M.Sc. (Applied Chemistry)

Duration – 2 Years Full Time

Programme Structure-2017

AMITY UNIVERSITY
R A J A S T H A N

Summary Sheet

M.Sc (Applied Chemistry)

Semester	CC	DE	VA	OE	Total
I	26	0	4	3	33
II	18	4	4	3	29
III	26	4	4	0	34
IV	30	0	0	0	30
Total	100	8	12	6	126

Core Courses**: CC,** Domain Electives**: DE,** Open Electives**: OE**

M. Sc (APPLIED CHEMISTRY)
PROGRAMME STRUCTURE

FIRST SEMESTER

Course Code	Course Title	Category	(L)	(T)	(P)	Credits
Core Courses						
MAC101	Physical Chemistry	CC	3	1	–	4
MAC102	Organic Chemistry	CC	3	1	–	4
MAC103	Computer programming using "c" Language	CC	3	1	–	4
MAC104/ MAC105	Applied Mathematics/Applied Biology	CC	2	1	–	3
MAC155	Seminar	CC	–	–		6
MAC120	Physical Chemistry lab	CC	–	–	4	2
MAC121	Organic Chemistry Lab	CC	–	–	4	2
MAC122	Computer programming using "c" Language lab	CC	–	–	2	1
Value Added Courses						
BCS111	Basics of Communication	VA	1	-	-	1
BSS111	Self Development and interpersonal skill	VA	1	-	-	1
FLF 111 FLG 111 FLS 111 FLC 111	Foreign Language – I French-1 German-1 Spanish-1 Chinese-1	VA	2	-	-	2
OPEN ELECTIVE-I						
	OE-I	OE				3
	TOTAL					**33**

SECOND SEMESTER

Course Code	Course Title	Category	(L)	(T)	(P)	Credits
Core Courses						
MAC 201	Analytical Chemistry	CC	3	1		4
MAC 202	Industrial and Applied Chemistry	CC	3	1		4
MAC 203	Inorganic Chemistry	CC	3	1		4
MAC-220	Analytical chemistry–Lab	CC			4	2
MAC-221	Industrial Chemistry–Lab	CC			4	2
MAC-223	Inorganic chemistry–Lab	CC			4	2
Domain Elective –I(Select any one of following)						
MAC-204	Drugs and Dyes	DE	3	1		4
MAC-205	Natural Products Chemistry	DE	3	1		4
MAC-206	Bioinorganic and Organomatallic Chemistry	DE	3	1		4
MAC-207	Industrial Management and Safety Processes	DE	3	1		4
MAC-208	Environmental Chemistry	DE	3	1		4
MAC-209	Chemistry of cosmetics	DE	3	1		4
MAC-210	Nano Chemistry	DE	3	1	–	4
Value Added Courses						
BCS 211	Corporate Communication	VA	1	-	-	1
BSS 211	Behavioral Communication and Relationship Management	VA	1	-	-	1
FLF 211 FLG 211 FLS 211 FLC 211	Foreign Language – II French German Spanish Chinese	VA	2	-	-	2
OPEN ELECTIVE-II						
	OE-II	OE				3
	Total					**29**

SUMMER INTERNSHIP

Note: Students must submit their summer internship report immediately on return from summer vacation in July /August and the same would be evaluated for 6 credit units, which would be included in the Third Semester marks.

THIRD SEMESTER

Course Code	Course Title	Category	(L)	(T)	(P)	Credits
Core Courses						
MAC 301	Instrumental Method of Analysis I	CC	3	1	-	4
MAC 302	Synthetic Organic Chemistry	CC	3	1	-	4
MAC 303	Introduction to Polymeric Materials	CC	3	1	-	4
MAC-304	Chemistry of Materials and Nano Materials	CC	3	1		4
MAC 355	Summer Internship(Evaluation)	CC	-	-	-	6
MAC320	Applied Chemistry Lab	CC			4	2
MAC321	Instrumental Lab	CC			4	2
Domain Elective –II(Select any one of following)						
MAC305	Medicinal Chemistry	DE	3	1		4
MAC306	Polymer Technology	DE	3	1		4
MAC307	Green Chemistry	DE	3	1		4
MAC308	Industrial Waste and Water Treatment	DE	3	1		4
MAC309	Nuclear Chemistry	DE	3	1		4
Value Added Course						
BCS 311	Communication Skills – III	VA	1	-	-	1
BSS 311	Behavioural Science – III	VA	1	-	-	1
FLF 311 FLG 311 FLS 311 FLC 311	Foreign Language – III French German Spanish Chinese	VA	2	-	-	2
	TOTAL					34

FOURTH SEMESTER

Core Courses

Course Code	Course Title	Category	(L)	(T)	(P)	Credits
MAC460	Research Work Based Project*	CC				30

*Student will be sent to laboratories at universities, national institute and industries for their project based research work during 4th semester. At the end of 4th semester student will be evaluated on the basis of dissertation followed by presentation of their research work.

PHYSICAL CHEMISTRY

Course Code: MAC-101 **Credit Units: 04**

MODULE I: CHEMICAL THEROMODYNAMICS

Concepts of laws of thermodynamics, free energy, work function, concept of entropy and entropies of chemical reactions, third law of thermodynamics, Maxwell‟s relation, partial molar properties, chemical potential, Vant Hoff‟s equation, Gibbs-Duhem equation, Concept and determination of fugacity, Non ideal systems: excess functions for non- ideal solutions, activity, activity coefficient, Debye-Huckel theory for activity coefficient of electrolytic solutions, ionic strength .

MODULE- II: PHASE EQUILIBRIA

Gibb‟s Phase rule-two component systems – classification – liquid-liquid and liquid vapour equilibria (fractional distillation) solid – gas (dehydration and rehydration of $CuSO_4$. $5H_2O$), solid-liquid systems(Bi-Cd, Al-Mg and – benzene – picric acid systems),– three component systems involving liquid–liquid equilibria.

MODULE-III: APPLIED ELECTROCHEMISTRY

Electrochemistry of solutions, ion-solvent and ion-ion interaction, ion transport in solution – electrochemical cells, Nernst equation, electrode kinetics, electrical double layer, Debuy Huckel theory, electrical double layer, Polarography Theory, Ilkovic Equation, Half Wave Potential an dits significance. Introduction to corrosion, Homogenous Theory, Forms of Corrosion, Corrosion Monitoring & Prevention methods.

MODULE IV: QUANTUM CHEMISTRY

a)Introduction to Exact Quantum Mechanical Results: Introduction to Schrodinger Equation and the postulates of Quantum Mechanics. Discussion of solutions of the Schrodinger Equation to some model systems viz. particle in a box , the harmonic oscillator, The rigid rotor, the hydrogen atom.

b) Approximate Methods: The Variation Theorem, Linear vibration Principle, Perturbation Theory (First order and non-degenerate). Application of variation method and perturbation,theory of helium atom.

c) MOT: Huckels Theory of conjugated system, bond order and charge densitycalculation, Application to ethylene, Butadiene, Cyclopropenyl radical, cyclobutadiene etc. Introduction to extended Huckel Theory

MODULE V: SURFACE CHEMISTRY AND CATALYSIS

Adsorption: Gibbs adsorption isotherm, BET equation and estimation of surface area Micelles:Surface active agents, classification of surface agents, micellization, critical micellar concentration (CMC) factors affecting the CMC of surfactants, thermodynamics of micellization. Concepts of catalysis: Homogenous catalysis, kinetics of enzyme reactions, Surface chemistry and catalysis.

MODULE VI: SOLID STATE CHEMISTRY

General Principals, experimental procedures and kinetics of Solid state reactions. Crystal Defects including thermodynamics of Schottky and Frenkel defects, colour centres, nonstoichiometric defects. Electronic Properties- band theory, insulators, intrinsic, extrinsic and doping semiconductors, p-n junction, super conductors. Magnetic properties- Classification of materials, quantum theory of paramagnetics, cooperative phenomena, magnetic domains, hysteresis.Optical properties – Optical reflectance, photoconduction, photoelectric effect.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Books Suggested:

1. J. P. Lowe and K.Peterson, Quantum Chemistry Academic Press.
2. D. A. McQuarrie, Quantum Chemistry Viva Books Pvt. Ltd.: New Delhi.
3. R. G. Mortimer, Mathematics for Physical Chemistry Elsevier.
4. F. L. Pilar, Elementary Quantum Chemistry, Dover Publication Inc.: NewYork.
5. P. W. Atkins and J. de Paula, Atkin‟s Physical Chemistry, Oxford University Press.
6. I. L. Levine, Quantum Chemistry, Prentice-Hall Inc., New Jersey.
7. T. Engel and P. Reid, Physical Chemistry, Benjamin-Cummings.
8. D. A. McQuarrie and J. D. Simon, Physical Chemistry: A Molecular Approach, Univ. Science Books.
9. R. J. Silbey, R. A. Alberty and M. G. Bawendi, Physical Chemistry, Wiley.

ORGANIC CHEMISTRY

Course Code: MAC-102 **Credit Units: 04**

MODULE I: STEREOCHEMISTRY

Conformational analysis of cycloalkanes, decalines, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding. Elements of symmetry, chirality, threo and erythro isomers, R,S-nomenclature, E,Z-nomenclature, methods of resolution, optical purity, sterospecific and steroselective synthesis, asymmetric synthesis-

Cram‟s rule-Prelog‟s rule. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes).

MODULE II: REACTION MECHANISM

Types of mechanism, types of reactions, thermodynamic and kinetic requirements, kinetic and thermo control. Hammond‟s postulate, Curtin-Hammett principle. Potential energy diagrams, transitions sta intermediates, methods of determining mechanism, isotope effects.

MODULE III: SUBSTITUTION REACTION

Aliphatic neucleophilic substitution reaction, SN1 and SN2 and SET mechanism, neighboring group participation, non -classical carbocation, ambidient nucleophile, regioselectivity. Aliphatic electrophilic substitution, SE_2 and SE_1. Aromatic nucleophilic substitution. S_NAr, S_N1, benzyne and $S_{RN}1$ mechanism.

MODULE IV: ELIMINATION AND ADDITION REACTION

E_2, E_1, $E1_{cB}$ mechanisms, Hoffmann and Saytzeff‟s rule – competition between and elimination and substitution reactions. Mechanistic and stereochemical aspects of addition reactions involving elctrophiles, nucleophiles and free radicals, region and chemo selectivity, orientation and reactivity.

MODULE V: PERICYCLIC REACTIONS

Conservation of molecular orbital symmetry, classification of pericyclic reactions – electrocyclic reactions, cyclo addition and sigmatropic rearrangements, ene reactions, woodward – Hoffmann correlation diagram.

