- learn the synthesis applications of macrocycles in biological system.

CO5- appreciate the existence and application of inorganic compounds.

C-3 **ORGANIC CHEMISTRY** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- acquaint with the basic ideas of chemical bonding, stability in molecules and obtain theoretical understanding of how reactive intermediates.

CO2- obtain theoretical understanding of how inorganic reaction take place in substitution reactions.

CO3- obtain theoretical understanding of stereochemistry of inorganic molecules of elimination reactions.

CO4- understand the reactions and mechanistic pathways of organic reactions.

CO5- explore about the reagents commonly used in organic synthesis.

C-4 **PHYSICAL CHEMISTRY** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1-get basic idea about fundamental of quantum chemistry.

CO2- get exposure about the statistical thermodynamics.

CO3- study the kinetics of different types of reactions and methodologies.

CO4- impart knowledge of micelles and macromolecules.

CO5- get the fundamentals and theories of electrochemistry.

C-5 **ADULTERANTS (MINOR for other Faculty)** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- get information about the different types of food and adulteration based on local and national needs.

CO2- to study the detection of adulterants.

CO3- analyze the adulterant in local materials commonly available in house hold products for employability.

CO4- impart knowledge about the false labelling and fake products in food packets available nationally and internationally.

CO5- get awareness about the food safety and standard and different standard laid down by the government.

C-6 **GROUP THEORY AND SPECTROSCOPY** **CREDITS-05**

After completion of this course successfully the students will be able to

CO1- understanding the basic concepts of molecular symmetry and to analyze the point group of chemical molecules.

CO2- apply the applications of rotational and vibrational spectroscopy.

CO3- On learning the course, students will be able to apply the concepts of electrostatic transitions in molecules.

CO4- familiarize the importance of AAS in metal analysis.

CO5- perform low cost, analysis of metals using flame photometry for local need.

C-7 BIO-INORGANIC CHEMISTRY CREDITS-05

After completion of this course successfully the students will be able to

CO1- learn the transport mechanism of metal ions in biological systems.

CO2- familiarize with structure and functions of biomolecules.

CO3-impart knowledge of bio-inorganic pigments.

CO4- learn the concepts of biochemistry of metals as well as nitrogen fixation.

CO5- to study the fundamentals of toxicity of metals and also to learn the metals ions as chelating agent in medicine.

C-8 BIO-PHYSICAL CHEMISTRY CREDITS-05

After completion of this course successfully the students will be able to

CO1- to understand the structure and theories of enzymes.

CO2- appreciate the importance and function of coenzymes.

CO3- study of the free energy in biochemical reactions.

CO4- learn the functions of transport of ion in cell membrane.

CO5- understand the different physical parameters in biological systems.

C-9 SPECTROSCOPIC METHODS OF ANALYSIS CREDITS-05

After completion of this course successfully the students will be able to

CO1- understand the theories of absorption spectroscopy.

CO2- know the fundamentals of raman spectroscopy.

CO3- learn the fundamentals and applications of NMR spectroscopy.

CO4- understand the fragmentation takes in mass spectrometry.

CO5- know the fundamentals of electronic spin resonance spectroscopy.

C-10 M.Sc. CHEMISTRY PRACTICAL (Semester VIII) CREDITS-04

After completion of this course successfully the students will be able to

CO1-analyze common chemical from their identity and composition

CO2- estimate different ions, and organic compounds quantitative and qualitatively.

CO3- gather experience on synthesis of inorganic materials and organic compounds.

CO4- analyze structure of organic compounds by use of spectra

CO5- have hand on experience / practical knowledge in performing physical experiments.

C-11 RESEARCH PROJECT CREDITS-08

After completion of this course successfully the students will be able to

CO1- understand research problems.

CO2- execute literature search on a research topic.

CO3- design new experiments to address research problems.

CO4- conducts experiments in a scientific way.

CO5-analyze and interpretation of the results.

C-12 PHOTO AND STEREOCHEMISTRY CREDITS-05

After completion of this course successfully the students will be able to

CO1- acquaint with the general principles involved in photochemistry.

CO2- understand the organic reactions involved in photochemistry and able to differentiate between photochemical and thermal reaction.

CO3- provide concept of chirality, various method for projection of chiral molecules, and effect of rotation on energy level.

CO4- learn the chiroptical properties and will able to analyze how a chiral compound is optical active.

CO5- get knowledge of separation of stereo organic compounds i.e., resolution of racemates and also how the organic compounds show selectivity based on functional group.

C-13 **SOLID STATE CHEMISTRTY, SURFACE PHENOMENONAND CHEMICAL EQUILIBRIA** CREDITS-05

After completion of this course successfully the students will be able to

CO1- understand the basic knowledge of crystal structure.

CO2- provide understanding of crystal defects in solid state and the properties associated in solid.

CO3- impart knowledge of electronic properties of metal, insulators and semiconductors.

CO4- learn the concept of physical and spectral properties of the surface of solid.

CO5- study the fundamental physical properties of mixing of one and two component system.

C-14 **COORDINATION CHEMISTRY** CREDITS-05

After completion of this course successfully the students will be able to

CO1- identify the bonding, structure and energy of selected coordination complexes.

CO2-perform applicationsof coordination compounds.

CO3- study the physical parameters of coordination compounds.

CO4- understanding the reaction mechanism in coordination compounds.

CO5- understanding the applications of spectral and magnetic properties of lanthanides and actinides.

C-15 **BASIC ANALYTICAL CHEMISTRY** CREDITS-05

After completion of this course successfully the students will be able to

CO1- apply amperometry technique in the characterization of metal ion

CO2- apply colometry for the identification and characterization.

CO3- understand and apply the conductometry for the characterization of metal ion

CO4- estimate metal ion using polarographic technique

CO5- estimate metal ion through voltammetry

C-16 CHEMISTRY OF NATURAL PRODUCTS CREDITS-05

After completion of this course successfully the students will be able to

CO1-understand the structure of selected plant pigments.

CO2- appreciate the importance of alkaloids.

CO3- understand the basic of terpenoids and carotenoids from local plants materials as natural products.

CO4- understand the isolation of steroids.

CO5-perform the synthesis of selected antibiotics and action of antibiotics as drugs.

C-17 INTERDISCIPLINARY TOPICS CREDITS-04

After completion of this course successfully the students will be able to

CO1- appreciate the importance of nanoscience and technology.

CO2- understand the role of green chemistry in chemical science.

CO3- study the concept of supra molecular chemistry and its applications.

CO4- understand the environment and atmosphere and the role of greenhouse effect, acid rain, air pollution in the environment.

CO5- understand the role of aquatic pollution and also study the hydrosphere and soils.

C-18 SEPARATION TECHNIQUES CREDITS-04

After completion of this course successfully the students will be able to

CO1- learn the applications of TLC and column chromatography in analysis of mixtures.

CO2- understand the principle, experimental setup and applications of partition.

CO3-acquaint the knowledge of GC in analysis of samples.

CO4- understand analyze and applications of HPLC and also applications of supercritical fluid and gel permeation chromatography.

