CURRICULUM

For

POSTGRADUATE DEGREE COURSE IN

BASIC SCIENCES
M.Sc. (CHEMISTRY)

(Second Year)

[Proposed from 2018-19]

IIMT University, Meerut

Study and Evaluation Scheme
Course: M.Sc. Chemistry
(Two Year Course)

Semester III

S.No.	Course Code	Subject	Periods			Credit	Evaluation Scheme		
			L	T	P		Internal	External	Total
1.	MSC-301	Photo Chemistry & Bioorganic Chemistry	4	1	-	4	30	70	100
2.	MSC-302	Chemistry of Natural Products	4	1	-	4	30	70	100
3.	MSC-303	Bio inorganic and Biophysical Chemistry	4	1	-	4	30	70	100
4.	MSC-304	Analytical Chemistry	4	1	-	4	30	70	100
5.	MSC-311P	Chemistry Lab – III (Inorganic, Organic, Physical Chemistry)					50	50	100
6.	ECC-321/322/323/324	Skill Enhancement	-	-		-	100	-	100
		Total	**16**	**4**	**4**	**16**	**270**	**330**	**600**

Study and Evaluation Scheme
Course: M.Sc. Chemistry
(Two Year Course)

Semester IV

S. No.	Course Code	Subject	Periods			Credit	Evaluation Scheme		
			L	T	P		Internal	External	Total
1.	MSC-401	Material Chemistry	4	1	-	4	30	70	100
2.	MSC-402	Environmental Chemistry	4	1	-	4	30	70	100
3.	MSC-403	Organic Synthesis	4	1	-	4	30	70	100
4.	MSC-404	Polymers	4	1	-	4	30	70	100
5.	MSC-411P	Chemistry Lab – IV (Organic Chemistry)					50	50	100
6.	ECC-421/422/423/424	Skill Enhancement	-	-	-	-	100	-	100
		Total	**16**	**4**	**4**	**16**	**270**	**330**	**600**

M.Sc. Chemistry II Year: III Semester
Photochemistry and Bioorganic Chemistry

Course Code MSC-301		L	T	P
		4	1	0

(A) Photochemistry **30 Hrs.**

1. Photochemical Reactions **4 Hrs.**

Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

2. Determination of Reaction Mechanism **4 Hrs.**

Classification, rate constants and life times of reactive energy states: determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions: photo-dissociation, gas phase photolysis.

3. Photochemistry of Alkenes **6Hrs.**

Intramolecular reactions of the olefinic bond - geometrical isomerism, cyclisation reactions, rearrangement of 1,4 and 1,5 dienes.

4. Photochemistry of Carbonyl Compounds **8 Hrs.**

Intramolecular reactions of carbonyl compounds: saturated, cyclic and acyclic, β, γ -unsaturated and α, β-unsaturated compounds. Cyclohexadienones.
Intermolecular cycloaddition reactions: dimerisations and oxetane formation, Paterno-Buchi Reaction.

5. Photochemistry of Aromatic Compounds **4 Hrs.**

Isomerisations, additions and substitutions.

6. Miscellaneous Photochemical Reactions **4 Hrs.**

Photo-Fries reactions of anilides, Photo-Fries rearrangement.
Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision.

(B) Bioorganic Chemistry

1. Introduction **2 Hrs.**

Basic considerations. Proximity effects and molecular adaptation.

2. Enzymes **6 Hrs.**

Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-Menten and Lineweaver -Burk plots, reversible and irreversible inhibition.

3. Mechanism of Enzyme Action **3 Hrs.**

Transition state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typcial enzyme mechanisms for chymotrypsin, ribonuclease, Lysozyme and carboxypeptidase A.

4. Kinds of Reactions Catalysed by Enzymes **6 Hrs.**

Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic

intermediates in isomerization reactions, I)-cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.

5. Co-Enzyme Chemistry **4 Hrs.**

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+,NADP+,FMN,FAD, lipoic acid, vitamin B12 , Mechanisms of reactions catalyzed by the above cofactors.