MODULE VI: NAMED REACTIONS

Clemmensen, Wolff Kishner, Meerwein – Ponndorrf- Verley, Claisen, Dieckmann, Benzoin, Michael addition, Mannich reaction, Wittig reaction, Chichibabin reactions, Hundsdiecker reactions, Robinson reaction, Reformatsky reaction, Gattermann Koch reaction, Wagner – Meerwein rearrangement, Benzil – benzylic reaction, Favorskii reaction, Pinacol- pinacolone rearrangement.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

References:

1. A guide book to mechanism in Organic chemistry (Orient-Longmens)- Peter Sykes
2. Organic reaction mechanism (Benjamin) R. Breslow
3. Mechanism and structure in Organic chemistry (Holt Reinh.)B. S. Gould.
4. Organic chemistry (McGraw-Hill)Hendrikson, Cram and Hammond.
5. Basic principles of Organic chemistry (Benjamin) J. D.Roberts and M. C. Caserio.
6. Reactive Intermediates in Organic chemistry (John Wiley)N. S. Issacs.
7. Stereochemistry of Carbon compounds. (McGraw-Hill)E.L.Eliel
8. Organic Stereochemistry (McGraw-Hill) by Hallas.
9. Organic reaction mechanism (McGraw-Hill) R. K. Bansal.
10. Organic chemistry- R. T. Morrison and R. N. Boyd,(Prentice Hall.)
11. Modern organic reactions(Benjumin) H. O. House.
12. Principle of organic synthesis- R.O.C. Norman and J. M. Coxon.(ELBS)
13. Reaction mechanism in organic chemistry- S. M. Mukharji and S. P. Singh.
14. Stereochemistry of organic compoundsc) D. Nasipuri.
15. Advanced organic chemistry (McGraw-Hill) J. March.
16. Introduction to stereochemistry (Benjumin) K. Mislow.
17. Stereochemistry by P. S. Kalsi (New Age International)
18. Reaction, Reagents and Rearrangements, S.N.Sanjal (Bharti Bhavan)

COMPUTER PROGRAMMING USING C LANGUAGE

Course Code: MAC-103 **Credit units: 04**

Course Objective:

This course aims to introduce the students with Computer Programming Concepts, taking C language as the medium with examples emphasized from chemistry. The course lays emphasis on foundations & basic principles of Computer Programming. The language is introduced in a structural manner, beginning with the simple constructs and working up to more complex issues, for example, pointers and dynamic data structures, file manipulations etc

Course Contents:

MODULE I: Introduction

Introduction to computer, history, von-Neumann architecture, memory system (hierarchy, characteristics and types), H/W concepts (I/O Devices), S/W concepts (System S/W & Application S/W, utilities). Data Representation: Number systems, character representation codes, Binary, octal, hexadecimal and their interconversions. Binary arithmetic, floating point arithmetic, signed and unsigned numbers, Memory storage unit.

MODULE II: Programming in C

History of C, Introduction of C, Basic structure of C program, Concept of variables, constants and data types in C, Operators and expressions: Introduction, arithmetic, relational, Logical, Assignment, Increment and decrement operator, Conditional, bitwise operators, Expressions, Operator precedence and associativity. Managing Input and output Operation, formatting I/O.

MODULE III: Fundamental Features in C

C Statements, conditional executing using if, else, nesting of if, switch and break Concepts of loops, example of loops in C using for, while and do-while, continue and break. Storage types (automatic, register etc.), predefined processor, Command Line Argument.

MODULE IV: Arrays and Functions

One dimensional arrays and example of iterative programs using arrays, 2-D arrays Use in matrix computations.Concept of Sub-programming, functions Example of user defined functions. Function prototype, Return values and their types, calling function, function argument, function with variable number of argument, recursion.

MODULE V: Advanced features in C

Pointers, relationship between arrays and pointers Argument passing using pointers, Array of pointers. Passing arrays as arguments.Strings and C string library.

Structure and Union, Defining C structures, giving values to members, Array of structure, Nested structure, passing strings as arguments.File Handling.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE

Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

1.Fundamentals of Computer: V. Rajaraman (Prentice Hall)

2. "ANSI C" by E Balagurusamy

3. Yashwant Kanetkar, "Let us C", BPB Publications, 2nd Edition, 2001.

4. Computers in Chemistry: K.V. Raman (Tata Mc Graw Hill)

APPLIED MATHEMATICS

Course Code: MAC104 **Credit Units: 04**

Course Objective:

This course is to develop mathematical techniques required for industrial applications. The course gives the students a basic understanding of Fourier and Laplace transforms, Probability and statistics. It also equips the students with basic knowledge of differential and integral calculus of real variable.

Course Contents

MODULE I: Differential & Integral Calculus

Definition of limit, continuity & Derivative of a real valued function of real variable at a point, Rolle‟s Theorem, Mean Value Theorem, Taylor‟s Theorem, Maxima and Minima of one Variable, partial differentiation Indefinite and definite integral, properties of definite integral, reduction formulae, Double Integration

MODULE II: Ordinary Differential Equations:

Formation of a differential equation, variable separable method, Homogeneous differential equation, Linear Differential equation of first order, second order Linear Differential equation with constant coefficients, cauchy‟s Linear Differential Equations,

MODULE III: Fourier Transforms

Fourier series expansion, Euler‟s formula, functions having point of discontinuity, fourier series of function having arbitary period, even and odd functions, half range series, Fourier Transforms, Inverse Fourier Transforms, Properties of Fourier Transforms and their applications to boundary value problems.

MODULE IV: Probability & Statistics

Probability: definitions, addition and multiplication laws, Baye‟s Theorem, random variables, discrete and continuous probability functions, Mean, Variance, Binomial, Possion, normal and exponential distributions, moment generating function, characteristicfunction of a probability distribution, joint probability distribution of two random variables.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

References:

1. Mathematical Calculus by Thomson & Finley.
2. Advanced Engineering Mathematics by Kreyszig.

APPLIED BIOLOGY

Course Code: MAC104 **Credit Units: 04**

Course Objective:

This course is to develop biological concept required for industrial applications mainly in drugs. The course gives the students a basic understanding of Biological concepts mainly for mathematical background students. It also equips the students with basic knowledge of cell structure, protein, carbohydrates etc.

Course Contents

Unit I Cell Structure and Functions.

Structure prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview and their functions, comparison of plant and animal cells. Overview of metabolic processes-catabolism and anabolism. ATP – the biological energy currency. Origin of life-unique properties of carbon chemical evolution and rise of living systems. Introduction to bio-molecules, building blocks of biomacromolecules.

Unit II Carbohydrates. Conformation of monosaccharides, structure and functions of important derivatives of mono-saccharides like glycosides, deoxy sugars, myoinositol, amino sugars. Nacetylmuramic acid, sialic acid disaccharides and polysaccharides. Structural polysaccharides cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological function of glucosaminoglycans of mucopolysaccharides. Carbohydrates of glycoporteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid.

Unit III Lipid. Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Liproproteins-compositiion and function, role in atherosclerosis. Properties of lipid aggregates-micelles,

bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism-boxidation of fatty acids.

Unit IV Amino-acids, Peptides and Proteins. Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins. force responsible for holding of secondary structures. ahelix, -b-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein-folding and domina structure. Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids, sequence determination, chemical/enzymatic/mass spectral, racemization/detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH).

Unit V Nucleic Acids. Purine and pyrimidine bases of nucleic acids, base pairing via Hbounding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

References:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

PHYSICAL CHEMISTRY LAB

Course code: MAC-120 **Credit units 02**

List of Experiments (Any 10 Experiments are to be performed)

1. Phase Equilibria:

i. Determination of congruent composition and temperature of a binary system (e.g.,diphenylamine – benzophenone system)
ii. Determination of mutual solubility curve of Phenol and water and hence the consolute point.
iii. To determine the distribution coefficient of I_2 between two immiscible solvents (CCl_4 and H_2O).

2. Chemical Kinetics:

(i) To study kinetically the alkaline hydrolysis of ethyl acetate.

(ii) To study the kinetics of reaction between $K_2S_2O_8$ and KI.

a. Determination of the rate constant and order of reaction.
b. To study the influence of ionic strength on the rate constant.

(iii) Determination of the effects of change of temperature, change of concentration of reactant and catalyst and ionic strength of the media on the velocity constant of hydrolysis of an ester or ionic reaction.

(iv) Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.

3. Electrochemistry:

(i) Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductomertically.

(ii) Determination of solubility and solubility product of sparingly soluble salts (e.g., $PbSO_4$, $BaSO_4$) conductometricaliy.

(iii) Determination of the strength of strong and weak acids in a given mixture conductomerically.

4. Potentiometry:

(i) Determination of the strength of strong and weak acids in a given mixture using a potentiometer/pH meter.

(ii) Acid base titration in a non-aqueous media using a pH meter.

5. Colligative Properties

(i) Determination of depression in Freezing point of solutions.
(ii) Determination of elevation in boiling point of solutions.

6. Adsorption

I. Determine the adsorption isotherms of acetic acid from aqueous solutions by charcoal and verify Freundlich adsorbtion isotherm.

Examination Scheme:

A	**EE**

A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

References:

1. A.Finlay and J.A.Kitchener, "Practical Physical Chemistry, Longman
2. F.Daniels and J.H.Mathews, "Experimental Physical Chemistry", Longman
3. H.H.Willard, L.L.Merritt and J.A.Dean, "Instrumental Methods of Analysis", Affiliated East-West Press
4. D.P.Shoemaker and C.W.Garland, "Experimental Physical Chemistry", McGraw-Hill
5. A.I.Vogel, "A Textbook of Quantitative Inorganic Chemistry", Longman
6. J.B.Yadav, "Advanced Practical Chemistry", Goel Publishing House
7. J.J.Lingane, "Electroanalytical Chemistry", Interscience
8. L.Meites, H.C.Thomas and R.P.Bauman, "Advanced Analytical Chemistry McGraw Hill.

ORGANIC CHEMISTRY LAB

Course Code: MAC-121 **Credit Units: 02**

1. Qualitative Analysis: Separation, purification and identification of compounds of binary mixture, derivative preparation and confirmatory tests.

2. Organic Synthesis:

1. Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.
2. Aldol condensation: Dibenzal acetone from benzaldehyde.
3. Sandameyer reaction: Chloro toluene from para toluidine
4. Friedel Craft‟s reaction
5. p – amino azobenzene from aniline via diazoaminobenzene.
6. m- phenylene diamine from Nitrobenzene via m-dinitrobenzene and m- nitroaniline.
7. Preparation of benzidine from benzene involving benzidine rearrangement.

3. Quantitative Analysis:

1. Determination of the percentage of sulphur in the given organic compounds by Messenger‟s method.
2. Estimation of Glucose using Fehling‟s solution.
3. Determination of equivalent weight of the given carboxylic acid using Silver-salt method.
4. Determine percentage purity of the given carbonyl compound using hydroxylamine hydrochloride.
5. Determination of strength of known aniline solution by bromination using KBr-$KBrO_3$ mixture.

Examination Scheme:

IA				**EE**	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

References:

1. A.I.Vogel, “A Textbook of Practical Organic Chemistry”, Longman
Analysis”
Longman
3. F.G.Mann and B.C.Saunders, “Practical Organic Chemistry”, Longman
4. B.B.Dey and M.V.Sitaraman, “Laboratory Manual of Organic Chemistry”,
5. B.L.Oser (Ed), “Hawk‟s Physiological Chemistry”, Tata McGraw-Hill
6. British Pharmacopoeia and Indian Pharmacopoeia,
7. A.C.Agarwala and R.M.Sharma (Eds), “A Laboratory Manual of Milk Inspection”, Asia Publishing House

COMPUTER PROGRAMMING USING C LANGUAGE LAB

Course Code: MAC-122 **Credit Units: 02**

<u>List of Experiments</u> (Any 10 Experiments are to be performed)

List of Experiments

- C program involving problems like finding the nth value of cosine series, Fibonacci series. Etc.

- C programs including user defined function calls
- C programs involving pointers, and solving various problems with the help of those.
- Creation of objects in programs and solving problems through them.
- Different use of private, public member variables and functions and friend functions.
- Use of Constructors and Destructors.
- File Handling.
- General practice on MS Excel, MS Word, MS Access and MS Power Point.
- Development of small computer codes in C Programming Language involving simple formulae.

- **Examination Scheme:**

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

- Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Text & References:

1.Fundamentals of Computer : V. Rajaraman (Prentice Hall)

2.“ANSI C” by E Balagurusamy

3.Yashwant Kanetkar, “Let us C”, BPB Publications, 2nd Edition,

2001. 4.Computers in Chemistry : K.V. Raman (Tata Mc Graw

Hill)

cond Semester

ANALYTICAL CHEMISTRY

Course Code: MAC-201 **Credit Units:04**

MODULE I: STASTICAL TESTS AND ERROR ANALYSIS:

Accuracy, precision, classification of errors, significant figures and computation, mean deviation and standard deviation, Least square methods, regression coefficient , F-test, t-test and Chi-test.

MODULE II: WET CHEMICAL METHODS OF ANALYSIS

Volumetric analysis –neutralization, precipitation, complexometric and redox titrations-

theoretical titrations curves - theory of indicators; Gravimetric analysis, volatilization and precipitation methods-homogeneous precipitation; Colorimetric analysis - principles and applications- estimation of iron and nickel.

