VELS UNIVERSITY

VELS INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)

(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)

NAAC ACCREDITED

PALLAVARAM - CHENNAI - INDIA

Program Specific Outcome

After completion of this programme the candidate will be

PSO1 : Global level research oppurtunities to pursue Ph.D programme targeted approach of CSIR – NET examination

PSO2: Enaromous job oppurtunities at all level of chemical , pharmaceutical , food products ,life oriented material industries

PSO3: Specific placements in R & D amd synthetic division of polymer industries & Allied Division

PSO4: Discipline specific competitive exams conducted by service commission

Department of Chemistry

M.Sc Organic Chemistry

Board of Studies Members List

Sl.No.	Name & Address	Designation
1.	Mr. Ganesh Babu, Associate Professor and Head Department of Chemistry, RKM Vivekananda College, Mylapore, Chennai 600 004.	External Expert
2.	Dr. P. Rajakumar Professor & Head Department of Organic Chemistry, University of Madras, Chennai 600 025.	External Expert
3.	Beninal Rajathi.K TCS India Pvt. Ltd. MEPZ Chennai -600 047	Alumini Member
4.	Dr . V. Mahalingam Professor Department of Chemistry, School of Basic Chemistry Vels University, Pallavaram,Chennai - 600 117	Member
5.	Dr. R. A. Kalaivani, Director HOD, Department of Chemistry, School of Basic Sciences, Vels University, Pallavaram,Chennai - 600 117	Convernor
6.	Dr. A. Perumal Professor Department of Chemistry, School of Basic Chemistry Vels University, Pallavaram,Chennai - 600 117	Member

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NAAC ACCREDITED

PALLAVARAM - CHENNAI - INDIA

M.Sc
Organic Chemistry

Curriculum and Syllabus
(Based on Choice based credit system)
2015 – 2016

Department of Chemistry
School of Basic Sciences

M. Sc. - ORGANIC CHEMISTRY
CURRICULUM

Total number of Credits: 90

Category	Code	Course	Hour/Week			Actual Credits
			Lecture	Tutorial	Practical	
SEMESTER I						
Core	15MOC001	Organic Chemistry – I	5	0	0	4
Core	15MOC002	Inorganic Chemistry – I	5	0	0	4
Core	15MOC003	Physical Chemistry-I	5	0	0	4
DSE		Discipline Specific Elective I	3	0	0	3
DSE		Discipline Specific Elective II	4	0	0	3
GE		Soft skill - I	1	1	0	2
Core	15MOC004	Practical-I Organic Chemistry-I	0	0	6	3
			23	**1**	**6**	**23**
SEMESTER II						
Core	15MOC005	Organic Chemistry – II	5	0	0	4
Core	15MOC006	Analytical Techniques	4	0	0	3
Core	15MOC007	Physical Chemistry-II	4	0	0	3
DSE		Discipline Specific Elective III	3	0	0	3
GE		Soft skill - II	1	1	0	2
GE		Generic Elective III	2	0	0	2
Core	15MOC008	Practical-II Physical Chemistry	0	0	5	3
Core	15MOC009	Practical-III Inorganic Chemistry	0	0	5	3
Core	15MOC010	Internship	0	0	0	2
			19	**1**	**10**	**25**
SEMESTER III						
Core	15MOC011	Organic Chemistry III	5	0	0	4
Core	15MOC012	Organo metallic and photochemistry	5	0	0	4
Core	15MOC013	Organic Spectroscopy	5	0	0	4
DSE		Discipline Specific Elective IV	4	0	0	3
DSE		Discipline Specific Elective V	3	0	0	3
GE		Generic Elective IV	2	0	0	2
Core	15MOC014	Practical-IV Organic Chemistry II	0	0	6	3
			24	**0**	**6**	**23**
SEMESTER IV						
Core	15MOC015	Synthetic organic chemistry	5	0	0	4
DSE		Discipline Specific Elective VI	3	0	0	3
Core	15MOC016	Project work/Review of Journals	0	0	24	12
			8	**0**	**24**	**19**
		Total	**74**	**2**	**46**	**90**

