

**NATIONAL EDUCATION POLICY-2020**  
**PAPER CODING AND CREDIT DISTRIBUTION**  
**M.Sc. (CHEMISTRY)**

S.No.	Name of Degree	SEMESTER	TITLE OF PAPER		CREDITS	CODE NUMBER
1	Bachelor (Research) of Science in Chemistry	VII	Computer for Chemists		5	B020701T
			Inorganic Chemistry		5	B020702T
			Organic Chemistry		5	B020703T
			Physical Chemistry		5	B020704T
			Adulterant in Foods (Minor For OTHER FACULTY)		4	B020705T
			Research Project			
2		VIII	Group Theory and Spectroscopy		4	B020801T
			Bio-Inorganic Chemistry		4	B020802T
			Bio-Physical Chemistry		4	B020803T
			Spectroscopic Methods of Analysis		4	B020804T
			Practical		4	B020805P
			Research Project		8	B020806R
One Minor Paper to be selected from OTHER FACULTY in VII or VIII Semester				4/5/6		
3	Master of Science in Chemistry	IX	Photo and Stereochemistry		5	B020901T
			Solid State Chemistry, Surface Phenomenon and Chemical Equilibria		5	B020902T
			Coordination Chemistry		5	B020903T
			Basic Analytical Chemistry	Choose any ONE	5	B020904T
			Chemistry of Natural Products		5	B020905T
			Polymer Chemistry		5	B020906T
			Research Project			
4		X	Interdisciplinary Topics		4	B021001T
			Separation Techniques		4	B021002T
			Advance Analytical Methods		4	B021003T
			Advance Inorganic Chemistry	Choose any ONE	4	B021004T
			Advance Organic Chemistry		4	B021005T
			Advance Physical Chemistry		4	B021006T
			Practical		4	B021007P
Research Project		8	B021008R			

Students of Science Faculty may choose MINOR paper from Faculty of Commerce/ Arts, Humanities and Social Sciences/ Languages/Fine Art and Performing Art/Education/Rural Science.

### **Purpose of the Program**

The purpose of the M.Sc. Program at the University is to provide the key knowledge of various disciplines in Chemistry and on-Advances in this field. To prepare students for careers as professional in various Research Institutes and Industries.

## SEMESTER-VII

**B020701T**

**COMPUTER FOR CHEMISTS**

**M.M. 75**

*Credits-05*

- Unit I:** 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.

**B020702T**

**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, Capping 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: polyphosphazenes, 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.

**B020703T**

**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 benzyne.
- Unit-II:** **Substitution reactions:**  
 $SN^1$ ,  $SN^2$ ,  $SN^{li}$  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 (Saytzeff and Hoffman), Pyrolytic syn-elimination, Stereochemistry of elimination reaction.
- Unit- IV:** **Common Organic Reaction and Mechanism**  
Aldol, Perkin, Dieckmann condensation, Reformatsky, Benzoin, Wittig, Mannich reaction, Michael reaction, Diels-Alder reaction, Knoevenagel 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, dicyclohexylcarbodiimide, 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, Edward Arnold.
5. Handbook of Organic Analysis Qualitative and Quantitative. H. Clark, Edward 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.

**B020704T**

**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 degenerate), application of variation method and perturbation theory to the helium molecule.

**Unit-II: Statistical thermodynamics:** Chemical equilibria and equilibrium constant in terms of partition function, Fermi-Dirac statistics, Distribution law and application of formalism, 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-Huckel limiting law, 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, Ira 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.



**B020705T**

**ADULTERANTS IN FODS**

**(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, neutralizers, hydrogen peroxide, formalin, sugar, starch, urea, ammonium sulphate, salt, pulverized soap, detergents, skim milk powder, vegetable fat, benzoic acid, salicylic acid, 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 tumeric 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

**B020801T**

**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.



**B020802T**

**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.

**B020803T**

**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 of Enzymology, 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

**B020804T**

**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 ( $pp^*$ ,  $sp^*$ ,  $np^*$  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  $^{13}\text{C}$ ,  $^{19}\text{F}$ , and  $^{31}\text{P}$ , FT-NMR advantages of FT-NMR, use of NMR in medical diagnostics.

**Unit IV: Mass Spectrometry:**

Introduction, molecule ion peak, base peak, isotopic abundance, 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  $\delta$  - 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.