CO5- learn the experimental setup and applications of solvent extraction.

C-19 ADVANCED ANALYTICAL METHODS CREDITS-04

After completion of this course successfully the students will be able to

CO1- appreciate the importance of data analysis in chemistry.

CO2-analyze common metal using inductively coupled plasma spectroscopy.

CO3- familiarize with instrumentation and application of x-ray diffraction.

CO4-gather knowledge of scanning electron microscopy and transmission electron microscopy in analysis of samples.

CO5- study the fundamental applications of thermal gravimetric analysis of materials.

C-20 ADVANCED INORGANIC CHEMISTRY CREDITS-04

After completion of this course successfully the students will be able to

CO1- advance learning of transition metal complexes in chemistry.

CO2-understanding of bio-inorganic metals in living system.

CO3- learning the role of metalloenzymes in biological system.

CO4- study the metal nucleic acid interaction as well as metal in biological systems.

CO5- known the excited states of metal complexes in coordination chemistry.

C-21 ADVANCED ORGANIC CHEMISTRY CREDITS-04

After completion of this course successfully the students will be able to

CO1- learning the basic of heterocyclic chemistry.

CO2- getting an idea about the mechanistic pathway of various common organic rearrangements.

CO3- understanding the concept and applications of pericyclic reactions in advanced organic chemistry.

CO4- learning the concept of disconnection approach in the designing and synthesis of complexed molecules.

CO5- understanding the structure and used of some important drugs.

C-22 ADVANCED PHYSICAL CHEMISTRY CREDITS-04

After completion of this course successfully the students will be able to

CO1- understanding and appreciate the advanced concepts of thin film and Langmuir-Blodgett films and liquid crystal.

CO2- advanced study of polymeric materials and its applications.

CO3-study ionic conductors its properties and applications.

CO4- developing skill in computational treatment of atoms and molecules.

CO5- studying of general properties of liquids.

C-23 POLYMER CHEMISTRY CREDITS-04

After completion of this course successfully the students will be able to

CO1- understanding the basic importance of polymers.

CO2- developing skill in the polymer characterization.

CO3- evaluating the structure and various properties of crystalline polymer.

CO4- learning the process of polymerizations.

CO5- understanding the properties of commercial polymer and its applications.

C-24 INDUSTRIAL CHEMISTRY CREDITS-04

After completion of this course successfully the students will be able to

CO1- understanding and apply of cement, ceramic and glass.

CO2- learning the basic of composites formation and its application.

CO3- understanding the different fertilizer and its specific application.

CO4- knowing the utilization and preparation of petrochemicals and lubricants.

CO5- knowledge of paints and its formulation.

C-25 **MEDICINAL CHEMISTRY** **CREDITS-04**

After completion of this course successfully the students will be able to

CO1- understanding the advanced knowledge of drug design and developments of new drugs.

CO2- studying of various pharmacokinetics of drugs and its applications in drug developments.

CO3- learning pharmacodynamics of drugs in medicinal chemistry.

CO4- understanding the drugs used as antineoplastic.

CO5- understanding the drugs used as cardiovascular drugs.

C-26 **M.Sc. CHEMISTRY PRACTICAL (SEMESTER X)** **CREDITS-04**

After completion of this course successfully the students will be able to

CO1- learn about the role of flame photometry in the analysis of metals.

CO2- learn about the spectroscopic and chromatographic technique in the analysis of substance.

CO3- evaluate the organic compound from natural resources.

CO4- learn the multistep and green synthesis of organic compounds.

CO5- utilization of thermodynamic spectroscopy, polarography in the analysis of sample.

C-27 **RESEARCH PROJECT** **CREDITS-08**

After completion of this course successfully the students will be able to

CO1- understand research problems specific topic.

CO2- execute literature search on a research topic assigned to students.

CO3- design new experiments to address research problems based on the allotted research topics.

CO4- conducts experiments in a scientific way.

CO5-analyze and interpretation of the results.

SEMESTER-VII

C-1 COMPUTERS FOR CHEMISTS

M.M. 75
Credits-05

Unit 1: History of Development of Computer, Classification of Computers, Generation of Computers, General Awareness of Computer Hardware – CPU and other peripheral devices, Input, Output and Auxiliary Storage Devices

Unit II: Softwares and their types (System Software & Application Software), Computer Language and their types (Low Level & High Level Languages), Operating System, requirement of OS, Types of OS : Single User and Multi-user OS with example

Unit III: **Computer and Internet 1:** What is Networking, Different types of Networking (LAN, WAN and MAN), Optical Fibres, Ethernet, Network Interface Card, Hub, Switch, Routers, Modems, Protocols TCP/IP, Internet Service Providers (ISP), Web Search Engine, Intranet, Difference between Internet & Intranet

Unit IV: Educational and Research Resources on Net for Chemical Sciences, Online Tutorials and Lectures Virtual Labs, Electronic Journals, E-books, Digital Libraries, Use of Chemdraws like tools for Chemical Education.

Unit V: MS Word, facilities in MS Word, MS- Excel, Facilities in MS Excel, MS PowerPoint, Oral Presentations using visual aids such as Power Point etc. Adobe Photoshop (Introductory), Multimedia, Digital Arts.

Employability Entrepreneurship Skill Development

C-2 **INORGANIC CHEMISTRY** **M.M. 75**

Credits-05

Unit I: **Mechanism of inorganic reactions**:

Mechanisms of redox reactions of metal complexes, Substitution reactions of octahedral and square planar complexes in aqueous solutions, cis- and trans effects.

Unit II: **Nuclear Chemistry**:

Radioactive decay and equilibrium, Nuclear reactions and its types, Q-value, cross section of reactions, chemical effects of nuclear transformation. Nuclear fission–Fission products, Fission Yield and Nuclear Reactors, Nuclear Fusion and Stellar energy.

Radioactive techniques **(i)** Tracer techniques (neutron activation analysis)

(ii) Counter techniques such as G.M., Ionization and proportional counters

Unit III: **Metal clusters**:

Higher boranes, carboranes, metalloboranes, metallocarboranes, metal carbonyl and halide clusters. Compounds with metal-metal multiple bonds, Wade's rule, LNCC & HNCC, Caping rule.

Unit IV: **Chemistry of macrocycles**:

Complexes of crown ethers, porphyrins and cryptands, their synthesis, important characteristics with special reference to hole size and importance in biological systems.

Unit V: **Inorganic Polymers**:

Classification, characteristics and properties. Type of inorganic polymerization (step growth, chain growth, ring opening, reductive coupling, condensation synthesis). Synthesis, properties and applications of important inorganic polymers: polyphosphazines, phosphonitrilic halides, polysiloxanes, polysilanes, co-ordinate polymers, condensed phosphate, silicates and S-N compounds.

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson , John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Comprehensive Coordination Chemistry Eds G.Wilkinson, R.D. Gillars and J.AMcCleverty,Pergamo
5. Nuclear and Radioactivity- Friedlander G; Kennedy J.M Mamas E.S., Miller J.M., Wiley Inter Science N.Y. (1981).
6. Nuclear Reactions R. Singh & S. N. Mukherjee, New Age International. New Delhi.