List of Discipline Specific Elective Courses

1.	15MOC101	Separation Techniques
2.	15MOC102	Organic name reactions and synthesis of reagents
3.	15MOC103	Analytical Techniques
4.	15MOC104	Fundamentals of Biochemistry
5.	15MOC105	Synthesis of APIs and manufacture
6.	15MOC106	Stereo chemistry and reaction mechanism
7.	15MOC107	Macromolecular Chemistry
8.	15MOC108	Nuclear and photochemistry
9.	15MOC109	Bioinorganic Chemistry
10.	15MOC110	Pharmaceutical Formulation Technology – I
11.	15MOC111	Pharmaceutical Chemistry
12.	15MOC112	Natural products
13.	15MOC113	Chemical & Instrumental Methods of Drug Analysis
14.	15MOC114	Electro analytical and Separation Techniques
15.	15MOC115	Enzyme technology and related entrepreneurial skills
16.	15MOC116	Novel materials and green industrial catalysis
17.	15MOC117	Pharmaceutical Formulation Technology – II
18.	15MOC118	Electrochemistry and group theory
19.	15MOC119	Strategic Management of Pharma Industry
20.	15MOC120	Electrochemistry and spectroscopy

List of Generic Elective Courses

1. 15SSK151 Soft Skill-1
2. 15SSK152 Soft Skill II
3. 15MOC151 Green Chemistry
4. 15MOC152 Cheminformatics
5. 15MOC153 Introduction to Nanoscience and Nanotechnology
6. 15MOC154 Food Chemistry and Adulteration

Syllabus
Core Course

		L	T	P	C
15MOC001	**ORGANIC CHEMISTRY – I**	**5**	**0**	**0**	**4**

Objectives:

To learn about optical activity of asymmetric and dissymmetric molecules. Basic idea about aliphatic nucleophilic substitution reactions, aromaticity, aromatic nucleophilic and electrophilic substitution reactions

Unit I Stereochemistry 20

Optical activity and chirality. Classification of chiral molecules as asymmetric and dissymmetric. A brief study of dissymmetry of allenes, biphenyls, spiro compounds, trans cyclo octene and cyclo nonene and molecules with helical structures. Absolute configuration – R, S notation of biphenyls and allenes. Fischer projection. Inter conversion of Sawhorse, Newman and Fischer projections. Molecules with more than one asymmetric center (restricted to five carbons) E.g. Erythro and threo compounds. Asymmetric synthesis, Crams's rule.

Geometrical isomerism. E, Z nomenclature of olefins, Geometrical and optical isomerism (if shown) of disubstituted cyclopropane, cyclobutane and cyclopentanes. Identification of enantiotopic, homotopic, diaestereotopic hydrogens and prochiral carbons in compounds containing up to ten carbons only, stereo specific and stereo selective reactions.

Unit II Aliphatic Nucleophilic Substitution Reactions 15

Kinetic and non-kinetic methods of determining organic reaction mechanisms. Hammett and Taft equations- Simple problems.

S_N1, S_N2 and S_Ni mechanisms –Neighbouring group participation –reactivity, Bredl's rule structural and solvent effects- substitution in norbornyl and bridgehead systems – substitution at allylic and vinylic carbons substitution by ambident nucleophiles-substitution at carbon doubly bonded to oxygen and nitrogen-alkylation and acylation of amines, halogen exchange. Von-Braun reaction, alkylation and acylation of active methylene carbon compounds, hydrolysis of esters, Claissen and Dieckmann condensations.

Unit III Aromatic Substitution Reaction – II 15

Aromaticity of benzenoid, heterocyclic and non-benzenoid compounds, Huckel's rule-Aromatic systems with pi electron numbers other than six-non-aromatic (cyclo octatetraene) and anti-aromatic systems (cyclo butadiene) –systems with more than 10pi electrons –Annulenes up to C_{18} (synthesis of all these compounds is not expected).