**B020805P**

**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  $K[Cr(C_2O_4)(H_2O)_2] \cdot 2H_2O$   
 (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, Benzoylation, Nitration.
- (C) **Quantitative Analysis:** [10]  
 (a) Determination of percentage or number of Hydroxyl Groups in an organic compound by acetylation method.  
 (b) Estimation of amines/ Phenols using bromated bromide solution/ or acetylation method.

**PHYSICAL CHEMISTRY**

**[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.  $\lambda_{max}$
  - II. Molar extinction coefficient ( $\epsilon$ )

**RECORD** [05]

**VIVA** [05]

**B020806R**

**RESEARCH PROJECT**

**M.M.100**

***Credits-08***

The research project is based on the following areas of 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

**B020901T**

**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 racemates.
  - 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.



**B020902T    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 Frenkel defects, structural imperfections and properties of solids such as ionic conductivity, diffusion, ferroelectric properties and luminescence, non-stoichiometry 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 Auger spectroscopy to the study of surfaces.

**Unit-V :     Chemical Equilibria**

Free energy and entropy of mixing, partial molar quantities, Gibbs-Duhem equation. 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 Publishing, Delhi

**B020903T**

**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 theory (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

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.

**B020905T**

**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,  $\beta$ - 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 and 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

**B020906T**

**POLYMER CHEMISTRY**  
(Elective-3)

**M.M.75**  
**Credits-04**

- Unit-I** 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 crystalline polymers-configurations of polymer chains. Crystal structures of polymers Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical propertiescrystalline melting point  $T_m$ . melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature,  $T_g$  relationship between  $T_m$  and  $T_g$  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. Otanbrite.
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.



## SEMESTER-X

**B021001T**

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



**B021002T**

**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, Hyphenated 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

**B021003T**

**ADVANCED ANALYTICAL METHODS**

**M.M.75**

***Credits-04***

- Unit I :**      **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

**B021004T**

**ADVANCED INORGANIC CHEMISTRY**

**M.M. 75**

**(Elective-1)**

***Credits-04***

- Unit I-** (i) **Transition metal  $\pi$ - complexes** : Transition metal  $\pi$ - 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<sub>12</sub>.
- 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.

**B021005T**

**ADVANCED ORGANIC CHEMISTRY**

**M.M.75**

**(Elective-2)**

***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, Favorskii and Baeyer- Villiger rearrangement.

**Unit III : Pericyclic Reactions:**

Classification and examples, Woodward-Hofmann's Rule, Electrocyclic 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), Synthons, 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, mefenamic 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. Leilnicer. John Wiley.

**B021006T**

**ADVANCED PHYSICAL CHEMISTRY**

**MM : 75**

**(Elective-3)**

***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 :** Mesomorphic behavior, thermotropic liquid crystal, positional order, bond orientation order nematic and smectic mesophases, smectic-nematic, transition and clearing temperature, homeotropic, planar and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases, Optical properties of liquid crystal, Dielectric description of ordering in liquid crystals.

**Unit II – Polymeric Materials :** Molecular shape, structure and configuration, crystallinity, stress-strain behaviour, thermal behaviour, polymer types and their application, conducting and ferro-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 –Oppenheimer approximation, Slater Condon rules. Hartree Fock equation, Koopmans and Brillouin theories, Roothaan 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 Publishing, 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



**B021007P**  
**100]**

**M.Sc. Chemistry Practical (Semester X)**

**[M.M.**

**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 R<sub>f</sub> 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  $\beta$ - carotene from carrot.
- (v) Isolation of lycopene from tomatoes.
- (vi) Isolation of cystine from human hair.
- (vii) Isolation of Nicotine from tobacco.

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

**[20]**

- (i) Preparation of p- Bromoaniline from Aniline (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) Transesterification 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 R<sub>f</sub> values / TLC. [15]
- 5. Spectrophotometric estimation/Identification: (One exercise) [20]
  - (i) Aspirin, 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 p<sub>K</sub>a 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-salicylic 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<sup>2+</sup> and Cd<sup>2+</sup>/Zn<sup>2+</sup> and Ni<sup>2+</sup> ions in a mixture of Pb<sup>2+</sup> and Cd<sup>2+</sup>/Zn<sup>2+</sup> and Ni<sup>2+</sup> 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]**

**B021008R**

**RESEARCH PROJECT**

**M.M.100**

***Credits-08***

The research project is based on the following areas of 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

### **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.