C-3 **ORGANIC CHEMISTRY** **M.M.75**

Credits-05

Unit-I: (a) Delocalized chemical bonding – conjugation, cross conjugation, resonance, hyperconjugation, tautomerism.

(b) Reaction intermediates- Generation, geometry, stability and reactions of carbocations, carbanions, free radicals, carbenes, nitrenes and benzynes.

Unit-II: **Substitution reactions:**

SN^1, SN^2 SN^{1i} and SN^{2i} mechanisms, neighbouring group participation in aliphatic nucleophilic substitutions, Electrophilic and nucleophilic aromatic substitutions reactions.

Unit- III: **Elimination reactions:**

The E^1, E^2, E^1CB mechanisms, orientation in E^2 reactions (Saytezeff and Hoffman), Pyrrolyticsyn-elimination, Stereochemistry of elimination reaction.

Unit- IV: **Common Organic Reaction and Mechanism**

Aldol, Perkin, Diekmann condensation, Reformatsky, Benzoin, Wittig, Mannich reaction, Michael reaction, Diels-Alder reaction, Knoevengel reaction.

Unit- V: **Reagents in Organic Synthesis:**

Lithium aluminium hydride, Sodium borohydride, lithium dialkylcuprate, lithium di-isopropylamine, Grignard reagents, mono &dialkylboranes, 1,3-Dithiane, Gerard's reagent P & T, dicyclohexylcarbodimide, N-bromosuccinimide.

Books Suggested

1. Vogel's Text book of Quantitative Analysis, revised. J. Bassett, R. C. Denney. G.H. Jeffery and J. Mendham ELBS.

2. Experiments and Techniques in Organic Chemistry, D. Pasto. C. Johnson and M. Miller, Prentice Hall.

3. Macroscale and Microscale Organic experiments, K.L. Williamson. D.C. Heath.

4. Systematic qualitative Organic Analysis, H. Middleton, Adward Arnold.

5. Handbook of Organic Analysis Qualitative and Quantitative. H. Clark, Adward Arnold.

6. Vogel's text book of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

7. Reaction and Reagents , O.P.Agrawal, Krishna Publication, Meerut.

C-4 **PHYSICAL CHEMISTRY** **M.M.75**

Credits-05

Unit-I : **Quantum Chemistry:**

Approximation Method:The variation theorem, Linear variation principles, Perturbation theory (First order and non degenerates), application of variation method and perturbation theory to be helium molecule.

Unit-II: **Statistical thermodynamics:** Chemical equilibria and equilibrium constant interms of partition function, Fermi-Diarc statistics, Distribution law and application of fomatal, Bose-Einstein statistics-distribution law and application to helium.

Unit-III: **Chemical Dynamics:** Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory, ionic reaction, kinetic salt effects, steady state kinetics, kinetics and thermodynamic control of reaction, treatment of unimolecular reactions treatment of unimolecular reactions. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde decomposition of ethane, Photochemical (hydrogen-bromine and hydrogen-chlorine reactions)

Unit-IV: **Micelles:** Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factor-affecting the CMC of surfactants.

Macromolecules: Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystals polymers, kinetics of polymerization, mechanism of polymerization.

Unit-V: **Electrochemistry:** Electrochemistry of solution, Debye-Huckel-Onsager treatment and its extension, ion solvent interaction, Debye-HuckelJerum mode, thermodynamic of electrified interface equation, over potential, exchange current density.

Book Suggested:

1. Physical chemistry, P.W. Atkins, ELBS
2. Introduction to Quantum chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum chemistry, Era N Levine, Prentice Hall.
4. Coulson's Valence, R. McWeeny, ELBS.
5. Chemical Kinetics, K.J. Laidler, McGraw- Hill.
6. Kinetics and mechanism of chemical transformations, J. Rajaraman and J. Kuriacose, McMillan.
7. Micelles, Theoretical and applied aspect, V. Moroi, Plenum.
8. Modern electrochemistry, Vol. 1 and Vol. 2, J.O.M. Bockris and A.K.N. Reddy, Plenum.

C-5 ADULTERANTS (MINOR for Other Faculty) M.M. 75

Credits-04

Unit-I **Introduction**

Food and food for life, adulteration, types of adulteration, identification of adulterants, adulteration problems, common adulterants in food and their injurious effects on health

Unit-II **Detection of adulterants**

Qualitative Analysis : Qualitative macro, semi-micro and micro techniques involving wet chemical tests, flame tests, etc, microscopic examination
Quantitative Analysis : Titrimetric and gravimetric method, instrumental methods

Unit-III **Materials to be analysed**

Milk analysis: Detection of added water, neutrialzers, hydrogen peroxide, formalin, sugar, starch, urea, ammonium sulphate, salt, pulverized soap, detergents, skim milk powder, vegetable fat, benzoic acid, salicylic acid, boraxm borax, boric acid and buffalo milk in cow's milk

Khoya and Sweet analysis: Detection of starch (maida, etc) aluminium foil replacing silver foil in sweets, detection of washing powder in ice cream.

Spice analysis: Detection of added starch, lead chromate, Metanil yellow in temeric powder, powdered dung in coriander powder, identification of artificially coloured foreign seeds shown as cumin seed, poppy seed and black pepper

Unit-IV **False labelling and fake products in food packets:** How to read a food label, elements of a food label, list of ingredients, terms used in food labels, market survey and analysis of packaged product/materials. Hazards of reckless use of faulty food preservatives in food products

Unit-V **Creation of public awareness:** Dissemination of information about the "food safety and standard (Packaging and Labelling) Regulation, Act 2011". Creation of consumer awareness for checking food adulteration and about fake and spurious products through print and view media

SEMESTER-VIII

C-6 GROUP THEORY AND SPECTROSCOPY M.M. 75

Credits-04

Unit-I: Symmetry elements and symmetry operation, point groups and their classification with examples, sub groups. General methods of assigning point groups to a molecules like water (C_{2v}), ammonia (C_{3v}), phosphorous (D_{3h}) and Xenon tetrafluoride (D_{4h}).

Unit-II: Rotational and vibrational spectroscopy: Introduction, fundamental principle and applications

Unit-III: Electronic spectroscopy: Introduction, theory involving electronic transition and applications

Unit-IV: Atomic absorption spectroscopy: Introduction, principle, technique instrumentation and applications

Unit-V: Flame photometry: Introduction, principle, technique, instrumentation, interference and applications

Books Suggested:

1. Modern spectroscopy, J.M. Hollas, John Willey.

2. Applied Electronic Spectroscopy For Chemical Analysis. Ed.H, Windawi and F.L. Ho, Wiley Interscience.

3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.

4. Physical Method in Chemistry, R.S. Drago, Saunders College.

5. Introduction to Molecular Spectroscopy, G.M. Barrow, Mcgraw Hill.

6. Basic Principles of Spectroscopy, R. Chang. McGraw Hill.

7. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBHOxford.