Unit IV Nucleophilic substitutions 10

Method for the generation of benzyne intermediate and reactions of aryne intermediate-Nucleophilic substitution involving diazonium ions. Aromatic Nucleophilic substitutions of activated halides. Ziegler alkylation. Chichibabin reaction.SandMeyers reagent.

Unit V Aromatic Substitution Reaction-I Electrophilic Substitutions 15

The arenium ion mechanism –Orientation and reactivity (ortho, meta and para directing groups), Hammett equations. Typical reactions –nitration, halogenation, alkylation, acylation and diazonium coupling. Formylation reactions-Gatterman, Gatterman-Koch, Vilsmeyer-Hack and Reimer –Tieman reaction. Synthesis of di and tri substituted benzenes (symmetrical tribromo benzene, 2-amino 5-methylphenol, 3-nitro - 4-bromobenzoic acid, 3,4-dibromonitrobenzene, 1,2,3trimethylbenzene) starting from benzene or any monosubstituted benzene. Electrophilic substitution of pyridine and pyridine -N-oxide, Naphthalene & Anthracene . hypso reactions

TOTAL: 75hours

Outcomes:

- To learn the concept stereochemistry and its importance
- To know what is aliphatic nucleophilic substitution
- To understand the various types of aliphatic nucleophilic substitution
- To learn what is aromatic substitution reaction
- To familiarize the various types of aromatic substitution reaction and their Mechanism
- To learn the concept aromaticity
- To understand the various types of aromaticity
- To learn the stereochemistry substitution and aromaticity
- To learn familiar name reactions

To identify the stereochemical notation

TEXT BOOKS:

1. R.O.C. Norman, Organic Synthesis, Chapman and Hall, New York, 2nd edition,1980.
2. S.M. Mukherji, S.P. Singh, Organic Reaction Mechanism, MacMillan India Ltd., Chennai,1990.
3. Francis A. Carey, Richard J. Sunderg, Advanced Organic Chemistry Part A and B, Plenum Press, 3rd Edition,1990.

REFERENCE BOOKS:

1. Jerry March,Advanced Organic Chemistry, Wiley Eastern Limited, Fourth edition, New Delhi, 1999.
2. John Mc. Murray,Organic Chemistry, Cengage Learning, 8th edition,2011.
3. T.L. Gilchrish and C.W. Rees, Carbenes, Nitrenes and Arynes ,Thomas Nelson and Sons Ltd., London,1969.

		L	T	P	C
15MOC002	**INORGANIC CHEMISTRY - I**	**5**	**0**	**0**	**4**

Objectives:

To learn about bonding in polyacids, inorganic polymers, formation, factors that affect stability of complexing stereo isomerism of inorganic complexes and crystal field theory and its limitations.

Unit I Bonding in Inorganic Compounds –I **15**

Poly acids: Isopolyacids and heteropolyacids of vanadium, chromium, molybdenum and tungsten.

Inorganic Polymers: Polysilanes and Silicones.

Poly sulphur – nitrogen compounds.

Unit II Bonding in Inorganic Compounds –II **15**

Boron hydrides: Polyhedral boranes–preparation and structure, carboranes-classification preparation and structure and metallo carboranes-preparation and structure. Metal Clusters: binuclear compounds- preparation and structure, multiple metal-metal bonds.

Unit III Coordination Chemistry **15**

Stability of complexes; thermodynamic aspects of complex formation; factors affecting stability; HSAB approach.

Determination of stability constants by spectrophotometric, polarographic and potentiometric methods.

Unit IV Stereoisomerism in inorganic complexes **15**

Stereochemical aspects; Stereoisomerism in inorganic complexes, isomerism arising out of ligand and ligand conformation; chirality and nomenclature of chiral complexes; optical rotatory dispersion and circular dichroism.