6. Enzyme Models **4 Hrs.**

Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality. Biomimetic chemistry, crown ethers, cryptates. Cyclodextrins, cyclodextrin-based enzyme models, calixarenes, ionophores, micelles, synthetic enzymes or synzymes

7. Biotechnological Applications of Enzymes **5 Hrs.**

Large-scale production and purificationof enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheese-making,syrups from corn starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA technology.

Books Suggested:

1. Bioinorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and Penny, Springer Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
3. Enzyme Chemistry: Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall.
4. Enzyme Mechanisms, Ed. M.I. Page and A. Williams, Royal Society of Chemistry.
5. Fundamentals of Enzymology, N.C. Price and L. Stevens, Oxford University Press.
6. Immobilized enzymes: An Introduction and Applications in Biotechnology, Michael D. Trevan, John Wiley.
7. Enzymatic Reaction Mechanisms, C. Walsh and W.H. Freeman.
8. Enzyme Structure and Mechanism, A. Fersht and W.H. Freeman.
9. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.
10. Fundamentals of Photochemistry, K.K. Rohtagi - Mukherji, Wiley Eastern,
11. Essentials of Molecular Photochemistry, A. Gilbert and J. Baggott, Blackwell Scientific Publication.
12. Molecular Photochemistry, N.J. Turro and W.A. Benjamin.
13. Introductory Photochemistry, A. Cox and T. camp, McGraw Hill.
14. Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.
15. Organometallic Chemistry: A Unified Approach (2nd edn.), R.C. Mehrotra & A. Singh. New Age International.
16. Advanced Inorganic Chemistry (5th Edn.), F. A. Cotton & G. Wilkinson, John Wiley.
17. Photochemistry and Photophysics of Metal Complexes,D. M. Roundhill, Plenum Press.

M.Sc. Chemistry II Year: III Semester
Chemistry of Natural Products

Course Code MSC-302		L	T	P
		4	1	0

1. Natural Products and their Biosynthetic Pathways

General classification of natural products, their isolation and characterisation and biosynthesis of common plant products; Biosynthesis pathways for natural products using co-enzymes and enzymes; Synthesis of selected natural products based on genetic classification – fatty acid derivatives and related compounds, general biogenesis and synthesis of cis-jasmone, methyl jasmonate, prostaglandins, exaltone and muscone.

2. Antibiotics

Cell wall biosynthesis, inhibitors of β-lactam rings, antibiotics inhibiting protein synthesis; Isolation, structure elucidation, synthesis, SAR and mode of action of penicillins; Synthesis of penicillin G, penicillin V, ampicillin, amoxicillin and cephalosporin. Isolation, structure elucidation, synthesis, SAR and mode of action of following antibiotics: streptomycin, tetracyclines and chloroamphanicol.

3. Terpenoids and Alkaloids

General biosyntheses of mono- and sesquiterpenes, *trans*-chrysanthemic acid, cyclo- pentato monoterpene lactones, Synthesis of α-vetinone and total synthesis of β-eudesmol; Synthesis of hirsutene, abietic acid, *cis* juvenile hormone; *trans* annular cyclisation of caryophyllene, synthesis of caryophyllene and isocaryophyllene; Rearrangements of santonic acid and thujospene; Synthesis and rearrangement of longifolene.

4. Steroids

Biosynthesis of diterpenes, higher terpenes and steroids; Nomenclature of steroids and synthesis of squalene; Lanosterol and caretonoids; Synthesis of equlenins; Estrogens and total synthesis of non-aromatic steroids (progesterones); Corticosteroids; Degradation of diosgenin to progesterone and its synthesis; Miscellaneous transformations of steroid molecules.

5. Biogenesis

a) Alkaloids (pyridine, morphine and indole type) terpenoids of classes with examples, cholesterol, flavones, coumarins, carbohydrates and proteins.
b) Vitamins - Synthesis and structure of biotin and vitamin B_2, synthesis of vitamin B_1, biological functions of B6, B12, folic acid and thiamin.

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. II, I.L.Finar, ELBS.
3. Stereoselective Synthesis: A Practical Approach, M. Nogradi, VCH.
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. Medicinal Chemistry and Drug Discovery, Vol. I, Ed. M.E. Wolff, John Wiley.
6. Natural Products Chemistry, Vols. I and II, K. Nakanashi, Academy Press, New York and London.
7. Strategies and Tactics in Organic Synthesis Vol. 4 &Vol. 5, M. Harmata, Academic Press.
8. Introduction to Flavonoids, B.A. Bohm, Harwood Academic Press.
9. New Trends in Natural Product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
10. Insecticides of Natural Origin, Sukh Dev, Harwood Academic publishers.