8. Introduction of Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.

9. Introduction of Magnetic Resonance, A. Carrington and A.D. Maclachlan, Harper and Row.

C-7 **BIO-INORGANIC CHEMISTRY** **M.M.75**

Credits-04

Unit-I: **Metal ions in biology:**
Molecular mechanism of ion transport across membranes sodium and potassium pump, Essential and trace elements.

Unit-II: **Biomolecules:**
Structures and functions of metalloproteins in electron transport process - cytochromes and Iron-Sulphur proteins, DNA polymerisation, glucose storage.

Unit-III: **Bio-inorganic pigments:**
Chlorophyll, Photosystem-I and Photosystem-II in cleavage of water, haemoglobin, myoglobin, haemocyanin and hemerythrin. Storage of oxygen and its transport.

Unit-IV: **Bio-Chemistry:**
Biochemistry of calcium, copper and zinc. Biological Nitrogen fixation (Associative nitrogen fixation, symbiotic nitrogen fixation).

Unit-V: (a) Toxicity of metals (cadmium, mercury, lead, arsenic, copper). Deficiency of Metal ions
(b) Medicinal Inorganic chemistry- Metal ions and chelating agent in medicines. Drug activity, control of metal ion concentration, *In vivo* removal of metal ions, Antimicrobial drugs, anticancer drugs.

Books Suggested:

1. Progress in Inorganic Chemistry, vol. 18 and 38 Ed. J J. Lippard, Wiley.

2. Inorganic Biochemistry vol. I and II ed. G. L. Eichhorn, Elsevier.

3. Principles of Bioinorganic Chemistry, S. J. Lippard and J. M. Berg, University Science Books.

C-8 **BIO- PHYSICAL CHEMISTRY** **M.M.75**

Credits-04

Unit-I: **Enzymes:**

Introduction, nomenclature and classification, Fischer lock and key: Kosland and Induced hypothesis: Transition state theory, acid base catalysis, Nucleophilic displacement on phosphorous atom. Multiple displacement reaction and the coupling of ATP, cleavage to endergonic processes, Addition and Elimination reaction of enzyme catalyzed carboxylation and decarboxylation

Unit-II **Coenzymes:**

Apoenzymes, structure and biological function of coenzymes, production, purification of enzymes, methods of immobilization of enzyme activity, application of immobilized enzymes, clinical use of enzymes

Unit-III **Bio-energetics:**

Standard and free energy change in biochemical reactions, exergonic endergonic, hydrolysis of ATP, synthesis of ATP from ADP

Unit-IV **Cell membranes and Transport of ions:**

Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamics treatment of membrane transport, nerve conduction.

Unit-V **Biopolymer Interactions:**

Forces involved in biopolymer interactions, electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interaction, multiple equilibrium and various types of binding processes in biological systems.

Books Suggested:

1. Understanding enzymes, Trevor Palmer, Prentice Hall.

2. Enzyme Mechanisms Ed, M. I. Page and A. Williams, RSC.

3. Fundamental ofEnzymology, N. C. Price and L. Stevens, Oxford University Press.

4. Biochemistry, L. Stryer, W.H. Freeman.

5. Macromolecules: Structure and Function, F. Wold. Prentice Wall. 6. Biochemistry, Voet and Voet, John Wiley

C-9 SPECTROSCOPIC METHODS OF ANALYSIS M.M.75

Credits-04

Unit I: Absorption spectroscopy

L-B's Law and its limitations, Einstein's two level transition model. Transition moment and its relation to molar extinction coefficient. Different types of transitions ($\pi\pi^*$, $\sigma\pi^*$, $n\pi^*$ etc.), Selection rules with symmetry arguments, Solvent perturbation method, Weak and CT transition, Vibronic and spin orbit coupling.

Unit II: Raman Spectroscopy

Classical and quantum theories of Raman Effect, pure rotational vibrational and vibrational-rotational, Raman spectra, Selection rules, Mutual exclusion principle, Resonance Raman spectroscopy, Coherent anti stokes raman spectroscopy (CARS)

Unit III: Nuclear magnetic resonance spectroscopy (NMR):

Introduction, Theory, relaxation process and saturation, environmental effects on NMR spectra, chemical shift, spin-spin splitting, factors influencing coupling constant 'J', Spin decoupling, basic ideas about instrument, NMR studies of nuclei other than proton ^{13}C, ^{19}F, and ^{31}P, FT-NMR advantages of FT-NMR, use of NMR in medical diagnostics.

Unit IV: Mass Spectrometry:

Introduction, molecule ion peak, base peak, isotopic abudance, metastable ions fragmentation mechanism of compounds containing C,H,O,N and halogen, Mac Lafferty rearrangement , nitrogen rule and ring rule and applications.

Unit V: ESR Spectroscopy:

Introduction, principle, hyperfine splitting, and significance of g-value, determination of δ - value. Rules for hyperfine splitting and applications.

Books Suggested:

1. Modern spectroscopy, J.M. Hollas, John Willey.

3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.

5. Introduction to Molecular Spectroscopy, G.M. Barrow, Mcgraw Hill.

6. Basic Principles of Spectroscopy, R. Chang. McGraw Hill.

7. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBHOxford.

9. Introduction of Magnetic Resonance, A. Carrington and A.D. Maclachlan, Harper and Row.

C-10 **M.Sc. CHEMISTRY Practical (Semester VIII)** **M.M.100**

Credits-04

INORGANIC CHEMISTRY

(A) Qualitative and Quantitative Analysis: **[20]**

(i) Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Zn, etc. involving volumetric and gravimetric methods.

(B) Inorganic Preparations: **[10]**

(i) Reineckel Salt
(ii) Tetraamine Cupric Sulphate
(iii) Chrome Alum
(iv) Aluminium Chloride Hexahydrate
(v) Nickel Dimethyl Glyoxime
(vi) Sodium Cobalt Nitrate
(vii) Potassium Trioxalato Ferrate (III)
(viii) *Cis*-Potassium DioxalatoDiaqua Chromate
(ix) *Trans*-Potassium DioxalatoDiaqua Chromate $K[Cr(C_2O_4)(H_2O)_2].2H_2O$
(x) Prussian Blue

ORGANIC CHEMISTRY

(A) Qualitative Analysis: **[10]**

Separation, Purification and Identification of compounds of tertiary mixtures (three solids)

(B) Organic Synthesis: **[10]**

Sulphonation, Diazotization, Aldol Condensation, Friedel Crafts Reaction, Cannizzaro Reaction, Acetylation, Benzylation, Nitration.

(C) Quantitative Analysis: **[10]**

(a) Determination of percentage or number of Hydroxyl Groups in an organic compound by accetylation method.