Unit V Theories of Coordination **15**

Crystal field theory and its limitations, d-orbital splitings, LFSE, spectro chemical series, evidences for metal ligand orbital overlap, molecular orbital theory - octahedral complex with σ and π bonding, John-Teller distortion, charge-transfer spectra.

TOTAL: 75hours

Outcomes:

- To know the structure and bonding in molecules / ions and predict the structure of molecules / ions.
- To learn the periodic properties of the different groups of compounds focusing on production methods and application of selected elements and compounds.
- To know the different definitions of acids / bases and predict the reactions between acids and bases
- To learn the selected crystal structures and to explain what kind of parameters that affects the crystal structure of a compound
- To be able to use Crystal Field Theory to understand the magnetic properties (and in simple terms the colour) of coordination compounds
- To be able to describe the stability of metal complexes by the use of formationconstants and to calculate thermodynamic parameters from them
- To be able to recognize the types of isomers in coordination compounds
- To be able to name coordination compounds and to be able to draw the structure based on it's name
- To become familiar with some applications of coordination compoundsTo be able to predict the geometries of simple molecules

TEXT BOOKS:

1. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, W.B. Saunders Co., 1977.
2. J. Huheey, Inorganic Chemistry, Harper and Collins, New York, Fourth Edition, 1983.

REFERENCE BOOKS:

1. R.B.Jordan, Reaction Mechanism of inorganic and Organometallic Systems, Oxford University Press,Third Edition,1991.
2. F.A. Cotton, F.A. Hart, The Heavy Transition Elements, McMillan Co., 1975.

		L	T	P	C
15MOC003	**PHYSICAL CHEMISTRY-I**	**5**	**0**	**0**	**4**

Objectives:

To learn about Determination of Fugacity, Partial molar properties, Concept of thermodynamic probability, and detail study of reversible reaction-first order opposed first order, first order opposed second order reactions.

Unit I Classical thermodynamics 15

Definition - Fugacity: Determination of Fugacity- Variation of Fugacity with temperature and pressure. Fugacity of solids and liquids. Mixture of ideal gases. Maxwell's relationships, spontaneity, equlibria-Temperature, pressure dependence of thermodynamic quantities, Lechatlier principle. The concepts of activity and activity coefficients and determination of activity coefficient.

Unit II Chemical potential 15

Partial molar properties -Partial molar free energy–Partial molar volume and partial molar heat content –their significance and determination of these quantities. Equilibrium in

heterogeneous system. Variation of chemical potential with temperature and pressure. Alternative definition of chemical potential.

Unit III Statistical thermodynamics 15

Concept of thermodynamic probability – distribution of distinguishable and non distinguishable particles.

Maxwell – Boltzmann, Fermi – Dirac and Bohr's Einstein statistics- Comparison and applications – modes of contribution to energy- Partition function – evaluation of translational, vibrational and rotational, nuclear and electronic partition functions for mono, di atomic and poly atomic ideal gases-thermodynamic functions in terms of partition functions to heat capacities of ideal gases – Law of equipartition energy- heat capacity of solids (Einstein and Debye models).

Unit IV Chemical Kinetics-I 15

Simultaneous reaction- A detail study of reversible reaction-First order opposed first order, first order opposed second order reactions-.Kinetics of complex/composite reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions, general treatment of chain reactions – chain length - Rice Herzfeld mechanism – explosion limits.

Study of fast reaction – relaxation methods – temperature and pressure jump method – stopped flow and flash photolysis methods.

Unit V Chemical Kinetics-II 15

Effect of temperature on reaction rate – Collision theory of reaction rates- Molecular beams – Collision cross sections- Effectiveness of collisions-Probability factor – Potential energy surfaces. Langmuir and BET absorption isotherms – study of kinetics of surface reaction – catalysis by metals semiconductor oxides – Mechanism of heterogeneous catalytic reaction – Absorption coefficient and its significance. Partition functions and activated complex. Eyring equation Estimation of free energy, enthalpy and entropy of activation and their significances.