M.Sc. Chemistry II Year: III Semester
Bio-inorganic and Bio-physical Chemistry

Course Code MSC-303		L	T	P
		4	1	0

(A)Bioinorganic Chemistry **30 Hrs.**

1. Metal Ions in Biological Systems **2 Hrs.**
Essential and trace metals.

2. Na^+/K^+ Pump **3 Hrs.**
Role of metals ions in biological processes.

3. Bioenergetics and ATP Cycle **6 Hrs.**
DNA polymerisation, glucose storage, metal complexes in transmission of energy; chlorophylls, photosystem I and photosystem II in cleavage of water.

4. Transport and Storage of Dioxygen **8 Hrs.**
Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerythirn, model synthetic complexes of iron, cobalt and copper.

5. Electron Transfer in Biology **6 Hrs.**
Structure and function of metalloproteins in electron transport processes -cytochromes and ion-sulphur proteins, synthetic models.

6. Nitrogenase **5 Hrs.**
Biological nitrogen fixation, molybdenum nitrogenase, spectroscopic and other evidence, other nitrogenases model system.

(B) Bio-Physical Chemistry

1. Biological Cell and its Constituents **2 Hrs.**
Biological cell, structure and functions of proteins, enzymes, DNA and RNA in iving systems, Helix coil transition.

2. Bio-energtics **3 Hrs.**
Standard free enrgy change in biochemical reactions, exergonic, endergonic, Hydrolysis of ATP, synthesis of ATP from ADP.

3. Statistical Mechanics in Bio polymers **6 Hrs.**
Chain configuration of macromolecules, statistical distribution end to end dimensions, calculation of average dimensions for various chain structures. Polypeptide and protein structures, introduction to protein folding problem.

4. Bio polymer Interactions **6 Hrs.**
Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curves.

5. Thermodynamics of Biopolymer Solutions **4 Hrs.**
Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechano-chemical system.

6. Cell Membrane and transport of Ions **3 Hrs.**

Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport, Nerve conduction.

7. Bio polymers and their Molecular Weights 6 Hrs.

Evaluation of size, shape, molecular weight and extent of hydration of biopolymersby various experimental techniques. Sedimentation, equilibrium, hydrodynamic methods, diffusion, sedimentation velocity, viscosity, electrophoresis and rotational motions.

Books Suggested

1. Principles of Biochemistry, A.L. Lehinger,Worth Publications.
2. Biochemistry, L. Stryer, W. H. Freeman.
3. Biochemistry, J. David Rawn, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry, E.E. Conn and P.K. Stumpf, John Wiley.
6. Principles of Bio-inorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
7. Bio-inorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
8. Inorganic Biochemistry Vol. I and II, Ed. G.L. Eichhn, Elsevier.
9. Progress in Inorganic Chemistry, Vol. 18 and 38, Ed. J.J. Lippard, John Wiley.
10. Macromolecules: Structure and Function, F World, Prentice Hall.

M.Sc. Chemistry II Year: III Semester
Analytical Chemistry

Course Code MSC-304		L	T	P
		4	1	0

1. Introduction **4 Hrs.**

Classification of analytical methods: classical and instrumental, types of instrumental analysis, selecting an analytical method.

2. Errors and Evaluation **6 Hrs.**

Definition of terms of mean and median, precision, standard deviation, accuracy, absolute error, relative error. Types of error in experimental data: determination (systematic), intermediate (random) and gross. Sources of errors and the effect upon the analytical results. Methods for reporting analytical data. Statistical evaluation of data, indeterminate errors. The use of statistics.

3. Radiochemical methods **10 Hrs.**

Elementary working, principles of Giger Muller, Ionization, proportional and γ-ray counters. Neutron radiation sources, radio tracer techniques, neutran activation analysis (NAA): Principle, techniques and applications in preparation of some commonly used radioactive isotope. Use of radioactive isotopes in analytical and physio-chemical problems, isotopic dilution analysis (IDA), sub-stoichiometric IDA, advantages and limitations of IDA and comparision of IDA with NAA. Principle of Radiometric titrations, types. Experimental techniques and its applications.