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

PHYSICALCHEMISTRY **[30]**

(1) To estimate hardness of water by ethylene diamine tetra-acetic acid (EDTA).
(2) To study the distribution co-efficient of benzoic acid between benzene and water.
(3) To determine the distribution co-efficient of iodine between water and CCl_4 at room temperature.
(4) To determine the specific reaction rate of the hydrolysis of methyl acetate/ ethyl acetate catalyzed by hydrogen ions at room temperature.
(5) To titrate the given mixture of CO_3 and HCO_3 ions against a strong acid (HCl) using p-meter and to determine the strength of it.
(6) To determine the amount of chloride ions present in the given KCl solution.
(7) To determine nickel as dimethyl glyoximate complex spectrophotometrically.
(8) Preparation of standard solution.
(9) Determination of proton coefficient between water and an organic solvent.
(10) To test the validity of lambert-Beer's Law (using methylene blue) and to determine

I. λmax
II. Molar extinction coefficient (€)

RECORD **[05]**

VIVA **[05]**

C-11 **RESEARCH PROJECT** **M.M.100**

Credits-08

The research project is based on the following topics –

1. Coordination Chemistry
2. Macro Cyclic Chemistry
3. Green Chemistry
4. Nano Chemistry
5. Pesticide Chemistry
6. Polymer Chemistry
7. Polymer Nano Composite
8. Environmental Science
   i. Air Pollution
   ii. Soil Pollution
   iii. Water Pollution
9. Natural Products
10. Synthetic Organic Chemistry
11. Drug Chemistry
12. Industrial Chemistry

SEMESTER-IX

C-12 PHOTO AND STEREOCHEMISTRY M.M. 75

Credits-05

Unit-I: General principles- Photochemical energy, Frank-Condon principle, Jablonski diagram, singlet and triplet states, photosensitization, quenching, quantum efficiency and quantum yield, energy transfer process in photochemistry, experimental methods of photochemistry.

Unit-II: Photochemistry of carbonyl compounds, Norrish type-I and Norrish type-II cleavages, Paterno-Buchi reactions, photoreductions, photochemistry of unsaturated systems like olefins, cis-trans isomerisation, dimerizations, hydrogen abstraction, addition. Photochemistry of enones-rearrangement of unsaturated ketones and cyclohexadienones.

Unit-III: A) Concept of chirality, elements of symmetry, R-S nomenclature, E-Z isomerisms. Interconversion of Fischer, Newman and Sawhorse projections

B) Conformation and reactivity in acyclic compound (upto four C-atoms) and cycloalkanes (upto cyclohexane)

C) Transannular effects in medium sized ring compounds.

Unit-IV: Molecular dissymmetry and chiroptical properties, linear and circularly polarized light, circular birefringences and circular dichroism, ORD and CD curves. Plain and Cotton effect curves and their applications. The octant rule and axial haloketone rule with applications

Unit-V: A) Racemates and their classification, method of resolution of recemates.

B) Chemoselectivity, regioselectivity, stereoselective, stereospecific reactions and enantioselectivity with examples.

Books Suggested:

1. Fundamental of Photochemistry, K. K. Rohtagi-Mukherji, Wiley-Eastern.
2. Molecular Photochemistry, N.J. Turro, W. A. Benjamin.
3. Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.
4. Photochemistry, R P. Kundall and A. Gilbert, Thomson Nelson
5. Stereoselective Synthesis: A Practical Approach M.Nogradi, VCH.

C-13 SOLID STATE CHEMISTRY, SURFACE PHENOMENON AND CHEMICAL EQUILIBRIA. M.M.75

Credits-05

Unit-I : Solid State

Crystalline state of solids, unit cells and Bravais lattices, Miller indices, Diffraction of X-rays by crystalline solids, fundamental aspects of X-ray, electron and neutron diffraction studies

Unit-II : Crystal Defects and Non- Stoichiometry

Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-Schottky defects and frenkeldefects, structural imperfections and properties of solids such as ionic conductivity, diffusion, ferroelectric properties and luminescence, non-stiochiometry and defects.

Unit-III : Electronic properties and Band theory

Metals, insulators and semiconductors, electronic structure of solids-band theory, band structure of metals, insulators and semiconductors, intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, superconductors,

Unit-IV : Surface Phenomenon

Surface tension, adsorption on solids, electrical phenomena at interfaces, including electrokinetic, micelles and reverse micelles: solubilization, micro-emulsion, application of photoelectron spectroscopy, ESCA and Augor spectroscopy to the study of surfaces.

Unit-V : Chemical Equilibria

Free energy and entropy of mixing, partial molar quantities, Gibbs-Duhemequation. Equilibrium constant, temperature- dependence of equilibrium constant, phase diagram of one- and two component systems, phase rule.

Books Suggested:

1. Solid State Chemistry and its Application, Anthony R. West, Wiley Publication, US
2. Solid State chemistry an Introduction, Lesley E.Smart and Elaine A.Moore,Taylor and Francis,London.
3. Principles of Physical Chemistry, Puri, Sharma and Pathania, Vishal Publising, Delhi

C-14 **COORDINATION CHEMISTRY** **M.M.75**

Credits-05

Unit I : Crystal field theory, crystal field splitting of d-orbitals in octahedral, tetrahedral and square planar complexes, crystal field stabilization energy (CFSE) in octahedral (weak and strong fields) and tetrahedral complexes, factor affecting CFSE and uses of CFSE, spectrochemical series.

Unit-II : **(a)** Applications of CFT in colour of transition metal complexes, limitations of CFT, valence bond theory and comparison of VBT and CFT.

(b) Ligand field theory, evidences of covalance and adjusted crystal field thery (ACFT), molecular orbital treatment of octahedral complexes and bonding, molecular orbitals for tetrahedral and square planar complexes, spin cross over coordination compounds.

Unit III : Coordination chemistry of transition metal ions, stability constants of complexes and their determination; stabilization of unusual oxidation states. Stereochemistry of coordination compounds. Jahn-Teller effect; Interpretation of electronic spectra including charge transfer spectra; nephelauxetic series, magnetism: Dia -, para -, ferro – and anti-ferromagnetism quenching of orbital angular moment, spin orbit coupling.

Unit-IV : Inorganic reaction mechanism; substitution reactions, trans effect and electron transfer reactions, photochemical reaction of chromium and ruthenium complexes. Fluxional molecules, iso- and heteropoly acid, metal clusters spin crossover in coordination compounds.

Unit-V : **Studies and Applications of Lanthanides and Actinides:**

Spectral and magnetic properties, Modern methods of separation of lanthanides and actinides. Organometallic compound of lanthanides, Applications of lanthanides and actinides compounds in industries. Use of lanthanides compounds as Shift's reagent.

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson , John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Comprehensive Coordination Chemistry Eds G.Wilkinson, R.D. Gillars and J.AMcCleverty,Pergamo
5. Synthesis and Characterization of Inorganic compounds, W.L. Jolly, Prentice Hall.
6. Concise Inorganic Chemistry, J.D.Lee, Wiley Publication

C-15 **BASIC ANALYTICAL CHEMISTRY** **M.M. 75**

(Elective-1) ***Credits-05***

Unit-I : **Amperometry:** Introduction, principle, types of current, technique, amperometric titrations with DME, amperometric titrations with rotating platinum micro electrode, biampero-metry, applications.

Unit-II : **Coulometry:** Introduction, constant current coulometry, controlled potential coulometry (principle and technique), types of coulometer, applications.

Unit-III : **Conductometry:** Introduction, principle, technique, electrolytic conductivity, measurement of electrolytic conductivity, conductometric titration, applications.