MODULE III: SPECTRAL METHODS

Molecular and atomic spectroscopy - interaction of electromagnetic radiation with matter – Beer-Lambert law - UV / Visible absorption spectroscopy, IR absorption spectroscopy; Fluorescence, phosphorescence and chemiluminescence methods; NMR Spectroscopy, Mass Spectroscopy, Principles, instrumentation and analytical applications of spectral methods.

MODULE IV: ELECTROANALYTICAL TECHNIQUES

Conductometry, and high frequency titrations; Potentiometry, pH-metry, Ion selective electrodes; Electrogravimetry and coulometry; Voltammetry –polarography, amperometric titrations and anodic stripping voltammetry; principles, practice and applications.

MODULE V: SEPARATION TECHNIQUES

Solvent extraction and Ion exchange techniques – principles and applications; Chromatographic techniques – adsorption chromatography, thin layer chromatography, Chromatographic techniques in combination with Mass Spectrometer (GC-MS, LC-MS etc) and their applications in various fields such as chemistry, biology, medicine, nanotechnology etc,, high performance chromatography, size exclusion chromatography; Supercritical fluid chromatography.

Examination Scheme:

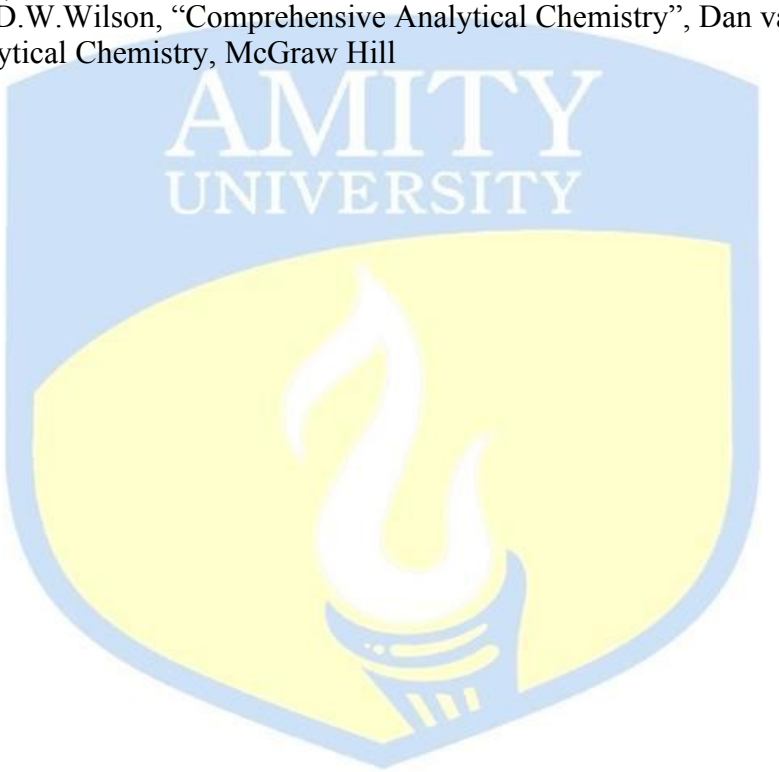
Components	**A**	**CT**	**S/V/Q**	**HA**	**EE**
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Book Suggested:

1. D.A.Skoog, D.M.West, F.J. Holler and S.R.Crouch, " Fundamentals of Analytical Chemistry", 8th Edn., - Thomson Brooks/Cole Pub. (2005).
2. J.Mendham, R.C.Denney, J.D. Barnes and M.J.K.Thomas, " Vogel‟s Text book of quantitative chemical analysis", 6th Edn., Pearson Education (2008).
3. F.W. Fifield and D.Kealey, " Principles and Practice of Analytical Chemistry, 1st Indian Reprint, Blackwell Pub. (2004).
4. H.H Willard, L.L Merritt, J.A Dean, and F.A Settle, " Instrumental Methods of Analysis", 7th Edn., - CBS Pub (2004).
5. G. D.Christian, "Analytical Chemistry", 6th Edn., John Wiley Press (2006).

6. K.A. Rubison and J,F. Rubison, " Contemporary Instrumental Analysis, Printice Hall, Inc. (2000). 7.A.K.Srivastva& P.C. Jain," Instrument approach to chemical analysis" 4th edition,S.Chand &
Company(2012)
8.C.L.Wilson and D.W.Wilson, "Comprehensive Analytical Chemistry", Dan van Nostrand
9. J.G.Dick, "Analytical Chemistry, McGraw Hill



INDUSTRIAL AND APPLIED CHEMISTRY

Course Code: MAC-202 **Credit Units: 04**

MODULE I: GLASS INDUSTRY

Introduction, classification of glass, basic raw materials of glass, manufacturing processes including chemical reactions, some special glasses: optical glass, coloured glass, fibre glass, laminate glass, safety glass, photosensitive glass, photochromatic glass, lead glass, borosilicate

glass and glass wool.

MODULE II: CEMENT INDUSTRY

Types of cement, manufacture of Portland cement, composition, setting and hardening of cement, Mortars and concrete, gypsum, plaster of paris, estimation of silica, alumina, calcium oxide and sulphates in Portland cement.

MODULE III: SOAPS AND SYNTHETIC DETERGENTS

Manufacture of detergent, types of detergents, anionic, cationic, nonionic and amphoteric detergents, manufacture of soap, Liquid soap**.**

MODULE III: HOMOGENEOUS AND HETEROGENEOUS CATALYSIS

Conversion, selectivity, contact time, time on stream, Kinetics of heterogeneous catalysis, adsoprtion, phase transfer catalysis, super acid catalysis, intramolecular catalysis, enzyme catalysis, semi-conductor catalysis and photocatalysis. Promoters, stabilizers, catalyst deactivation by poisoning, fouling and sintering

MODULE IV: OPERATING CATALYTIC PROCESS

Mechanism of performing mass and heat balance, reactors – batch reactor, flow reactor and fluidised bed reactor - plug-flow and back - mixed reactors, isothermal and adiabatic reactors, Applications of Boilers and Reactors in Industry

MODULE V: INDUSTRIAL CATALYTIC PROCESSES

Cracking, reforming, alkylation, isomerization, hydrogenation/dehydrogenation, dehydrocyclisation, dehydrosulphurization, hydrocracking, oxidation, metathesis, carbonylation, polymerization, synthetic fuels, hydrogen generation.

Examination Scheme:

Components	**A**	**CT**	**S/V/Q**	**HA**	**EE**
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

BOOKS SUGGESTED:

1. Jens Hagen,Industrial catalysis, 2nd Edition, Wiley-VCH Verlay Gambh & Co,.(2006).
2. Herman Pines, The chemistry of catalytic hydrocarbon conversions, Academic Press, New York (1981).
3. R. Pearce and W.R.Patterson, Catalysis and chemical processes, Leonard Hill, London (1981).
4. Charles, N. Satterfield, Heterogeneous catalysis in industrial practice, 2nd Edn. Mc.Graw Hill, International Edition, Singapore (1993).
5. Catalytic Chemistry, Bruce-gates, John Wiley & Sons
6. Organic Chemistry Vol.2 IL Finar 5th Edn. Longmans 1975
7. Dryden‟s outlines of Chemical Technlolgy 2nd Edn., edited and revised by M.Gopala Rao, Marshel sitting – EastWest Press, 1973.
8. Chemical Process Industries 3 Edn., R Norries Shreve, Mc Graw Hill 1967.
9. Chemistry of Engg Materials by CV Agarwal.
10. Applied Chemsitry for Engineer‟s by Diamont

11. Industrial Chemistry by BK Sharma, Goel Publishing house Meerut.

INORGANIC CHEMISTRY

Course Code: MAC-203 **Credit Units -04**

MODULE-I: METAL-LIGAND EQUILIBRIUM IN SOLUTION

Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Chelate effect and its thermodynamic origin, determination of binary formation constants by potentiometry and spectrophotometry.

MODULE-II: REACTION MECHANISM OF TRANSITION METAL COMPLEXES

Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, anation reactions, Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, inner sphere type reactions.

MODULE-III: METAL-LIGAND BONDING

Crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, p-bonding and molecular orbital theory.

MODULE-IV: ELECTRONIC SPECTRA AND MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES

Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d1-d9 states), calculations of 10Dq, B and β parameters, charge transfer spectra, anomalous magnetic moments, Orbital contribution to magnetic moment, spin crossover.

MODULE- V: METAL π-COMPLEXES

Metal carbonyl, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding structure and important reaction of transition metal nitrosyl.

MODULE-VI:

Metal Clusters, Chains and Fullerenes

Compounds with metal-metal multiple bonds.Isopoly and heteropoly acids and their salts. Fullerenes

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

BOOKS SUGGESTED:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magnetio chemistry, R.1. Carlin, Springer Verlag.
6. Comprehensive Coordiantion Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. Mc Cleverty,Pergamon.
7. Advanced Inorganic Chemistry, Malik, Tuli, Madan,S.Chand & Company

ANALYTICAL CHEMISTRY LAB

Course Code: MAC-220 **Credit Units:02**

Chromatography

Separation of cations and anions by Column Chromatography: Ion exchange,

a. Cadium and zinc

b. Zinc and magnesium.

c. Thin-layer chromatography-separation of nickel, manganeses, cobalt and zinc.

d. Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

Physical Analytical Chemistry Section

1) To verify Beer-Lambert‟s Law for potassium permanganate solution and hence to determine the molar extinction coefficient and unknown concentration of given sample colorimetrically
2) To determine the solubility of calcium oxalate in presence of KCl (Ionic Strength Effect)
3) To determine the solubility of calcium oxalate in presence of HCl (H+ ion Effect)

Organic Analytical Chemistry

I. To verify the Beer-Lamberts Law and determine the concentration of given dye solution colorimetrically.
II. To estimate the amount of D-glucose in given solution colorimetrically.

Quantitative Analysis

I. Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.
II. Estimation of amines/phenols using bromate bromide solution/or acetylation method.
III. Determination of Iodine and Saponification values of an oil sample.
IV. To determine the acid value of given oil

Examination Scheme:

IA				**EE**	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Reference Books

1. C.L.Wilson and D.W.Wilson, “Comprehensive Analytical Chemistry”, Dan van Nostrand
2. J.G.Dick, “Analytical Chemistry, McGraw Hill
3. D.A.Skoog and D.M.West, “Analytical Chemistry – An Introduction”, Reinholdt. (practical Book)
4. I.M.Kolthoff, V.J.Elving and Sandell, “Treatise on Analytical Chemistry”, Interscience.

(practical
Book)

INDUSTRIAL CHEMISTRY LAB

Course Code: MAC-221 **Credit Units:02**

A. Analysis of cement
B. Analysis of polymers
1. Determination of Acid Values of plastic material.
2. Determination of Saponification value of plastic material.
3. Determination Iodine value of a plastic material.
4. Determination of hydroxyl Value of plastic material.
5. Determination of Carbonyl Value of plastic material.
6. Determination of Molecular Weight of a polymer.
7. Determination of Capacity of cation exchange resin.
8. Determination Capacity of an anion exchange resin.