4. Thermal methods of Analysis **10 Hrs.**

Introduction of different thermal methods, Thermogravimetry: TGA and DTG, static thermogravimetry, quasi thermogravimetry and dynamic thermo gravimetry, instrumental and balances, X-Y recoder, thermogram, factors affecting thermograms. Application of thermogravimetry.

Differential Scanning Calorimetry (DSC): Introductin, instrumentation, DSC – curves, factors affecting DSC curves and applications.
Thermometric Titrations: Introduction, instrumentation, apparatus, theory and applications.

5. Chromatographic techniques **8 Hrs.**

Adsorption and partition chromatography, paper chromatography, thin layer chromatograpahy, Ion exchange and gas chromatography, HPLC, Size exclusion chromatography, their principles, techniques and important applications.

6. Electroanalytical Techniques **15 Hrs.**

a. Voltametry

General introduction, Principle, instrumentation, Types of voltammetry, Polarography (Principle and Instrumentation), Cycle Voltammetry, pulse methods.
Stripping Technique: Anodic and cathodic stripping, Voltametry abd their applications in the trace determination of metal ions and biologically important compounds.

b. Ion Selective Electrodes

Electrical properties of membrane, glass electrode with special reference to H^+, Na^+, K^+ ions, opereation of solid membrane electrode, operation of liquid membrane electrode, coated type ion electrode. Applications of ion selective electrode in determination of some toxic metals and some anioins (F^-, Cl^-, Br^-, I^- and NO_3^{2-})

7. Atomic Absorption Spectroscopy & Flame Photometry **7 Hrs.**

Introduction, basic principle, instrumentation and application.

Books Suggested:

1. Quantitative Analysis. Day and Underwood.
2. A text book of Quantitative analysis. A I Vogel.
3. Advanced Analytical Chemistry. Meites and Thomas.
4. Analytical Chemistry, R.K. Soni.
5. Instrumental Methods of Chemical Analysis, G.W. Ewing.
6. Physical Methods in Inorganic Chemistry, R.S. Drago.
7. Analytical Chemistry, G.D. Christian.
8. Basic Concepts of Analytical Chemistry, S.M. Khopkar.
9. Polarography, Kolltath and Lingane.
10. Instrumental Methods of Chemical Analysis, Braun.
11. Instrumental Methods of Analysis, Willard, Merritt and Dean.
12. Analytical Chemistry, Strouts, Crifillan and Wilson.
13. Introduction to Radiation Chemistry, J.W.T. Spinks & R.J. woods.
14. Fundamentals of Analytical Chemistry, S.A. Skoog and D.W. West.
15. Analytical Chemistry, R.V. Dilts.

M.Sc. Chemistry II Year: III Semester
Chemistry Lab – III

Course Code MSC-311P		L	T	P
		0	0	3

(A) Analytical Practical

1. To verify Lambert's – Beer's Law with the help of UV-Visible spectrophotometer.
    a. To determine λmax of a given sample.
    b. To determine the concentration of unknown sample.
2. To scan theUV-Vis spectra of unknown sample with the UV-Vis double beam spectrophotometer.
3. To determine the dynamic viscosity of polymeric plasticizer at different temperatures with the help of Brukfield viscometer.
4. To determine formation constant of $FeSCN^{2+}$ compounds by conductometry.
5. To determine rate constants of intermediate complex in the reaction of Cerium (IV) ammonium nitrate and hypophosphoric acid in acid medium.

(B) Bio-Chemistry Practical

1. Qualitative test for carbohydrates: Molisch's, Iodine, Benedict, Fehling.
2. Qualitative test for lipids: Acrolein test, Test for presence of free acid (FA), Test for unsaturation of free acid (FA).
3. Determination of acid values of fats and oils.
4. Determination of iodine number of a fat sample.
5. Determination of saponification value of fats and oils.
6. Estimation of amylase activity in saliva.
7. To estimate sugar in blood.
8. To prepare casein protein from milk and its estimation.