Unit-IV : **Polarography :** Introduction, principle, technique, D.M.E., half-wave potential, residual current, migration current, diffusion current, limiting current, applications.

Unit-V : **Voltammetry :** (a) Introduction, principle, technique and applications

(c) Cyclic voltammetry and anodic stripping voltammetry.

Books Suggested

1. Instrumental Method of Chemical Analysis, B.K. Sharma, Krishna Prakashan, Media, Meerut.
2. Instrumental Method of Chemical Analysis, Gurdeep Chatwal, Himalaya Publication House, New Delhi.
3. Instrumental Method of Chemical Analysis, H. Kaur, Pragati Prakashan, New Delhi
4. Instrumental Method of Analysis, Willard, Meritt, Dean,Wadsworth Publishing Co. Inc, Australia
5. Basic Concept of analytical Chemistry, S.M. Khopkar,New Age International Publisher, New Delhi.
6. Fundamental of Analytical Chemistry, Holler and Crouch, Brooks Cole, US.

C-16 **CHEMISTRY OF NATURAL PRODUCTS** **M.M.75**

(Elective-2) ***Credits-05***

Unit-I : **Plant Pigments:**

Introduction, occurrence, general methods of structure determination, isolation and synthesis of apigenin, luteolin, vitexin, myrcetin, quercetin, lycopene, aureusin, cyanidin, hirostidin.

Unit-II : **Alkaloids**:

Introduction, classification, occurrence, isolation of alkaloids, general methods of determination of structure of alkaloids, Constitution and synthesis of cocaine, nicotine, atropine, morphine, reserpine. Biosynthesis of alkaloids.

Unit –III : **Terpenoids and Carotenoids:**

Introduction, classification, occurrence, general methods of structure determination, isoprene rule, constitution and synthesis of citral, zingiberene, farnesol, bisabolene, β- carotenoids, Biosynthesis of terpene.

Unit-IV : **Steroids**:

Introduction, classification, occurrence, isolation, constitution and synthesis of cholesterol, testosterone, progesterone, androsterone. Biosynthesis of steroid.

Unit-V: **Antibiotics:**

Introduction classification, synthesis of penicillin-G, penicillin-V, amoxycillin, tetracyclin, chloramphenicol, streptomycin.

Books Suggested:

1. Natural Products: Chemistry and Biological Significance J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope an J.B. Harborne, Longman Essex

2. Organic Chemistry, Vol 2, I L. Finar. ELBS.

3. Rodd's Chemistry of Carbon Compounds, Ed, S. Coffe Elsevier.

4. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston, Harwood Academic Publishers.

5. Introduction to Flavonoids, B.A. Bohm, Harwood Academic Publishers.

6. New Trends in Natural Product Chemistry, Atta-Ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.

7. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers

SEMESTER-X

C-17 **INTERDISCIPLINARY TOPICS** **M.M. 75**

Credits-04

Unit I : **Chemistry in Nanoscience and Technology**

Introduction to nanotechnology, scope of applications, techniques for synthesis of nano particles, important nano materials (Nano optics, Nano magnetic, Nano electronics) carbon nanotubes (types, properties and applications)

Unit II : **Catalysis and Green Chemistry:**

Introduction to green chemistry, principles of green chemistry, designing and chemical synthesis, examples of green synthesis / reactions, future trends in green chemistry.

Unit III : **Supra Molecular Chemistry:**

Introduction, concept and language, molecular recognition, supra molecular reactivity and catalysis, transport processes and carrier design.

Unit IV : **Environment and Atmosphere:**

Environmental chemistry, chemical composition of atmosphere – particles, ions and radicals and their formation. Heat budget of the earth atmospheric system, vertical stability of atmosphere, chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect, green house effect, acid rain, air pollution controls and their chemistry.

Unit V: **Environmental chemistry (Hydrosphere and soils):**

Aquatic pollution – inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants, water quality parameters, water quality standards, purification and treatments of waste. Soil composition, micro and macro nutrients, pollution – fertilizers and pesticides, waste treatment.

Books Suggested:

1 A Text Took of Nanoscience and Nanotechnology, Mc Graw Hill Education, New York
2 Principles of Physical Chemistry, Puri, Sharma and Pathania, Vishal Publising, Delhi
3 New Trends in Green Chemistry, V.K. Ahluwalia, Springer, New York.
4 Environmental Chemistry, H.Kaur, Pragati Prakashan, Meerut

C-18 **SEPARATION TECHNIQUES** **M.M. 75**

Credits-04

UNIT I- **Adsorption Chromatography:** Principles, classification, experimental set up and applications of TLC and column chromatography.

UNIT II- **Partition Chromatography:** Principles, classification, experimental set up, special features, mechanism of separation procedures, advantages and disadvantages, and applications liquid-liquid and reverse phase partition chromatography, paper chromatography, thin layer chromatography (TLC) and ion pair chromatography.

UNIT III- **Gas Chromatography (GC):** Principles, classification, experimental set up, special features, mechanism of separation procedures, advantages and disadvantages, and applications Plate theory, gas-solid and gas-liquid chromatography, Hyphened technique. GC-MS and its applications.

UNIT IV- **HPLC:** Principles, classification, experimental set up, special features, mechanism of separation procedures, advantages and disadvantages, and applications Super critical fluid chromatography, gel permeation chromatography and molecular sieves.

UNIT V- **Solvent Extraction:** Principles, classification, experimental set up, special features, mechanism of separation procedures, advantages and disadvantages, and applications Extraction equilibria, partition coefficient and extraction coefficient, extraction by chelation and solvation; solid-phase extraction (SPE).

Books Suggested:

1 Instrumental Method of Chemical Analysis, B.K. Sharma, Krishna Prakashan, Media, Meerut
2 Instrumental Method of Chemical Analysis, Gurdeep Chatwal, Himalaya Publication House, New Delhi
3 Instrumental Method of Chemical Analysis, H. Kaur, Pragati Prakashan, New Delhi
4 Instrumental Method of Analysis, Willard, Meritt, Dean,Wadsworth Publishing Co. Inc, Australia
5 Basic Concept of analytical Chemistry, S.M. Khopkar,New Age International Publisher, New Del

C-19 **ADVANCED ANALYTICAL METHODS** **M.M.75**

(Elective-1) ***Credits-04***

Unit 1 : **Data Analysis :** Errors, classification of errors, mean deviation and standard deviation, accuracy precision, rejection of measurements, confidence interval tests significance, error curve, minimization of errors, significant figures and computation of results, certified reference material and standard reference material.

Unit II : Principle, Instrumentation, Applications of Inductively Coupled Plasma (ICP) Spectroscopy.