C. Preparation of polymers
1. Preparation of Urea Formaldehyde resin.
2. Preparation of Phenol Formaldehyde resin.
3. To synthesize and hydrolyse Nylon 6:6 in the laboratory

D. Water Analysis
(i) Total dissolved solids
(ii) Carbonate and non-carbonate hardness by EDTA
(iii) Dissolved oxygen, BOD, COD
(iv) Alkalinity
(v) Turbidity

Examination Scheme:

IA				**EE**	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Course Code: MAC-222 **Credit Units:02**

MODULE I QUANTITATIVE INORGANIC ANALYSIS & SPECTROPHOTOMETRIC DETERMINATION

(i) Ores analysis (oxides and carbonate ores or any other)

(ii) Nickel/molybdenum/tungston/vanadium/uranium by extractive spectrophotometric method. (Any other experiments may be added) (Dry Lab)

MODULE II ESTIMATION OF INDUSTRIAL PRODUCTS

(i) Active CaO in lime

(ii) Chlorine in bleaching powder

(iii) Lead content in red lead

MODULE IV PREPARATION OF TYPICAL INORGANIC COMPLEXES

Preparation of selected inorganic compounds and their study by IR, electronic spectra, Mossbauer. ESR and magnetic susceptibility measurements.Handling of air and moisture sensitive compounds involving vacuum lines. Selection can be made from the following:

1. Sodium amide[1].
2. Trialkoxyboanes- IR and NMR spectra.
3. Preparation of Tin (IV) iodide, Tin (IV) chloride and Tin (II) iodide[2]
4. Sodium tetrathionate $Na_2S_4O_6$.
5. Determination of Cr (III) complexes. $[Cr(H_2O)_6]NO_3.3HO$,$[Cr(H_2O)_4Cl_2]Cl.2H_2O$, $[Cr(en)_3]Cl_3$, $Cr(acac)_3$. Inorg.synths., 1972, 13, 184.
6. Preparation of Fe(II) chloride (use it as Friedel-Craft chlorination source) J. Org. Chem.,1978, 43, 2423; J. Chem. Edu., 1984, 61, 645; 1986, 63, 361.
7. Reaction of Cr(III) with a multidentate ligand; a kinetics experiment (visible spectra Cr-EDTA complex) J.A.C.S., 1953, 75, 6570.
8. Preparation and use of Ferrocene. J. Chem. Edu. 1966, 43, 73; 1976, 53, 730.

(Any five preparations)

MODULE V QUALITATIVE INORGANIC SEMI-MICRO ANALYSIS

Detection of atleast four cations (2 common and 2 uncommon) in a mixture of salts.

Examination Scheme:

IA				**EE**	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

REFERENCES (Inorganic Chemistry Lab)

1. G.H.Jeffery, J.Bassett, J.Mendham and R.C.Denney Vogel‟s Text book of quantitatives chemical analysis, ELBS 5th Edn. Longman, Singapoor Publishers,Singapore, 1996.
2. R. Mukhopodhyay, P.Chatterjee, “ Advanced practical Chemistry”
3. Dinesh Sharma, “ A hand book of Analytical Inorganic chemistry”, First Published(2004)
4. I.M.Kolthoff, E.B.Sandell et.al. Quantitative chemical analysis, CHYmillan, Madras 1980.
5. A Text book of quantitative Inorganic Analysis – A. I. Vogel
6. Standardsmethodsof ChemicalAnalysiF.J.Welcher
7. Experimental Inorganic Chemistry – W. G. Palmer.
8. Manual on Water and Waste Water Analysis, NEERI- Nagpur D.S. Ramteke and C. A. Moghe
9. Inorganic synthesis- King.
10. Synthetic Inorganic Chemistry-W .L. Jolly
11. EDTA Titrations –F Laschka

INSTRUMENTAL METHODS OF ANALYSIS

Course Code: MAC 301 **Credit Units: 04**

Course Objective: The curriculum is developed to help the students to understand the basic theory & applications of various sophisticated instruments. The instrumental analysiscourse aims to provide students with an understanding of the functioning and applications of these instruments in our day to day life. It covers the basic principles of theory, its operation and their applications in chemistry, physics, biology, nanotechnology, material science and materials chemistry. Recent advances in the characterization of nanomaterials will also include in the course. The course is further enhanced with invited lectures on recent developments and applications in characterization of nanomaterials.

Course Contents:

MODULE I: ADVANCED ANALYTICAL TECHNIQUES

Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance

MODULE II: SPECTROSCOPIC TECHNIQUES

(UV- Vis- NIR Spectrophotometer), FTIR Spectrometer, Thermal Analysis (DSC, TGA, DTA etc).Applications of XRD measurements, Calculation of particle size from XRD measurements using Debye Scherer formula.Applications of spectroscopic techniques in chemistry, biology, nanotechnology, nanomedicine etc.

MODULE III: MOSSBAUER SPECTROSCOPY

Magnetic property of materials using Vibrating Sample Magnetometer, Mossbauer Spectrophotometer. Hysteresis loop, Remnant magnetization, Coercivity, Saturation Magnetization etc. Principle and Applications of CHNS analyzer. Applications of VSM, Mossbauer spectrometer and CHNS analyzer

MODULE IV: Atomic structure and spectroscopy:
Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle,
Chemical applications of group theory: symmetry elements; point groups; character tables; selection rules. Symmetry elements and symmetry, operations, groups, classes, multiplication and character tables, applications of group theory in hybridisation and molecular vibrations.

MODULE V: Nuclear Magnetic Spectroscopy: Nuclear moments, nuclear spin states in a magnetic field and the resonance phenomenon, relaxation processes, Bloch equations outline of NMR detection methods; chemical shifts and spin-spin coupling, spectra of a two-spin system (A2, AB and AX cases); interpretation of simple first order spectra of organic molecules. NMR lineshapes and molecular dynamics. FT-NMR spectroscopy, measurement of relaxation times, introduction to 13C NMR spectroscopy**.**

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

Text and References

1. Fundamentals of Analytical Chemistry (with CD-ROM and InfoTrac) by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, Hardcover: 992 pages, Publisher: Brooks Cole

2. Dean‟s Analytical Chemistry Handbook by Pradyot Patnaik, Hardcover: 1280 pages, Publisher: McGraw-Hill Professional

3. Quantitative Chemical Analysis, Sixth Edition by Daniel C. Harris, Hardcover: 928 pages, Publisher: W. H. Freeman

4. Analytical Chemistry by Gary D. Christian, Hardcover: 848 pages Publisher: Wiley; 6th edition

5. Comprehensive Medicinal Chemistry by Hansh C, Vol IV, Elsevier Pergamon.

6. Medicinal Chemistry-A Biochemical Approach by Nogrady T, Oxford University Press New York, Oxford.

SYNTHETIC ORGANIC CHEMISTRY

Course Code: MAC 302 **Credit Units: 04**

Course Objective: The main objective of this organic chemistry course is to give a good idea of different important chemical reactions. Synthetic organic chemistry plays an important role in our daily life due to the importance of synthesis of various organic compounds for the prevention of various diseases.It couse includes the disconnection approach, synthons and umpolung reactions and applications of complex metal hydrides. This course also covers the various important reagent such as LDA, PPA, diazomethane, ozone phase transfer catalyst etc. It also includes invited lectures on the recent development of synthetic organic chemistry recations.

Course Content:

MODULE I : **DISCONNECTION APPROACH**

Introduction to disconnection approach,functional group interconversions.Introduction to Retro-synthesis of aromatic Heterocyclesand 3, 4, 5 and 6 membered carbocyclic and heterocyclic rings. One group C-X and two group disconnections in1,2,1,3 -,1,4-& 1,5- difunctional compounds.

MODULE II: SYNTHONS AND UMPOLUNG

An introduction to Synthons and synthetic equivalents, importance of the order of events in organic synthesis, chemoselectivity, regioselectivity.Diels Alder reaction,Michael addition and Robinson annulation.Reversal of polarity (Umpolung).

MODULE III : INTRODUCTION TO PROTECTING GROUPS AND APPLICATIONS.

a) Protecting Groups: Principle of protection of alcohol, amine, carbonyl and carboxyl groups**b) Application of the following in synthesis** Merrifield resin, polymeric reagents. Solid phase synthesis of polypeptide &oligonucleotides, electro organic synthesis, enzyme catalyzed reaction in synthesis &resolution of racemic mixtures.

MODULE IV: APPLICATION OF FOLLOWING REAGENTS &REACTION IN SYNTHESIS.

Complex metal hydrides, lithium dialkyl cuprate, lithium diisopropylamide (LDA) Dicyclohexylcarbodiimide(DCC), Trimethyl silyl iodide, tributyltin hydride, peracids, lead tetra acetate, PPA, Diazomethane , ozone phase transfer catalyst, woodward-prevost hydroxylation, Barton and Shapiro reaction Hoffmann – Loffler- Fretag, Peterson synthesis.
Selenium dioxide, crown ethers, DDQ

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

Text and References

1. S.Warren: Designing of organic synthesis
2. J. Fuhrhop & G. Penzlin. : Organic synthesis (2nd ed.)
3. Carruthres: some modern methods of organic synthesis.
4. Fieser & Fieser : Reagent in organic synthesis
5. R.O.C.Norman: principle of organic synthesis
6. CAREY & sundberg: Advanced organic Chemistry
7. Bartan and Ollis : comprehensive organic Chemistry
8. R.Admas: - organic reactions
9. Stone & west: Advances in organometallic Chemistry
10. C.W.Bird: Transition metal intermediate in organic synthesis
11. Swan &black :organometallic in organic synthesis.
12. A. Mitra : synthesis of prostaglandins
13. John Apsimon: Total synthesis of natural products
14. M. K. Mathur, C. K. Narang & R.E.Williams: polymers as aid in organic Synthesis
15. P. HODGE & D.C.SHERRINGTON: Polymer supported reaction in organic synthesis.
16. C.J.Gray: Enzyme catalysed reactions
17. T.W. Green & P.G.M.Wats : Protecting groups in organic Chemistry
18. Weber &Gokel : phase transfer catalyst in organic synthesis.
19. Protecting group chemistry J. Roberton (OX)

INTRODUCTION TO POLYMERIC MATERIALS

Course Code: MAC-303 **Credit Units: 04**

Course Objective: The curriculum is developed to help the students to understand the importance of polymeric materials and their usefulness in day to day life. The Polymeric materials course aims to provide students with an understanding of the different kinds of polymers, their preparation, polymerization and chemical bonding between them. It also covers the applications of these polymeric materials in plastics, elastomers

Course Content:

MODULE I: INTRODUCTION TO POLYMER

History and Concept of macromolecules, monomers with specific example viz. acrylonitrile, vinyl, chloride, methyl methacrylate, isobutylene, isoprene, styrene, hexamethylene diamine and adipic acid, caprolactum, ethylene oxide and sebacic acid, ethylene glycol and terephthalic acid, functionality, Degree of polymerization, Classification of polymers depending on – a) The origin (natural, Semisynthetic, synthetic etc. b) The structure (linear, branched, network, hyperbranched, dendrimer.c) The formation (condensation, addition). d) Homopolymers, copolymers. e) The behaviour on application of heat and pressure (thermoplastic and Thermosetting). f) The form and application (plastics, fiber. elastomers and resin. g) Stereisomers: Isotactic, Syndiotactic, Atactic, Organic and Inorganic polymers. Concept of molecular mass, polydispersity, number average and weight average, molecular weight distribution in linear polymers.

MODULE II- METHODS OF POLYMERISATION

Methods of polymerization. Bulk polymerization, Solution polymerization, Emulsion polymerization, Suspension polymerization, Melt polycondensation. Controlled polymerization methods, viz, Nitroxide mediated polymerization (NMP), Atom Transfer Radical Polymerization (ATRP), Reversible Addition Fragmentation Termination (RAFT).

MODULE III- CHEMISTRY OF POLYMERIZATION (MECHANISM)

chain polymerization- Free radical, Ionic and coordination mechanism, Common features of two types of Mechanism of cationic polymerization and anionic polymerization, Mechanism of coordination polymerization – Ziegler-Natta catalysts, Ring opening polymerization-mechanism of polymerization of cyclic ethers, cyclic amides and cyclosiloxanes.

MODULE IV-SPECIAL POLYMERS AND THEIR APPLICATIONS

polyethylene, rubber and rubbers derived from butadiene – acrylic acid copolymers, stereoregular polybutadienes, polychloroprene (neoprene), styrene- butadiene – acrylonitrile copolymers, polystyrene, polymethyl methacrylate(PMMA), polyvinyl acetate (PVA), polyvinyl alcohol, poly vinychloride, fluoro carbon polymers.

polyamides (Nylon 6, Nylon 6,6, Nylon 6,10), polyesters (poly ethylene terephthalate (PET), polybutylene, terphthalate (PBT), aromatic polyesters), polycarbonate, polyurethanes – Flexible and rigid polyurethane, polyurethane elastomers, coatings, adhesives, sulphur, containing polymers, polimdes, polyethersulphones, polyetherketones. Thermosetting resins – phenolic resins, amino resins, epoxy resins, silicone polymers, and cyanate ester resins.