Books Suggested:

1. Vogel's Qualitative Inorganic Analysis, revised, svehla, Orient Longman.
2. Vogel's Textbook of Quantitative Inorganic Analysis (revised), J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
3. Standard Methods of Chemical Analysis, W.W. Scott, The Technical Press.
4. Experimental Inorganic Chemistry, W.G. Palmer, Cambridge.
5. Handbook of Preparative Inorganic Chemistry, Vol. I & II, Brauer, Academic Press.
6. Inorganic Synthesis, McGraw hill.
7. Experimental Organic Chemistry Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai. Tata McGraw Hill.
8. Laboratory Manuel in Organic Chemistry, R.K. Bansal, Wiley Eastern.
9. Experiments in General Chemistry, C.N.R. Rao and U.C. Agarwal, East-West Press.
10. Experiments in Physical Chemistry, R.C. Dass and D. Behra, Tata McGraw Hill.
11. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing house.
12. Advanced Experimental Chemistry, Vol. I – Physical, J.N. Gurtu and R. Kapoor, S. Chand & Co.
13. Experiments in Physical Chemistry, J.C. Ghosh, Bharti Bhavan.
14. Practical Organic Chemistry, F.G. Mann and B.C. Saunders, Pearson Education.
15. Practical Organic Chemistry, 5th Ed., B.S Furniss, A.J. Hannaford, P.W.G. Smith and A.R. Tatchell, Pearson.

M.Sc. Chemistry II Year: IV Semester
Materials Chemistry

Course Code MSC-401	L	T	P	
		4		

1. Introduction
Materials and their classification, Role of Chemistry in Material design.

2. Synthesis and Characterization of Materials
Preparative techniques: Ceramic methods; chemical strategies, chemical vapour deposition; Preparation of nanomaterials; Langmuir-Blodgett Films; Fabrication of ordered nanostructures; Composition and purity of materials.

3. High – Tc Oxide Superconductors
Structural features of cuprate superconductors, 1-2-3 and 2-1-4 cuprates; Structure; Normal state properties: anisotropy and temperature dependence of electrical resistance; Superconducting state: heat, capacity, coherence, length, Relation between Tc and hole concentration in cuprates; mechanism of superconductivity in cuprates; Applications of high Tc-cuprates.

4. Organic Materials
Conducting organics - Metals from molecules; Charge transfer materials and conducting polymers; Organic superconductors; Fullerenes; Molecular ferromagnets and ferroelectrics; Liquid crystals: mesomorphic behavior; Optical properties of liquid crystals; Display devices.

5. Non-linear materials
Second and third order non-linear effects; molecular rectifiers and frequency doublers; Unimolecular electronic devices; Photo-chromic materials; Optical data storage; memory and switches.

Books Suggested:

1. Solid State Chemistry and its Applications, John Wiley & Sons, Singapore.
2. New Directions in Solid State Chemistry, C.N.R. Rao & J. Gopal krishnan, Cambridge Univ. Press.
3. Superconductivity Today, T.V. Ramakrishnan & C.N.R. Rao, Wiley Eastern Ltd., New Delhi.
4. Designing the Molecular World: Chemistry at the Frontier, Princeton Univ. Press.
5. Solid State Physics, N.W. Ashcroft and N.D. Mermin, Saunders College.
6. Material Science and Engineering: An Introduction, W.D. Callister, Wiley.
7. Principles of Solid State, H.V. Keer, Wiley Eastern.
8. Thermotropic Liquid Crystals, Ed. G.W. Gray, John Wiley.
9. Handbook of Liquid Crystals, Kelker and Hatz, Chemie Verlag.
10. Materials Science, J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rawlings, ELBS.

M.Sc. Chemistry II Year: IV Semester
Environmental Chemistry

Course Code MSC-402		L	T	P
		4	1	0

1. Environment **8 Hrs.**

Introduction, Composition of atmosphere, vertical temperature, heat budget of the earth atmospheric system, vertical stability atmosphere. Biogeochemical cycles of C,N,P,S & O. Biodistribution of elements.

2. Hydrosphere **12 Hrs.**
Chemical composition of water bodies-lakes streams, rivers and wet lands etc., Hydrological cycle.