Unit III : Principle, Instrumentation, Applications of X-Ray Diffraction (XRD)

Unit IV : Principle, Instrumentation, Applications of Scanning Electron Microscopy (SEM) & TEM

Unit V : **TGA :** Introduction, principal, instrumentation, Curie point, factor affecting the TGA curves and applications & DTA

Books Suggested:

1. Instrumental Method of Chemical Analysis, B.K. Sharma, Krishna Prakashan, Media, Meerut
2. Instrumental Method of Chemical Analysis, Gurdeep Chatwal, Himalaya Publication House, New Delhi
3. Instrumental Method of Chemical Analysis, H. Kaur, Pragati Prakashan, New Delhi

4 Instrumental Method of Analysis, Willard, Meritt, Dean,Wadsworth Publishing Co. Inc, Australia

C-20 **ADVANCED INORGANIC CHEMISTRY** **M.M. 75**

(Elective-2) ***Credits-04***

Unit I- **(i) Transition metal π- complexes :** Transition metal π- 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.

(ii) Transition metal compounds with bonds to hydrogen.

Unit II- **(i)** Metal Storage Transport and Biomineralizations, Ferritin, Transferrin and Siderophores.

(ii) Calcium in Biology : Calcium in living cells, Transport and regulation, molecular aspects of intramolecular processes, extracellular binding proteins.

Unit III- **Metalloenzymes :** 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 B_{12}.

Unit IV- **(i) Metal Nucleic Acid Interactions :** Metal ions and Metal complex interaction, metalcomplexes-nucleic acids.

(ii) Metal in Medicine : Metal deficiency and disease, toxic effect 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, charge transfer excitations, methods for obtaining charge -transfer spectra.

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson , John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4.Comprehensive Coordination Chemistry Eds G.Wilkinson, R.D. Gillars and J.AMcCleverty,Pergamo
5. Synthesis and Characterization of Inorganic compounds, W.L. Jolly, Prentice Hall.

C-21 **ADVANCED ORGANIC CHEMISTRY** **M.M.75**

(Elective-3) ***Credits-04***

Unit I : **Heterocycles:**

Introduction, classifications, IUPAC names of mono and bicyclic hetero aromatic compounds. Criteria of aromaticity in heterocycles. Synthesis and reaction of benzo [b] and benzo [c], benzodiazoles and acridines, pyrazole, imidazole oxazole, thiazole, indole, pyrimidine.

Unit II : **Common Organic Rearrangements and their mechanism:**

Pinacol- Pinacolone, Wagner- Meerwein, Demjanove Beckmann, Hoffmann, Curtius, Schmidt, Lossen, Sommelet-Hauser, Favoroskii and Baeyer- Villiger rearrangement.

Unit III : **Pericyclic Reactions:**

Classification and examples, Woodword-Hofmann's Rule, Electrolytic reaction, Cycloaddition reaction ([2+2] and [4+2] only) and Sigmatropic shifts [1,3]- shift, [1,5]-shift and [3,3]- shift (Cope rearrangement and Claisen rearrangement), FMO approach only.

Unit IV : **Disconnection Approach**

Introduction to disconnection approach, FGI (Functional Group Interconversion), Synthon, Guidelines for order of events in disconnection, use of protecting group in disconnection approach

Unit V : **Drugs**

Antibacterials Drugs:-Introduction, preparation and uses of sulphanilamide, sulpha pyridine, sulphathiazole, sulpha guanidine.

Antihistaminic Drugs:- Introduction, preparation and uses of Benadryl, dimenhydrinate, antergan, pyribenzamine.

Anti-inflammatory:- Introduction, Preparation and uses of Steroid and non-steroid drugs (Ibuprofen, mefanamic acid, diclofenac)

Antimalarials:- Synthesis of mepacrine, chloroquin, Pamaquin, paludrin.

Books Suggested:

1. Heterocyclic Chemistry Vol. 1-3, R. R. Gupta, M. Kumar and V. Gupta. Springer Verlag.

2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.

3. Heterocyclic Chemistry, J.A. Joule, K. Mills and G. F. Smith, Chapman and Hall.

4. Heterocyclic Chemistry, T. L. Gilchrist, Longman Scientific Technical

5 The Organic Chemistry of Drug Design and drug Action, R.B. Silverman, Academic Press.

6. Strategies for Organic Drug Synthesis and design. D. Lednicer, John Wiley.

C-22 **ADVANCED PHYSICAL CHEMISTRY** **MM : 75**

(Elective-4) ***Credits-04***

Unit I – **Thin Film 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 Crystal : Mesmorphic behavior, thermotropic liquid crystal, positional order, bond orientation order nematic and smetic mesophates, 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 crystal, Dielectric 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.

Unit III **Ionic Conductors :** Types of ionic conductors, mechanism of 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 IV – Theoretical and computation treatment of atoms and molecules, Hartree-Fock theory. Review of the principles of quantum mechanics, Born –oppen heimer approximation, Staler Condon rules. Hartree Fock equation, Koopmans and Brilloning theories, Roothan equation, Gaussian sets.

Unit V– **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, additivity of pair potential approximation.

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

Book Suggested:

1. Physical chemistry, P.W. Atkins, ELBS

2. Advanced Physical Chemistry, Gurdeep Raj, Goel Publishing House, Meerut.

3. Principles of Physical Chemistry, Puri, Sharma and Pathania, Vishal Publising, Delhi

4. Solid State Physics ,N. W. Aschcroft and N.D. Mermin , Holt, Rinehart and Winston, New York, 1976.

5.Textbook of Polymer Science, F. W. Billmeyer. Jr.Wiley

C-23 | **POLYMER CHEMISTRY** | **M.M.75**

(Elective-5) | ***Credits-04***

Unit-1 Basics Importance of polymers basic concepts; Monomers, repeat units, degree of polymerization, Linear, branched and network polymers, classification of polymers. Polymerization : condensation, addition, radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

Unit-II. Polymer Characterization Polydispersion - Average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. Endgroup, viscosity, light scattering, osmotic and ultracentrifugation methods Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study, Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue. impact. Tear resistance. Hardness abrasion resistance.

Unit-III. Structure and Properties Morphology and order in cryststalline polymers-configurations of polymer chains. Crystal structures of polymers Morphology of cryststalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical propertiescrystalline melting point Tm. melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Tg relationship between Tm and Tg effects of molecular weight diluents, chemical structure, chain topology, branching and cross linking, property requirements and polymer utilization.

Unit- IV. Polymer Processing Plastics, Elastomers and fibres. Compounding Processing Techniques; Calendering, Die casting, rotational casting. Film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

Unit-V. Properties of Commercial Polymers Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicon polymers. Functional polymers - Fire retarding polymers and electrically conducting polymers. Biomedical polymers-contact lens, dental polymers artificial heart, kidney, skin and blood cells.

Books Suggested:

1. Textbook of Polymer Science, F. W. Billmeyer. Jr.Wiley.
2. Polymer Science. V. R. Gowarikar, N.V. Viswanathan and J. Sreedhar, Wiley - Eastern.
3. Functional Monomers and Polymers , K. Takemoto, Y. Inaki and R.M. Ottanbrite.
4. Contemporary Polymer Chemistry, H.R. Alcock and F.W. Lambe, Prentice Hall.
5. Physics and Chemistry of polymers, J.M.G. Cowie, Blackie Academic and Professional.