MODULE V- POLYMER DEGRADATION

Introduction, Types of degradation-Thermal, mechanical, Photodegradation, oxidative degradation, Hydrolytic degradation, Degradation by ultrasonic waves and high energy radiation.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

Text & References:

1) F.W. Billmeyer, Jr. Textbook of polymer science, Wiley- Interscience, N.Y.(1971)
2) Introduction to polymer chemistry, R. Seymour, Wiley –Interscience (1981)
3) Physical chemistry of CHYromolecules, by D.D. Deshpande, Vishal publications, (1985)
4) principles of polymerization, G.Odian, Wiley – Interscience (1981)
5) Organic polymer chemistry, K. J. Saunders, Chapman and Hall, London (1973).
6) Principles of polymer chemistry by P.J. Flory.
7) Polymer Science –V R Gowarikar.

CHEMISTRY OF MATERIAL & NANOMATERIAL

Course Code: MAC-304 **Credit Units:04**

Course objective: Material science plays a vital role in this modern age of science and technology. The rapid development in the field of nanomaterials and composite science have opened vast opportunities for better understanding and utilization of various materials. The course curriculum is designed to give students an idea of the detailed aspects of important topics of material science like composites, nano materials and their synthesis and characterization.

Course Contents:

MODULE I: INTRODUCTION TO CHEMISTRY OF MATERIALS & NANOMATERIALS

Materials & their classification, Role of chemistry in material design, Nanoscale Science and Technology-Implications for Physics, Chemistry, Biology and Engineering; Classifications of nanostructured materials, nano particles; quantum dots, nanowires, ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.

MODULE II: SYNTHESIS OF MATERIALS & NANOMATERIALS

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. Nanomaterial Synthesis: Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, general method of preparation, properties, detection, and characterization of organic nanoparticles: hydrophobic drugs, protein, peptide, lipid, cyclodextrine, polysaccharides. Nanocochleates, Prospects and Future Challenges.

MODULE III: CHARACTERIZATION TECHNIQUES OF MATERIALS AND NANOMATERIALS:

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMSNanoindentation, Small-angle X-ray and neutron scattering, DLS, Ellipsometer, Confocal microscopy

MODULE IV: APPLICATION OF MATERIAL CHEMISTRY & NANOCHEMISTRY

Application of Organic Nanoparticles: Application of Lipids, CNTs, Proteins, peptides, Dendrimer, cyclodextrin, Polysaccharide based organic nanoparticles in nanomedicineand drug delivery through nanoscopic structure and nanoformulation; Applications of zero-dimensional Nanoparticles: Quantum dots for solar cells, Quantum dots for lightemitting diode, Molecular electronics, Nanoparticles as catalysts; Applications of one dimensional nanotubes and nanowires: Nanotube/nanowire-based field effect transistors for biosensing, gas sensing,

Piezoelectric nanowires as nanogenerator, Thermoelectric Nanowires, Quantum dots for bio-sensing; Application of Nanoporous materials: A Single Nanopore for DNA sequencing, Nanoporous anodized aluminum oxide, Nanoporous metal-organic framework for gas absorption, Nanoporous materials for Li/Cd-ion battery applications;Application of Nano ceramics: Dielectrics, ferroelectrics, magnetoceramics, and multiferroics Magnetism; Dia-, Para-, Ferro-, Antiferro-, Ferri-magnetism, Magnetic properties; Gaintmagnetoresistance, Tunneling magnetoresistance, Colossal magnetoresistance, Superparamagnetism High-temperature superconducting (High-Tc) materials: Yttrium barium copper oxide (YBCO) and Bi-systems.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Books suggested:

1.Introduction to Nanoscience by Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, Anil K. Rao.CRC Press, 2008.

2. Nanotechnology: Importance and Application by M.H. Fulekar, IK International, 2010.

3. Environanotechnology by Mao Hong fan, Chin-pao Huang, Alan E Bland, Z Honglin Wang, RachidSliman, Ian Wright. Elsevier, 2010.

4. Nanotechnologies, Hazards and Resource efficiency by M. Steinfeldt, Avon Gleich, U. Petschow, R. Haum. Springer, 2007.

5. Nanotechnlogy: Health and Environmental risk by Jo Anne Shatkin. CRC press, 2008.

6. Nanotechnology in Biology and Medicine: Methods, Devices and Application by Tuan Vo-Dinh .CRC press, 2007.

7. Nanomaterials for Biosensors by Challa Kumar. Wiley-VCH, 2007.

8. Nanosystem characterization tools in the life sciences by Challa Kumar. Wiley-VCH, 2006.

APPLIED CHEMISTRY LAB

Course Code: MAC-320 **Credit Units: 02**

List of Experiments (Any 15 Experiments are to be performed)

Polymers

1. Caprolactum from cyclcohexanone .
2. Synthesis of Nylon-6,10
3. Preparation of Polystyrene.
4. Study the morphology of polymers through optical microscopy.
5. Preparation of Epoxy resin using Bisphenol-A and Epichlorohydrin.
6. Determination of molecular weight of high polymer using viscosity method.
7. Determination of melt flow index of polymers and Compare their Melt Flow Characteristics

Dyes

8. Preparation of Methyl Orange- An azodye.
9. Preparation of Indigo

Food Industry

10. Separation of artificial colorants in confectionary using TLC.
11. Determination of protein content of wheat flour.

Cosmetic Products

12. Shampoo
13. Detergent
14. Talc
15. Lipstick
16. Perfumes

Drugs Analysis

17. Preparation of Paracetamol and Aspirin
18. Analysis of Drugs:

a. Novalgin

b. Sulfa-drugs

c. Paracetamol

Inorganic preparation

19. Acetylation of ferrocene
20. Preparation of Tetraamminecarbonatocobalt(III)nitrate.
21. Preparation of Pentaamminechlorocobalt(III)chloride.
22. Synthesis of meso-tetraphenylporphyrin
23. Synthesis of p-substituted tetraphenylporphyrins

Examination Scheme:

IA				**EE**	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Text & References:

1. A Textbook of quantitative chemical analysis, VIth Edition Vogel, Pearson Education Limited.

2. Practical Organic Chemistry, Mann and Saunders, IV Edition, ELBS and Longman Publication

3. Comprehensive Experimental Chemistry, V. K. Ahluwalia, New Age Publication, Delhi

4. Practical Manual of Organic Chemistry, R. K. Bansal

5. A Textbook of quantitative inorganic analysis including elementary instrumental analysis, IVth Edition Vogel, ELBS and Longman Publication

6. Advanced Practical Inorganic Chemistry, Gurdeep Raj, Goel Publishing House, Meerut

INSTRUMENTAL LAB

Course Code: MAC-321 **Credit Units: 02**

Course Contents:

1. Determination of R_f value of the materials using Paper Chromatography

2. Conductometric titrations

3. Colorimetric measurements

4. Separation of metal ions using chromatographic techniques

5. Spectral analysis of organic compounds

6. Measurement of molecular weight using intrinsic viscosity measurements

7. pH measurements

(a) Measurement of pH of different solutions using pH-meter.
(b) Preparation of buffer solutions
(i) Sodium acetate-acetic acid
(ii) Ammonium chloride-ammonium hydroxide
(c)Measurement of the pH of buffer solutions and comparison of the values

8. Determine the crystallinity and phase identification of metal oxides using X-Ray diffractometer

9. Determine the thermal stability of materials using Thermo gravimetric analysis

10. Determine the Oxidation state of materials using XPS

11. Determine the Phase change of materials (Endothermic or exothermic) using Differential Scanning Calorimetry (DSC)

12. Determine the Magnetic behavior of the Materials Using Vibrating Sample magnetometer

13. Determine the molecular mass of the materials using ESI- Mass Spectrometer

14. Determine the percentage of Carbon, Hydrogen, Nitrogen and Sulphur Using CHNS Analyzer.

15. Determine the λ_{Max} of the materials using UV-Visible Spectrophotometer

16. Determine the Functional Group of the Materials using IR Spectrometer.

17. Separation of Mixtures of organic compounds using HPLC

18. separation and identification of molecular mass of the materials using GC-MS

19. Identification of particle size measurement of the materials using Photon Correlation Spectroscopy

20. Determination of Morphology of the materials using SEM analysis

21. Determination of the particle size, shape, SAED pattern of the Materials Using HRTEM

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

DRUGS AND DYES

Course Code: MAC-205 **Credit Units: 04**

Course Objective: At the end of this course students must acquire a good knowledge about the various drugs their active constituents, their pharmacological actions and therapeutic uses. Beside drugs they will learn about various dyes used in day to day life, their properties and applications.

Course Content:

MODULE I: INTRODUCTION TO DRUGS

Definition of drug (WHO), classification of drugs, nomenclature of drugs, stereochemical aspects of drugs, definitions of terms commonly used in the chemistry of drugs, routes of drug administration and different dosage forms and applications

MODULE II: MECHANISM OF ACTION, STRUCTURE AND SYNTHESIS OF DRUGS

Sulphonamides : Sulphathiazole, Sulphadiazine(any two)

Antiseptics : Iodoform, Dettol

Antileprotic drugs : Dapsone (DDS), Acedapsone (DADDS)

Anticancer agents : Alkylating agents

CardiovascularDrugs : Amyl nitrate, Methyldopa

Antipyretics&Analgesics: Novalgin, Paracetamol

Antimalarials :Chloroquine ,Primaquine,Mepacrine

Anti diabetic : Tolbutamide

Antitubercular: p-amino salicylic acid, Ethambutol

MODULE III: INTRODUCTION TO DYES

Historical development of synthetic Dyes - Introduction, Nomenclature, classification based on structure & mode of applications of fibres.Structural features of a dye (chromophores and auxochromes), bathochromic and hypsochromic effects, diazotisation and coupling, colour and chemical constitution

(Witt‟s theory, Armstrong theory and Modern theory). Dye intermediates- unit, batch & continuous process in the preparation of dye intermediates,

MODULE IV: STRUCTURE AND PREPARATION OF DYES

Nitro Dyes	Picric acid, Martius yellow, Naphthol yellow S
Nitroso Dyes	Fast green O, Naphthol green Y
Azo Dyes	Methyl orange, Methyl red, Congo Red
Phthaleins	Phenolphthalein
Phthalocyanines:	Copper phthalocyanine
Xanthenes	Fluorescein, Eosin, Mercurochrome
Rhodamines	Rhodamine B
Thiazine Dyes	Methylene blue
Cyanine Dyes	Quinoline blue
Antraquinone Dyes:	Alizarin
Indigoids	Indigo (Indigotin)
Thioindigos	Thioindigo
Azine Dyes	Safranine T

Action of light on dyes and dyed fibres, Factors affecting fastness of dyed fibres General consideration, fluorescence, phototropy, mechanism of fading.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

Text & References:

1. The Organic Chemistry of Drug Synthesis, Vol. 1,2,3,4 by Lednicer Daniel, 1st edition, John Wiley & Sons INC.
2. Exploring QSAR Vol; I Fundamentals and Applications in Chemistry and Biology by CHansh and A Leo Vol. II: hydrophobic, Electronic and Steric Constants by C Hansh, A Leoand D Hockman ACS Book Catalog.
3. Foye‟ s Principles of Medicinal Chemistry by Foye, 6th edition, Lippincott William Wilkins.

4. Comprehensive Medicinal Chemistry by Hansh C, Vol IV, Elsevier Pergamon.
5. Quantitative Drug Design- A Critical Introduction by Martin YC, Marcel Dekker Inc. NewYork.
6. Medicinal Chemistry-A Biochemical Approach by Nogrady T, Oxford University Press NewYork, Oxford.
7. Computer Aided Drug Design, by Pops and Perruns, Academic Press, NY
8. Burger‟ s Medicinal Chemistry by Wolff ME, John Wiley & Sons, New York.
9. Introduction to Medicinal Chemistry‟ – How Drugs Act and Why by Alex Gringauz, Willey-VCH Publication 1997.
10. Drug Design by Bothara KG &Kulkarni VM, 3rd edition, NiraliPrakashan.
11. An Introduction to Drug Design by SN Pandeya& IR Dimmock, 1st edition, New AgeInternational Publishers.
12. Structure based Drug Design by Veerapandian, 1st edition, Taylor & Francis New York,London.
13. Holtje. Sippl.,Rognan and Folkers, Molecular Modeling.
14. P.K. Larsen, Tommy and U.Madsen, textbook of Drug Design and Discovery.