Aquatic pollution - inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Water quality parameters -dissolved oxygen, biochemical oxygen demand, solids metals, content of chloride, sulphate, phosphate nitrate and micro-organisms.

Water quality standards: Analytical methods for measuring BOD, DO, COD ,F, Oils, metals (As, Cd, Cr, Hg, Pb, Se etc.), residual chlorine and chlorine demand. Purification and treatment of water.

3. Soils **6 Hrs.**
Composition, micro and macro nutrients, Pollution - fertilizers, pesticides, plastics and metals, Waste treatment.

4. Atmosphere **8 Hrs.**
Chemical composition of atmosphere - particles, ions and radicals and their formation Chemical and photochemical reactions in atmosphere, smog formation, oxides of N,C, S, O and their effect, pollution by chemicals, petroleum, minerals chlorofluorohydrocarbons. Green house effect, acid rain, air pollution controls and their chemistry.

Analytical methods for measuring air pollutants. Continuous monitoring instruments

5. Industrial Pollution **12 Hrs.**
Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants, metallurgy. Polymers, drugs etc. Radionuclide analysis. Disposal of wastes and their management.

6. Environmental Toxicology 9 Hrs. Chemical solutions to environmental problems, biodegradability, principles of decomposition, better industrial processes. Bhopal gas tragedy, Chernobyl, Three Mile Island, Sewal D and Minamata disasters.

7. Radiation pollution **5 Hrs.**
Classification & effects of radiation; Effects of ionizing radiation on man; Effects of non-ionizing radiation on life; Radioactivity and Nuclear fallout; Protection and control from radiation.

Books Suggested:

1. Environmental Pollution A.K. De, Wiley Eastern.
2. Environmental Chemistry, S.E. Manahan, Lewis Publishers.
3. Environmental Pollution Control in Process Industries, S.P. Mahajan.
4. Environmental Pollution, B.K. Sharma & H. Kaur, Krishna Publications.
5. Introduction to Air Pollution, P.K. Trivedi.
6. Environmental Toxicology, Ed. J. Rose, Gordon and Breach Science Publication.
7. Standard Method of Chemical analysis, F.J. Welcher Vol. III, Von Nostrand Reinhold Co.
8. Environmental Chemistry, C. Baird and W.H. Freeman.

M.Sc. Chemistry II Year: IV Semester
Organic Synthesis

Course Code MSC-403		L	T	P
		4	1	0

15 Hrs.

1.Organometallic

Principle, preparations, properties and applications of the following in organic synthesis with mechanistic details:
Group I & II metal organic compounds
Li, Mg, Hg, Cd, Zn, and Ce Compunds
Transition metals
Cu,Pd, Ni, Fe, Co, Rh, Cr and Ti Compounds.
Other elements
S,Si,B and I compounds.

11 Hrs.

2. Oxidation
Introduction. Different oxidative processes.
Hydrocarbons: alkenes, aromatic rings, saturated C-H groups (activated and unactivated).
Alcohols, diols aldehydes, ketones, ketals and carboxylic acids.
Amines, Hydrazines and sulphides.
Oxidation with ruthenium tetraoxide, iodobenzene diacetate and thallium (III) nitrate.

11 Hrs.

3. **Reduction**

Introduction. Different reductive processes.
Hydrocarbons: alkanes, alkenes, alkynes and aromatic rings.
Carbonyl Compounds: aldehydes, ketones, acids and their derivatives. Epoxides, nitro, nitroso, azo and oxime groups.

4. **Rearrangements** **15 Hrs.**
General mechanistic considerations- nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements: Pinacol-Pinnacolone, Wagner-Meerwin, Demjanov, benzyl-Benzilic acid, Favorskii, arndt-Eistern synthesis, Neber, Beckmann, Hoffman, Curtius, Schmidt, Baeyer Villiger, Shaprio reaction, Bartom, Chichibaben, Hoffman-Lofler Freytag reaction; wittig reaction.

5. Metallocenes, Nonbenzenoid Aromatic and Polycylic Aromatic Compounds General considerations, synthesis and reactions of Ferrocene, Chrysene, Azulene.