C-24 **INDUSTRIAL CHEMISTRY** **M.M.75**

(Elective-6) ***Credits-04***

Unit 1: Cement, Ceramic and Glass Composition of cement, mixing of cement clinker with Gypsum, Setting of cement. Composition, Physical and Chemical properties of Glass, Varieties of glass, Introduction to ceramics.

Unit 2: Composites Introduction, constituents of composites, Types, of composites, Microscopic and Macroscopic Composites, Dispersion, Strength, Particle and Fiber- reinforced Composites.

Unit 3: Fertilizers N - Ammonia, Ammonium nitrate and Urea; P - Phosphoric acid, Single and Triple superphosphate, DAP; K- Potassium Nitrate and Muriate of potash.

Unit 4: Petrochemicals and Lubricants Introduction, Occurrence, Composition of Petroleum, Natural gas, cracking, refining, octane rating, cetane number, flash and fire point determination. Lubricating oils and additives, Naphtha crackers and Profile of their products, Synthetic and Blended oils.

Unit 5: Paints General characteristic, their function, Manufacture and Classification, Enamels, Emulsion paints, Water based paints. Formulation of paints: Function of vehicles, solvent, thinner, pigment, dyes, filler, resins, drier, insecticides, additives in paint formulation.

Books Suggested:

1. Molecular Magnetism, Oliver Kahn, VCH Publishers, UK,1993.
2. Materials Science and Engineering: An Introduction, W.D. Callisters,Wiley, 2006.
3. Solid State Physics ,N. W. Aschcroft and N.D. Mermin , Holt, Rinehart and Winston, New York, 1976.
4. Materials Science,J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rowlings . ELBS, 2003.
5. Hand Book of Liquid Crystals, Kelker and Hatz , 2nd Ed. Wiley, 2014.
6. Basics of Paint Technology, V.C. Malshe and Meenal Sikchi, Part I & II, 2008,
7. Introduction to Paint Chemistry, G.P.A. Turner, Chapman& Hall, 1967.

C-25 **MEDICINAL CHEMISTRY** **M.M.75**

(Elective-7) ***Credits-04***

Unit-I Drug Design Development of New Drugs, Procedures followed in drug Design, Concepts of Lead Compound and Lead Modification, Concepts of Prodrugs and Soft Drugs, structure activity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism, spatial considerations. Theories of drug activity : occupancy theory, rate theory, induced fit theory. Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors, Elementary treatment of drug receptor interaction. Physico-chemical parameters: Lipophilicity, partition coefficient, electronic ionization constants, Steric, Shelton and surface activity parameters and Redox Potentials.

Unit-II Pharmacokinetics Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in the rapeutics. Mention of uses of pharmacokinetics in drug development process.

Unit-III Pharmacodynamics Introduction, elementary treatment of enzyme stimulation, enzyme inhibition sulphonamides membrane active drugs, drug metabolism, xenobiotics biotransformation, significance of drug metabolism in medicinal chemistry.

Unit-IV Antineoplastic Agents Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors.

Unit-V Cardiovascular Drugs Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output. Direct acting arteriolar dilators. Synthesis of amyl nitrate, sorbitrate and diltiazem.

Books Suggested:

1. Introduction to Medicinal Chemistry, A. Gringuage, Wiley-VCH
2. Wilson And Gisvold Es Text Rook of Organic Medicinal and Pharmaceutical Chemistry. Ed. Robert F.Dorge.
3. An Introduction to Drug Design, S.S. Pandeya and J.R. Dimmock, New Age International. 4. Burger's Medicinal Chemistry and Drug Discovery, Vol-1(Chapter-9 and Ch-14), Ed. M.E. Wolff, John Wiley.
4. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
5. The Organic Chemistry of Drug Design and drug Action, R.B. Silverman, Academic Press.
6. Strategies for Organic Drug Synthesis and design. D. Leilnicer. John Wiley.

C-26 **M.Sc. Chemistry Practical (Semester X)** **[M.M. 100]**

Credit 4

M.Sc. (Inorganic Chemistry) Practical

1. Flame Photometric Determinations
   (a) Sodium and Potassium when present together
   (b) Li/ Ca/ Ba/ 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

M.Sc. (Organic Chemistry) Practical

1. Extraction of Organic compounds from natural resources: (One exercise) **[20]**

(i) Isolation of lactose from milk.
(ii) Isolation of casein from milk.
(iii) Isolation of caffeine from tea leaves.
(iv) Isolation of β- carotene from carrot.
(v) Isolation of lycopene from tomatoes.
(vi) Isolation of cystine fromhuman hair.
(vii) Isolation of Nicotine from tobacco.

2. Multi- step synthesis of organic compounds: (One exercise) **[20]**

(i) Preparation of p- Bromoaniline fromAniline (Bromination)
(ii) Preparation of p-nitroaniline from Aniline (Nitration)
(iii) Preparation of quinoline from aniline (Skraup Synthesis)
(iv) Preparation of 2- phenyl indole from phenyl hydrazine (Fischer- Indole synthesis)
(v) Benzoyl chloride to Benzaniline (Benzoylation)
(vi) Benzene to Acetanilide (Acetylation)

3. Green chemistry: (One exercise) **[15]**

(i) Coenzyme catalysed benzoin condensation (Thiamine hydrolysed catalysed synthesis of benzene)
(ii) Electrophilic aromatic substitution reaction-I (Nitration of Phenol)
(iii) Radical coupling reaction (Preparation of 1,1-Bis-2-naphthol)
(iv) Three component coupling (Synthesis of dihydropyrimidinone)
(v) Transestrification reaction (Synthesis of biodiesel)

(vi) Preparation of Iron (III) acetylacetonate.

4. Paper chromatography, separation and Identification of sugars present in glucose, fructose, sucrose by paper chromatography and determination of Rf values / TLC. [15]

5. Spectrophotometric estimation/Identification: (One exercise) [20]

(i) Asprin, disprin, Sprintas
(ii) Caffeine
(iii) Ascorbic Acid (Lemon, Amla)
(iv) Carbohydrate (Glucose, Sucrose, Fructose)
(v) Amino acids

M.Sc. (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

1. Thermodynamics :

(i) Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.

(ii) 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.

2. 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 (e.g. amine iodine) complexes.

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

3. Polarography :

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

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

4. Electronics :

(i) Measurements of resistance with multimeter and calculate the colour code.

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

(iii) To study the characteristics of light emitting diode.

(iv) To study the characteristics of Zener diode.

(v) To study the characteristics of FET

(vi) To plot the characteristics curve of a diode.

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

RECORD **[05]**

VIVA **[05]**

C-27 **RESEARCH PROJECT** **M.M.100**

Credits-08

The research project is based on the following topics –

1. Coordination Chemistry
2. Macro Cyclic Chemistry
3. Green Chemistry
4. Nano Chemistry
5. Pesticide Chemistry
6. Polymer Chemistry
7. Polymer Nano Composite
8. Environmental Science
   i. Air Pollution
   ii. Soil Pollution
   iii. Water Pollution
9. Natural Products
10. Synthetic Organic Chemistry
11. Drug Chemistry
12. Industrial Chemistry

Employability Entrepreneurship Skill Development