NATURAL PRODUCTS CHEMISTRY

Course Code: MAC-206 **Credit Units: 04**

Course Objective: The main idea of this course is the give the students a brief idea of natural product chemistry, which includes the study of Vitamins, alkaloids, terpenes and steroids etc. These plays a key role in our day to day life. The course covers the importance of these naturally occurring materials and their applications in chemistry, biology and medicine. The course will alos includes the invited lectures on recent advances in natural product chemistry and it gives a reasonable good overview of the naturally occurring chemicals and their important reactions, their applications etc.

Course Content:

MODULE I: 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.

MODULE II: VITAMINS

Vitamins: Classification, occurrence, chemistry of Vitamins A, C and E, structure elucidation and synthesis, deficiency syndromes,

MODULE III :ALKALOIDS

Drugs (cocaine, opiates, quinine, vincristine, curare, mescaline, etc.) and toxins (nicotine, lupinines, strychnine, tetrodotoxin, etc.Introduction 2. Simple Alkaloids I: Pyrrole Derivatives 3. Simple Alkaloids II: Piperidine Derivatives 4. Aromatic Alkaloids I: Simple Derivatives 5. Aromatic Alkaloids II: More Complex Derivatives 6. The Indole Alkaloids 7.Miscellaneous Alkaloids with Interesting Bioactivities.

MODULE IV:TERPENES AND STEROIDS

Classification and biosynthesis of mono- sesqui-, di- and triterpenoids and steroids.Acetyl CoA,

Mevalonic acid, acetoacetyl CoA, squalene to lanosterol, Cholesterol to estradiol, diosgenin and its utility in hormone synthesis.

MODULE V: GENERAL CHEMISTRY OF THE FOLLOWING COMPOUNDS
Cholesterol, Artemisinin, Gibbereline A3, Azadirachtin.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

Text and References:

1. K. Nakanashi. Natural Products Chemistry, Vols. I and II, Academic Press, New York andLondon (1974).
2. M. Harmata. Strategies and Tactics in Organic Synthesis 4 & 5, Academic Press (2004)
3. T. L. Gilchrist. Heterocyclic Chemistry (2nd edn.), Longman Scientific & Technical Publicns.(1992).
4. R. K. Bansal. Heterocyclic Chemistry: Synthesis, Reactions and Mechanisms, Wiley Eastern (1991).

BIOINORGANIC AND ORGANOMETALLIC CHEMISTRY

Course Code: MAC-207 **Credit Units: 04**

Course Objective: The main idea of this course is to give students a brief idea about Bioinorganic chemistry that examines the role of metals in biology. It includes the study of both natural phenomena such as the behaviour of metalloproteins as well artificially introduced metals, including those that are non-essential, in medicine and toxicology. Many biological processes such as respiration depend upon molecules that fall within the realm of inorganic chemistry. The discipline also includes the study of inorganic models or mimics that imitate the behaviour of metalloproteins. It also covers organometallic chemistrywhich is the study of chemical compounds containing bonds between carbon and a metal. Since many compounds without such bonds are chemically similar, an alternative may be compounds containing metal-element bonds of a largely covalent character. Organometallic chemistry combines aspects of inorganic chemistry and organic chemistry.

Course Content:

MODULE I: ROLE OF METAL IONS IN BIOLOGICAL SYSTEM
Elements of life: essential major, trace and ultratrace elements. Basic chemical reactions in the biological systems and the role of metal ions (specially Na+, K+, Mg2+, Ca2+, Fe3+/2+, Cu2+/+, and Zn2+).Metal ion transport across biological membrane Na+-ion pump, ionophores. Toxic metal ions and their effects, chelation therapy (examples only), Pt and Au complexes as drugs (examples only), metal dependent diseases.

MODULE II: METALLOPROTEINS AND METALLOENZYMES

Biological functions of hemoglobin and myoglobin, cytochromes and ferredoxins, carbonate bicarbonate buffering system and carbonicanhydrase. Biological nitrogen fixation, Photosynthesis: Photosystem-I and Photosystem-II.

MODULE III: METALLOCENE

Metallocenes, Structure and synthesis of cyclopentadienyl complexes, Covalent vs Ionic bonding in metallocenes, Arene complexes

MODULE IV: REACTIONS IN ORGANOMETALLIC CHEMISTRY

Substitution reactions in carbonyl complexes, Oxidative addition and reductive elimination, Insertion and elimination, Nucleophilic and electrophillic attack of coordinated ligands, Synthesis of ferrocenes derivatives, carbonylate anion as nucleophile

MODULE IV: APPLICATIONS OF ORGANOMETALLICS IN CATALYSIS

(b) In Catalysis: Asymmetric hydrogenation; synthesis of acetic acid and glycol (Monsanto acetic acid process) Cativa process ; Arylation/vinylation of olefins (Heck reaction); Wacker process (olefin oxidation); Asymmetric epoxidation.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

Texts & References

1. C. Elschenbroich. Organometallics (3rd edn.), Wiley-VCH Publication (2006).
2. C. Elschenbroich & A. Salzer.Organometallics – A Concise Introduction (2nd edn.),VCHPublication (1992).
3. F. Mathey & A. Sevin.Molecular Chemistry of the Transition Elements, John Wiley (1996).
4. F. A. Cotton & G. Wilkinson.Advanced Inorganic Chemistry (5th edn.), John Wiley (1988).
5. R. C. Mehrotra & A. Singh. Organometallic Chemistry: A Unified Approach (2nd edn.), New Age International (2000).
6. Yamamoto, Organo Transition Metal Chemistry,

INDUSTRIAL MANAGEMENT AND SAFETY PROCESSES

Course Code: MAC-208 **Credit Units: 04**

Course Objective: The curriculum is developed to help the students understand the basic functions & responsibilities of a manager, provide him tools and techniques of managing

different activities of the business concerned and to understand & interpret the provisions of some of the important provisions related to patent, trademark etc. It also aims at minimizing the chances of risks, injuries and accidents by implementing risk management techniques and safety management operations, monitoring the operating systems and bolstering the safety measures of an industry in general. With the rise of natural disasters in and around our world, the importance of the safety of human capital, protection of the environment and conservation of existing assets of an industry is increasing, leading to growing relevance of these skills.

Course Contents:

MODULE I: BASIC CONCEPTS OF MANAGEMENT FUNCTION OF MANAGEMENT

Planning, Organizing, Directing, Control, Decision-making, Budgeting, Inventory Management (IM) & Quality Control (QC), Meaning & Importance of Inventory management, Inventory models, Cost consideration, Economic order quantity model.

MODULE II :QUALITY MANAGEMENT

Meaning & definition of Quality-Quality control systems-quality assurance-planning for quality-total quality management (TQM) philosophy-implementation of TQM in service and manufacturing industries-national & international standards.

MODULE III: MANUFACTURING MANAGEMENT

Production planning & control, dynamics of material flow-inventory-bottlenecks and process variability, planning levels and time scales, forecasting-aggregate planning, synchronized manufacturing and theory of constraints-just in time production-shop floor performance monitoring.

MODULE IV:SAFETY IN CHEMICAL PROCESS INDUSTRIES

Safety in industries; need for development; importance safety consciousness in Indian chemical industry; safety programmes, elements of safety programme; effective realization, economic and social benefits.Industrial safety- Chemical process industries; potential hazard; chemical and physical job safety analysis; high presssure; high temperature operation; dangerous and toxic chemicals; highly radioactive materials; safe handling and operation of materials and machineries; planning and layout.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

Text & References:

1. William Handley, “Industrial Safety ", Hand Book McGraw-Hill Book Company 2nd Edition, 1969.
2. Fawatt, H.H. and Wood, W.S., “Safety and Accident Prevention in Chemical Operation", Interscience, 1965.
3. Heinrich, H.W. Dan Peterson, P.E. and Nester Rood, “Industrial Accident Prevention ", McGraw-Hill Book Co., 1980.
4. Blake, R.P., “Industrial Safety ", Prentice Hall Inc., New Jersy - III Edition, 1963.
5. Subbaram N.R. “Handbook of Indian Patent Law and Practice", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.
6. Eli Whitney, Moduleed States Patent Number: 72X, Cotton Gin, March 14, 1794.
7. Intellectual Property Today: Volume 8, No. 5, May 2001, [www.iptoday.com].

ENVIRONMENTAL CHEMISTRY

Course Code :MAC-208 **Credit Units: 04**

MODULE I: CHEMISTRY AND THE ENVIRONMENT

Chemistry and the environment - environmental pollution - causes - pollutants – air pollution - effects of air pollution: Environmental fate of pollutants – transformation process - bioConcentration - fate of air, water and soil pollutants

MODULE II: WATER POLLUTION

Water pollution - water quality parameters - turbidity, colour, pH, acidity, alkalinity, solids, hardness, chlorides, residual chlorine, sulphates, fluorides, phosphates, iron and manganese, DO, BOD, COD, nitrogen, grease, volatile acids, gas analysis.

MODULE III: INDUSTRIAL POLLUTION

Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants, metallurgy.Polymers, drugs etc.

Environmental disasters – Cherbonyl, Three mile island, Seveso and minamata disasters, Japan tsunami

MODULE IV: BIOLOGICAL ACTIVITY

Biological activity - biodegradation of carbohydrates, proteins, fats and oil, detergents, pesticides; Metabolic fate of pollutants - adsorption – distribution -metabolism - excretion.

MODULE V: ENVIRONMENTAL TOXICOLOGY

Toxic heavy metals **:**Mercury, lead, arsenic and cadmium. Causes of toxicity. Bioaccumulation, sources of heavy metals. Chemical speciation of Hg, Pb, As, and Cd. Biochemical and damaging effects. Toxic Organic Compound **:**Pesticides, classification, properties and uses of organochlorine and ionospheres pesticides detection and damaging effects.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE

Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

BOOKS SUGGESTED:

1. Environmental Chemistry, S.E. Mahan, Lewis Publishers.
2. Environmental Chemistry, Sharma & Kaur, Krishna Publishers.
3. Environmental Chemistry, A.K. De, Wiley Eastern
4. Environmental Pollution Analysis, S.M. Khopkar, Wiley Eastern
5. Standard Method of Chemical Analysis, F.J. Welcher Vol. III, Van Nostrand Reinhold Co.
6. Environmental Toxicology, Ed. S. Landsberger and M. Creatchman, Gordon and Breach Science Publication.
7. Enviromental Chemistry, C. Baird, W.H. Freeman.

CHEMISTRY OF COSMETICS

Course Code: MAC-209 **Credit Units:04**

Course Objective: This course is intended to provide a comprehensive survey of ingredients fundamental to the cosmetic industry. The course will emphasize current trends in the selection of cosmetic ingredients. The chemistry and technology of cosmetic raw materials will be related to their behavioral properties as utilized in the construction of stable functional systems. In this way, it is intended to generate a better understanding of the contributions of ingredients to the performance of finished product formulations. Emphasis will be placed on recognizing and dealing with problem areas associated with the use of various ingredients. Safety considerations and other pertinent matters which can influence ingredient selection will be included in these discussions.

Course Content:

MODULE I: INTRODUCTION

Classification of raw materials and raw materials used in the cosmetic industry for the manufacture of finished products. Method of sampling, Indian Standard specification laid down for sampling and testing of various cosmetics in finished form by the bureau of Indian standards. Factors affecting stability of a formulation, ICH guidelines, Methods of stabilizations and Methods of stability testing.Concept of development of stability indicating analytical methods.