Reactions in solutions – Effect of pressure, dielectric constant and ionic strength on reactions in solutions – Kinetic isotope effects – Linear free energy relationships – Hammett and Taft equations – Acid base catalysis – Mechanism of acid base catalysed reactions – Bronsted catalysis law.

TOTAL: 75 hours

Outcomes:

- To learn about the Principle and applications of ultraviolet and Woodward Fisher Rule
- To understand the Maxwell's relationships, spontaneity, equlibria-Temperature, pressure dependence of thermodynamic quantities
- To know about the concepts of activity and activity coefficients and determination of activity coefficient
- To familiarize the Partial molar properties and its determination
- To learn about the chemical potential and its determination
- To study the concept of thermodynamic probability
- To learn the Maxwell – Boltzmann, Fermi – Dirac and Bohr's Einstein statistics Comparison and applicationsTo know about the Partition functions

- To know the detail study of Simultaneous reaction
- To study the Kinetics of different types reactions
- To learn the reaction rate theories and reactions in solution

TEXT BOOKS:

1. K.J. Laidler, Chemical Kinetics, Harper and Row, New York, third edition, 1987.
2. Rajaram J. and Kuriacose J.C. – Kinetics and Mechanism of Chemical Transformation, Mc Millan India Ltd., third edition, New Delhi, 1999.

REFERENCE BOOKS:

1. S. Glasstone and D. Lewis, Elements of Physical Chemistry, Macmillan, 2nd Edition, 1995.
2. P.W. Atkins, Physical Chemistry, Oxford University Press, 5th edition, 1995.

		L	T	P	C
15MOC004	**PRACTICAL-I ORGANIC CHEMISTRY-I**	**0**	**0**	**6**	**3**

Objectives:

To learn the techniques of separation of organic mixture. To apply the skill in two stage preparation, purification and recrystallisation.

I. Separation of two component and characterization.

1. Acid substance and neutral substance
2. Basic substance and neutral substance
3. Phenolic substance and neutral substance
4. Acid substance and phenolic substance
5. Phenolic substance and basic substance

II. Double stage preparations

1. p-bromo acetanilide from Aniline
2. p-Nitro aniline from Acetanilide
3. 1,3,5 Tribromobenzene from Aniline
4. Aspirin from Methylsalycilate
5. Benzanilide from Benzophenone
6. m-Nitro Benzoic acid from Methyl benzoates
7. p-Nitro benzaldehyde from p-Nitro Toluene

TOTAL: 90hours

Outcomes:

- To familiarize the solubility nature of organic substances of different functional group.
- To learn the pilot separation of bimixtures .
- To familiarize the systematic producers organic substances analysis
- To learn two stage preparation involving molecular rearrangement oxidation .
- To know the preparation involving nitration and bromination
- To familiarize the test involving indentification of special elements
- To learn the conformatory test for various functional groups.
- To learn the preparations of derivative all functional groups aspects of electrical experiments
- To understand the techniques involving drying and recrystalliation by various method
- To expertise the various techniques of preparation and analysis of organic substances

TEXT BOOKS:

1. N.S. Gnanapragasam, G. Ramamurthy, Organic Chemistry Lab Manual, S. Vishwanath Printers & Publishers Pvt. Ltd., Chennai, 2010.

2. Vogel, Text book of Inorganic quantitative analysis, Longman Sc & Tech, 4 edition, 1980.

REFERENCE BOOKS:

1. Dougles A. Skoog, Principles of Instrumental Analysis, 3rd Edition, 1997.

2. Arthur I. Vogel, A Text Book of Practical Organic Chemistry, Longman Sc & Tech, 4 edition, 1978

		L	T	P	C
15MOC005	**ORGANIC CHEMISTRY – II**	**5**	**0**	**0**	**4**

Objectives:

To learn the mechanism of addition and elimination reaction, oxidation of methylene to carbonyl, oxidation of aryl methanes, allylic oxidation of olefins, reduction and coupling reaction.