Books Suggested:

1. Modern Synthetic Reactions, H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge University Press.
3. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, J. March, John Wiley.
4. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic and Professional.
5. Advanced Organic Chemistry Part B, F.A. Carey and R.J. Sundberg, Plenum Press.
6. Rodd's Chemistry of Carbon compounds, Ed. S. Coffey, Elsevier.

M.Sc. Chemistry II Year: IV Semester
Polymers

Course Code MSC-404		L	T	P
		4	1	0

1. Introduction **8 Hrs**

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 co-polymerization. Polymerization conditions and polymer reaction. Polymerization in homogeneous and heterogeneous system.

2. Polymer Characterization **14 Hrs.**

Polydispersion-average molecular weight concept. Number, Weight and Viscosity average molecular weight. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weight. End group, viscosity light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers and chemicals analysis of polymers, spectroscopic methods, physical testing: tensile strength, fatigue, impact, Tear resistance, Hardness and Abrasion resistance.

3. Structure and Properties **14 Hrs.**

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 properties-crystalline 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 & Tg, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

2. **Polymer Processing** **12 Hrs**.

Plastics, elastomers and fibers. Compounding. Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fiber spinning.

3. **Properties of Commercial Polymers** **12 Hrs**.

Polyethylene, Polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicon polymers. Functional Polymers- Fire polymers and electrically conducting polymers. Biomedical polymers- contact lens, dental polymers, artificial heart, kidney , skin and blood cells.

Books Suggested:

1. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
2. Text Book of Polymer Science, F.W. Billmeyer Jr., 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.

M.Sc. Chemistry II Year: IV Semester
Chemistry Lab – IV

Course Code MSC-411P		L	T	P
		0	0	

1. To perform quantitative separation and determination of the following pairs of metal ions using gravimetric and volumetric methods:
(i) Ag^{+} (gravimetrically) and Cu^{2+}(Volumetrically)
(ii) Cu^{2+} (gravimetrically) and Zn^{2+}(Volumetrically)
(iii) Fe^{3+} (gravimetrically) and Ca^{2+}(Volumetrically)
(iv) Mg^{2+} (gravimetrically) and Ca^{2+}(Volumetrically)

2. To determine separation of a mixture of cations/anions by paper chromatographic technique using aqueous/nonaqueous media.
(i) Pb^{2+} and Ag^{+} (aqueous and non-aqueous media) (ii) Co^{2+} and Cu^{2+} (non-aqueous medium)
(iii) Cl^{-} and I^{-} (aqueous-acetone medium) (iv) Br^{-} and I^{-} (aqueous-acetone medium)

3. Three step organic preparations
   (a) To prepare o-chloro benzoic acid from phthalic anhydride.
   (b) To prepare benzilic acid from benzaledhyde
   (c) To prepare dibenzil from benzaldehyde
   (d) To prepare benzoic acid from benzophenone.

Books Suggested:

4. Vogel's Qualitative Inorganic Analysis, revised, svehla, Orient Longman.
5. Vogel's Textbook of Quantitative Inorganic Analysis (revised), J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
6. Standard Methods of Chemical Analysis, W.W. Scott, The Technical Press.
7. Experimental Inorganic Chemistry, W.G. Palmer, Cambridge.
8. Handbook of Preparative Inorganic Chemistry, Vol. I & II, Brauer, Academic Press.
9. Inorganic Synthesis, McGraw hill.
10. Experimental Organic Chemistry Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai. Tata McGraw Hill.
11. Laboratory Manuel in Organic Chemistry, R.K. Bansal, Wiley Eastern.
12. Experiments in General Chemistry, C.N.R. Rao and U.C. Agarwal, East-West Press.
13. Experiments in Physical Chemistry, R.C. Dass and D. Behra, Tata McGraw Hill.
14. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing house.
15. Advanced Experimental Chemistry, Vol. I – Physical, J.N. Gurtu and R. Kapoor, S. Chand & Co.
16. Experiments in Physical Chemistry, J.C. Ghosh, Bharti Bhavan.
17. Practical Organic Chemistry, F.G. Mann and B.C. Saunders, Pearson Education.
18. Practical Organic Chemistry, 5th Ed., B.S Furniss, A.J. Hannaford, P.W.G. Smith and A.R. Tatchell, Pearson.