MODULE II: PHYSICAL AND CHEMICAL PROPERTIES OF COSMETICS

Determination of Physical and chemical constants such as extractive values, moisture content,

alcohol content, volatile oil content, ash values, bitterness values, foreign matters, and physical constants applicable to the lipid containing drugs. Microbial counts, bioburden and Pharmacopoeial microbial assays.

MODULE III: PREPARATION OF COSMETICS

Brief introduction of the following cosmetic preparation and a detailed study on their quality control: Shampoo, Tooth paste, skin powder, skin creams, hair creams, nail polish, after shave lotion, bath and toiletries, lipstick and hair dyes, perfumes, depilatories.

MODULE IV: PACKAGING OF COSMETICS

Packaging of cosmetics –Filling of solids, semisolids & liquids. Materials used for cosmetic packaging Rules & regulations and legal provisions for packaging & labeling.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

Text & References:

1. Comprehensive Pharmacy Review 5th Edition by Leon Shargel, Alan H. Mutnick, Paul F. Souney, Larry N. Sawnson – 2004.

2. Applied Biopharmaceutics and Pharmacokinetics, 4th Edition by Leon Shargel / Andrew B.C., Yu
– 1999.

3. A. H. Beckett and J. B. Stenlake Practical Pharmaceutical Chemistry, Part I and Part II, 4th Edition.

4. G. H. Jeffery, J. Basset, J. Mendham, R. C. Denny (Rev. by) Vogels Text Book of Quantitative Chemical Analysis, 5th Edition 1989, ELBS.

5. The Controller of Publications; New Delhi, Govt. of India, Indian Pharmacopoeia, Vol. I and Vol. II - 1996.

6. J. B. Wilkinson and R. J. Moore :Herry‟sCosmeticology; Longman Scientific and Technical Publishers, Singapore.

7. P.D. Sethi; Quantitative Analysis of Drugs in Pharmaceutical Formulations, 3rd Edition - 1997,

8. ICH guideline for impurity determination and stability studies.

9. Practical HPLC method development by Lloyd R. Snyder, Joseph J. Kirkland, Joseph I. Glajch, John Wiley and Sons 2nd Edition – 1997

NANO CHEMISTRY

Course Code: MAC-210 **Credit Units: 04**

Course Objective: To provide an adequate knowledge on various nanochemistry aspects.

Course Content:

MODULEI :SIZE EFFECTS ON STRUCTURE AND MORPHOLOGY OF NANOPARTICLES

Fundamental Properties - Size Effects on Structure and Morphology of Free or Supported Nanoparticles - Size and Confinement Effects - Fraction of Surface Atoms - Specific Surface Energy and Surface Stress - Effect on the Lattice Parameter - Effect on the Phonon Density of States - Nanoparticle Morphology - Equilibrium Shape of a Macroscopic Crystal - Equilibrium Shape of Nanometric Crystals - Morphology of Supported Particles.

MODULE II:SUPERPLASITICITY AND REACTIVITY OF METAL NANOPARTICLE

Superplasticity – Introduction – Mechanism - Superplastic Nanostructured Materials - Industrial Applications .Reactivity of Metal Nanoparticles - Size Effects-Structural Properties - Electronic Properties - Reactivity in Chemisorption and Catalysis of Monometallic Nanoparticles - Support Effects - Alloying Effects - Effect of Surface Segregation - Geometric Effects -Electronic Effects - Preparation and Implementation in the Laboratory and in Industry.

MODULEIII:SUPERCRITICAL FLUIDS

Supercritical Fluids –Introduction – Physicochemical Properties - Solubility - Viscosity - Diffusion - Thermal Conductivity - Applications - Purification and Extraction - Synthesis.

MODULEIV:FEATURES OF NANOSCALE GROWTH

Specific Features of Nanoscale Growth – Introduction - Thermodynamics of Phase Transitions - Dynamics of Phase Transitions - Thermodynamics of Spinodal Decomposition - Thermodynamics of Nucleation – Growth - Size Control - Triggering the Phase Transition- Application to Solid Nanoparticles - Controlling Nucleation - Controlling Growth - Controlling Aggregation. Stability of Colloidal Dispersions - Breaking Matter into Pieces.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

References:

1. C. Brechignac, P. Houdy, M. Lahmani, ―*Nanomaterials and Nanochemistry*‖, Springer publication (2007).
2. Kenneth J. Klabunde, ―*Nanscale materials in chemistry*‖, Wiley Interscience Publications (2001).

3. C. N. Rao, A. Muller, A. K. Cheetham ,—*Nanomaterials chemistry*‖, Wiley-VCH (2007).

MEDICINAL CHEMISTRY

Course Code: MAC-305 **Credit Units: 04**

Course objective: To introduce awareness among the students about the basic ideas of medicines & their working mechanism.

Course Contents:

MODULE I: DRUG DEVELOPMENT

Drug development: Lead modification. a) Identification of active part -Pharmacophore b) Fundamental group modification c) Structure-activity relationship d) Structure modification to increase potency and therapeutic index. i) Homologation ii) Chain branching iii) Ring chain transformations iv) Bioisosterism. Drug development process: a) Pre-formulation, product development. b) Preclinical studies; Acute toxicity, sub acute toxicity, chronic toxicity, LD_{50}, ED_{50}, pharmacodynamicsutagenecity and reproductive studies.

MODULE II: PHARMACOKINETICS

Basic principles of pharmacokinetics including absorption, distribution, metabolism and excretion of drugs and metabolites in the human body, important pharmacokinetic parameters in defining drug therapeutics, mathematical approach to pharmacokinetic modeling.

MODULE III: PHARMACODYNAMICS

Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, sulphonamides, membrane active drugs, drug metabolism, biotransformation, significance of drug metabolism in medicinal chemistry.Therapeutic index, explanation of quantal dose, graded dose, dose-effect curves, efficacy, potency, margin of safety

MODULE V: ANTIBIOTICS

Definition, characteristics, classification, synthesis and therapeutic uses of Penicillin, Ampicillin, Amoxicillin, Chloramphenicol, Cephalosporin, Tetracycline and Streptomycin

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

Books suggested:

1. Principles of Medicinal Chemistry, W. C. Foye, Philadelphia, USA
2. An introduction to Medicinal chemistry, G. L. Patrick, Oxford University Press
3. Burger‟s Medicinal Chemistry and Drug Discovery, Vol. 1-5, John Wiley
4. The Organic Chemistry of Drug Design and Drug Action, Richard B. Silvermann, Academic Press
5. Medicinal Chemistry, Ashutosh kar, New Age International Ltd
6. Essentials of Medical Pharmacology, K. D. Tripathi, Jaypee Brothers
7. A textbook of medicinal chemistry, P. Primo, CBS Publishers & Distributors
8. Text book of pharmaceutical organic chemistry, Md. Ali, CBS Publishers

POLYMER TECHNOLOGY

Course Code: MAC-306 **Credit Units: 04**

Course objective: This course is designed to familiarize students with the various polymer characterization and manufacturing techniques for converting polymer feed stocks into plastic end products. It involves a study of various plastics processing techniques. Students will become familiar with specialty polymers and their industrial uses, and design factors to create materials with desirable end-use properties

Course Contents:

MODULE I: POLYMER PROCESSING

Plastic Technology: Extrusion, injection molding, blow molding, compression molding, thermoforming, rotational molding, casting.*Fiber Technology* Textile and fabric properties, spinning, fiber treatments.*Elastomer Technology*- Vulcanization, reinforcement, elastomer properties and compounding.Recycling of polymers Classification of polymer recycling processes. Waste polymer recovery, sortation, microsortation, polymer reprocessing. Polymer incineration

MODULE II: POLYMER BLENDS AND ALLOYS

Definition, Polymer Blends, compatibilisation, Industrial Blends , Industrial applications of polymer blends.

MODULE III: SPECIALTY POLYMERS

Liquid Crystal Polymers (LCP): Smectic, nematic, cholestric crystals, thermotropic main chain LCP, side chain LCP, chiral nematic LCP, properties of commercial LCP‟s. *Electroactive polymers*: Filled polymers, conducting polymers- doping, conducting mechanism, EMI shielding, applications-rechargeable batteries, sensors, photoconductive polymers. *Ionic Polymers*: Ionic crosslinking, ion exchange, hydrophilicity, ionomers, polyelectrolytes, applications, *Synthetic Polymeric membranes*-membrane preparation, membrane modules, applications *Others:* High temperature and fire resistant polymers, Hydrogels, smart polymers, . Dendritic polymers- their applications.*Biomedical polymers*: Contact Lens, Dental Polymers, Artificial heart, Kidney and skin cells *Biobased polymers:* PLA, PCL

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

Books suggested:

1. Principles of Polymerization by G. Odian, (Wiley Interscience, New Delhi)
2. Polymer Science by Gowarikar
3. Thermal Characterization of Polymeric Materials- E. Turi (Academic Press)
4. Polymer Characterization- Physical Techniques by D. Campbell and J.R.White (Chapman and Hall)
5. Text Book of Polymer Science, F.W.Billmeyer (Willey Eastern)
6. Applied Rheology in Polymer Processing by B. R. Gupta, (Asian Books, Pvt. Ltd. New Delhi)
7. Polymer Blends and Alloys by R.P. Singh, C.K. Das and S. K. Mustafi, (Asian Books Pvt. Ltd.)
8. Principles of Polymer Science by Bahadur and Shastry
9. Plastics Technology Handbook by Manas Chanda and S.K.Roy (4th Edition, CRC Press, New York)
10. Analysis of polymers- an introduction, by Crompton T.R., pergaman press 1989.
11. Thermal characterization of polymeric materials, by Turi E.A., Academic press Inc.

GREEN CHEMISTRY

Course Code: MAC-307 **Credit Units**: **04**

Course Objective: A detailed exposition of the course for the student, opting for Applied Chemistry is so vitally important for a clear understanding of recent intricate theories of non-conventional sources of energy.

Course Contents:

MODULE I: SOLAR ENERGY

Heat Transfer in Renewable Energy Systems - conduction, convection and radiation, Heat transfer and engineering concepts to the renewable energy systems Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, Spectral distribution, the solar constant, radiation on titled surface / earth, instruments for measuring solar radiation. Application of solar energy and solar photovoltaic system

MODULE II: BIO-GAS

Raw materials, Properties/ characteristics of bio gas, Principles of Bio-Conversion; Photosynthesis, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion, Transportation of bio gas, bio gas plant technology & status, Biomass cogeneration Energy recovery from urban waste, Power generation from liquid waste, Bio gas applications.

MODULE III: GEOTHERMAL AND WIND ENERGY

Structure of earth‟s interior, earthquakes & volcanoes, Geothermal resources, Hot springs, Steam ejection, Principal of working, Types of geothermal station with schematic representation, Applications. Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals; types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Recent development and applications.

MODULE IV: OCEAN AND HYDROGEN ENERGY

Principle of ocean thermal energy conversion (OTEC), setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Fundamentals of tidal power, Potential and conversion techniques, mini-hydel power plants. Use of tidal energy, Limitations of tidal energy conversion systems. Properties of hydrogen in respect of it‟s use as source of renewable energy, Sources of hydrogen, Production of hydrogen; electrolysis of water, thermal decomposition of water, thermo chemical production bio-chemical production. Applications of hydrogen energy.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

Books suggested:

1. Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata Mc Graw Hill.
2. Kothari D.P., “Renewable energy resources and emerging technologies”, Prentice Hall of India

Pvt. Ltd.
3. Rai G.D, "Non-Conventional energy Sources", Khanna Publishers.
4. Ashok V. Desai, "Nonconventional Energy", New Age International Publishers Ltd.
5. Tiwari and Ghosal, “Renewable energy resources” Narosa Publication.
6. Twidell & Weir, “Renewable Energy Sources”
7. K Mittal “Non-Conventional Energy Systems” , Wheeler Publication
8. Ramesh & Kumar, “Renewable Energy Technologies”, Narosa Publications.

INDUSTRIAL WASTE AND WATER TREATMENT

Course Code: MAC-308 **Credit Units: 04**

Course Objectives: This course will give the basic understanding of the chemical principles involved in water and wastewater treatment. It presents the basic chemistry and treatment methodologies used in drinking water and wastewater operations. The students would be able to characteristics and treatment of industrial waste, advanced methods of treatment waste and disposal, reuse and recovery of waster from various industries. A brief introduction to environmental Impact assessment has also been added to create general awareness.

Course Contents:

MODULE I: **AN INTRODUCTION TO SOURCE, CHARACTERISTICS AND TREATMENT OF INDUSTRIAL WASTE**

Undesirable waste characteristics, sources and characteristics of waste water, industrial waste survey, waste characteristics - estimation of organic content, water reuse and in-plant waste control, idea of different technologies for the treatment of industrial waste water and the basis for the selection of treatment technology.

MODULE II: **TREATMENT OF INDUSTRIAL WASTES**

Different steps in the treatment of industrial waste (equalization, neutralization, sedimentation, oil separation, flotation, coagulation), sources and removal of heavy metals e.g. As, Ba, Cd, Cu, F, Fe, Rb, Mn, Hg, Ni, Se, Ag & Zn)

MODULE III: **ADVANCE WATER TREATMENT OF INDUSTRIAL WASTE**

Aeration, air stripping of volatile organics (VOC), biological oxidation - removal of organics (sorption, stripping, biodegradation), nitrification and de-nitrification. Lagoons and stabilization basins, membrane processes, trickling filtration, adsorption, ion exchange, chemical oxidation, sludge dewatering and disposal.

MODULE IV:**WASTE WATER REUSE AND RECOVERY**

Treatment, disposal, reuse and recovery of trade waste from (1) Textile Manufacture (2) Distilleries (3) Sugar (4) Paper and Pulp mills (4) Tanneries (5) Food Processing industries (6) Fertilizer Industry.

MODULE V: **ENVIRONMENTAL IMPACT ASSESSMENT**

Introduction to EIA, impact assessment methodologies, environmental inventory, environmental impact assessment (planning and management), environmental indices and indicators for describing the affected environment, EIA guidelines, introduction to environmental impact

statement.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

Books suggested:

1. Thomous S. Spiro and William M. Stiglicini, Chemistry of The Environment, Prentice Hall of India Pvt. Ltd. (2002)
2. Nicholas P. Cherimisinoff, Biotechnology for Waste and Waste Water Treatment, Prentice Hall of India Pvt. Ltd. (2001).
3. Jarry A. Nathanson, Basic Environmental Technology, 4th ed ,Prentice Hall of India Pvt. Ltd. (2003).
4. W.Wesley Eckenfelder, Indusrtrial Water Pollution Control, 2nd ed., Tata Mc-Graw Hill Book Company (1989).
5. Larry W. Canter. , Environmental Impact Assessment, 2nd ed, Tata Mc Graw Hill (1996).

NUCLEAR CHEMISTRY

Course Code: MAC-309 **Credit Units: 04**

Course objective: To provide an essence of basic fundamental knowledge of nuclear science and radioactivity to the students.

Course Contents:

MODULE I: INTRODUCTION TO RADIOACTIVITY

Discovery of radioactivity, α, β and γ radiations, the radioactive series, radioactive decay, modes of decay, the n/p ratio, odd even rule, artificial radioactivity, transmutation of elements, the G.M counter

MODULE II: CHEMISTRY OF RADIOACTIVE ELEMENTS

Positions of radioactive elements in periodic table, trans-uranides and trans-actinides, super heavy elements; nomenclature & predicted chemistry, the Seaborg model, radiation dosimetry,

radiolysis of aqueous solutions

MODULE III: USES OF NUCLEAR ISOTOPES

Introduction to nuclear medicine, positron emission tomography (PET) , radiocarbon dating and its uses, nuclear reactors, uses of heavy water in nuclear reactors, Trace analysis of elements and compounds - neutron activation analysis, isotope dilution analysis. Nuclear waste and its environmental effect

MODULE IV: NUCLEAR MODELS

Liquid-drop model, electron shell model, nuclear reactions, fission and fusion, cold fusion, idea about nuclear spin and its application in NMR, nuclear splitting, Zeeman effect and stark effect (only definition and qualitative explanation)

Examination Scheme:

Components	**CT**	**HA**	**S/V/Q**	**ATTD**	**EE**
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

Books suggested:

1. Essentials of Nuclear Chemistry, H. J. Arnikar, 4th Edition Wiley Eastern (1987).
2. Chemical Applications of Radioisotopes, H. J. M. Bowen. Buttler and Tanner (1969).
3. Introduction of Nuclear and Radiochemistry, G Friedlander, T. W. Kennedy, E. S. Macias and J. M. Miller, 3rd Edition, John Wiley (1981).

PROJECT (DISSERTATION)

Course Code: MAC-460 **Credit Units: 28**

GUIDELINES FOR PROJECT FILE AND PROJECT REPORT

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critically analyzed by the faculty guide and corrected by the student at each stage.

PROJECT FILE

The Project File may be a very useful tool for undertaking an assignment along-with a normal semester, an exploratory study, sponsored projects, a project undertaken during summer period or any other period as per curriculae where the researcher is working with a company/organization. The project/ assignment may also be a part of the bigger research agenda being pursued by a faculty/ institution/ department

The Project File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation. This file may be considered in continuous assessment.

In general, the File should be comprehensive and include:

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated objectives;
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen and may be useful to document for future reference.

PROJECT REPORT

The Project Report is the final research report that the student prepares on the project assigned to him. In case of sponsored project the lay out of the project could be as prescribed by the sponsoring organization. However, in other cases the following components should be included in the project report:

- **Title or Cover Page**

  The title page should contain Project Title; Student‟s Name; Programme; Year and Semester and Name of the Faculty Guide.

- **Acknowledgement(s)**

Acknowledgment to any advisory or financial assistance received in the course of work may be given.

It is incomplete without student‟s signature.

Abstract

A good"Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project. It should not exceed more than 1000 words.

Table of Contents

Titles and subtitles are to correspond exactly with those in the text.

Introduction

Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods

This section should aim at experimental designs, materials used (wherever applicable). Methodology should be mentioned in details including modifications undertaken, if any. It includes organization site(s), sample, instruments used with its validation, procedures followed and precautions.

Results and Discussion

Present results, discuss and compare these with those from other workers, etc. In writing this section, emphasis should be laid on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary, do not write in “point” form.

While presenting the results, write at length about the the various statistical tools used in the data interpretation. The result interpretation should be simple but full of data and statistical analysis. This data interpretation should be in congruence with the written objectives and the inferences should be drawn on data and not on impression. Avoid writing straight forward conclusion rather, it should lead to generalization of data on the chosen sample.

Results and its discussion should be supporting/contradicting with the previous research work in the given area. Usually one should not use more than two researches in either case of supporing or contradicting the present case of research.

Conclusion(s) & Recommendations

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Check that your work answers the following questions:

- Did the research project meet its aims (check back to introduction for stated aims)?
- What are the main findings of the research?
- Are there any recommendations?
- Do you have any conclusion on the research process itself?

- **Implications for Future Research**

  This should bring out further prospects for the study either thrown open by the present work or with the purpose of making it more comprehensive.

- **Appendices**

  The Appendices contain material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

- **References**

  References should include papers, books etc. referred to in the body of the report. These should be written in the alphabetical order of the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

  Examples:

  For research article:

  Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic *Escherichia coli* O157: H7. *Clin Microbiol Infect* ,**8** (suppl 1): 116–117.

  For book:

  Kowalski,M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

The Layout Guidelines for the Project File & Project Report:

- A4 size Paper
- Font: Arial (10 points) or Times New Roman (12 points)
- Line spacing: 1.5
- Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

ASSESSMENT OF THE PROJECT FILE AND THE PROJECT REPORT

Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The Project should fulfill the following ***assessment objectives:***

- Range of Research Methods used to obtain information
- Execution of Research
- Data Analysis (Analyze Quantitative/ Qualitative information)
  - Quality Control
  - Conclusions

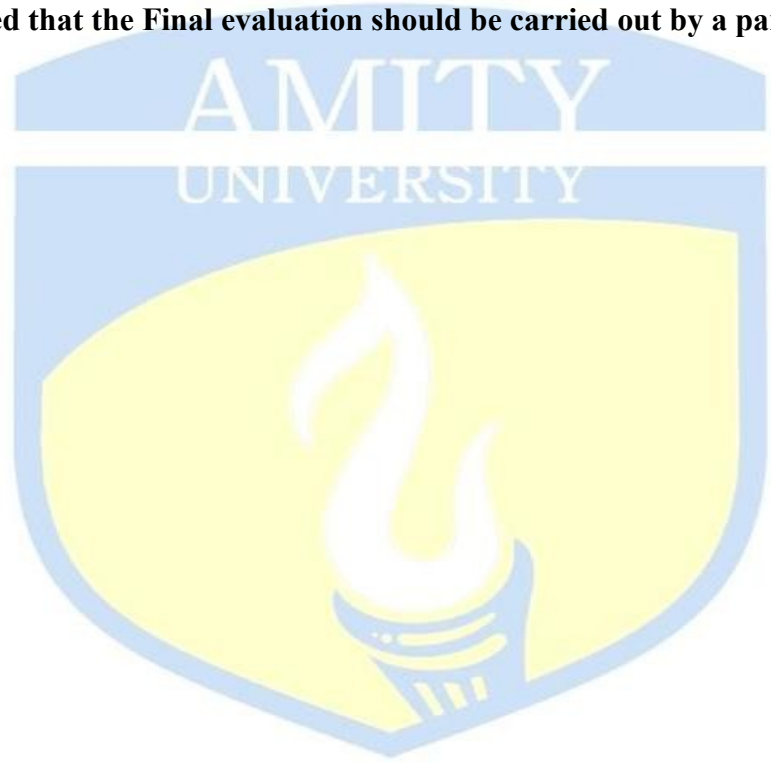
<u>Assessment Scheme:</u>
Continuous Evaluation:

40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/mid-course corrections etc. as reflected in the Project File.)

Final Evaluation:

60% (Based on the Documentation in the file, Final report layout, analysis and results, achievement of objectives, presentation/ viva)

It is recommended that the Final evaluation should be carried out by a panel of evaluators.



Open Elective

GREEN AND ENVIRONMENTAL CHEMISTRY

Course Code : MAC-001 **Credit Units: 03**

MODULE I: CHEMISTRY AND THE ENVIRONMENT

Chemistry and the environment - environmental pollution - causes - pollutants – air pollution - effects of air pollution: Environmental fate of pollutants – transformation process – bio Concentration - fate of air, water and soil pollutants

MODULE II: WATER POLLUTION

Water pollution - water quality parameters - turbidity, colour, pH, acidity, alkalinity, solids, hardness, chlorides, residual chlorine, sulphates, fluorides, phosphates, iron and manganese, DO, BOD, COD, nitrogen, grease, volatile acids, gas analysis.

MODULE III: INDUSTRIAL POLLUTION

Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants, metallurgy.Polymers, drugs etc.

Environmental disasters – Cherbonyl, Three mile island, Seveso and minamata disasters, Japan tsunami

MODULE IV: ENVIRONMENTAL TOXICOLOGY

Toxic heavy metals **:**Mercury, lead, arsenic and cadmium. Causes of toxicity. Bioaccumulation, sources of heavy metals. Chemical speciation of Hg, Pb, As, and Cd. Biochemical and damaging effects. Toxic Organic Compound **:**Pesticides, classification, properties and uses of organochlorine and ionospheres pesticides detection and damaging effects.

BOOKS SUGGESTED:

1. Environmental Chemistry, S.E. Mahan, Lewis Publishers.
2. Environmental Chemistry, Sharma & Kaur, Krishna Publishers.
3. Environmental Chemistry, A.K. De, Wiley Eastern
4. Environmental Pollution Analysis, S.M. Khopkar, Wiley Eastern
5. Standard Method of Chemical Analysis, F.J. Welcher Vol. III, Van Nostrand Reinhold Co.
6. Environmental Toxicology, Ed. S. Landsberger and M. Creatchman, Gordon and Breach Science Publication.
7. Enviromental Chemistry, C. Baird, W.H. Freeman