UNIT I Addition to Carbon - Carbon Multiple Bonds 15

Electrophilic, nucleophilic addition reaction and neighbouring group participation, mechanism-Addition of halogen and nitrosyl chloride to olefins. Hydration of olefins and acetylenes. Hydro boration, Syn & Anti stereochemistry. Hydroxylations, Michael addition, Diels Alder reaction, 1, 3-dipolar additions.

UNIT II Addition to Carbon-Hetero Multiple Bonds 15

Carbenes and their addition to double bonds-Simmon Smith reaction, Mannich, Stobbe, Darzen, Wittig, Wittig – Horner and Benzoin reactions, C ≡ N with Grignard reagent. Stereochemical aspects to be studied wherever applicable. Nitrene: methods for generating nitrenes and their reactions.

UNIT III Elimination Reactions 15

E_1, E_2 and E_1cB mechanism- E_1, E_2 and E_1cB Spectrum—orientation of the double bond –Hofmann and Saytzeff rule - competition between elimination and substitution. Typical elimination reactions – dehydration, dehydrohalogenation and dehalogenation. Stereochemistry of E_2 eliminations in cyclohexane systems(Menthyl,Neomenthyl). Mechanism of pyrolytic elimination. Chugaev and Cope eliminations. Heck Coupling-Suzki coupling-Tin Coupling-Transition metal catalyzed coupling reactions.

UNIT IV Oxidation 15

Mechanisms – study of the following oxidation reactions – oxidation of alcohols- use of DMSO in combination with DCC or acetic anhydride in oxidizing alcohols- oxidation of methylene to carbonyl- oxidation of aryl methanes – allylic oxidation of olefins.

UNIT V Reduction 15

Reductions : selectivity in reduction of 4-T- Butyl cyclo hexanone using selectrides hydride reductions - LAH, $NaBH_4$, DIBAL, Super hydride, Lithium hydride, Sodium hydride – synthetic importance of Clemmenson and Wolff- Kishner reductions- modifications of Wolff-Kishner reduction – Birch reduction, MPV reduction.

TOTAL: 75hours

Outcomes:

- To get a clear picture about the nucleophilic and electrophilic groups
- To learn the addition reactions which are happening through the nucleophiles and electrophiles
- To learn about the addition reactions between a hetero atom and double bonded carbon compounds
- To gain knowledge about some specific compounds like Grignard reagents, nitrenes etc
- To obtain an outline about elimination reactions and rules used to study elimination reactions
- To learn about some specific examples of elimination reactions
- To learn the basic mechanism of oxidation in organic compounds
- To acquire knowledge about the reagents which causes oxidation in various compounds
- To learn about the two types of reduction reactions like complete reduction and selective reduction
- To know the reagents that causes selective and complete reduction

TEXT BOOKS:

1. R.O.C. Norman, Principles of Organic Synthesis, Chapman and Hall, London, 2nd Edition 1980.
2. Francis A. Carey, Richard J. Sundberg, Advanced Organic Chemistry-Part B Reactions and Synthesis, Plenum Press, 3rd Edition,1990.

REFERENCE BOOK:

1. S.M. Mukherji and S.P. Singh, Organic Reaction Mechanism, Macmillan India Ltd., 1990.

		L	T	P	C
15MOC006	**ANALYTICAL TECHNIQUES**	**4**	**0**	**0**	**3**

Objectives:

To learn analytical techniques like poloarography. Complex metric titration radio analytical methods and DTA and TGA application.

UNIT I Analytical Techniques –I **15**

Polarography – theory, apparatus, DME, Diffusion, Kinetic and catalytic currents, Current - voltage curves for reversible and irreversible system, qualitative and quantitative applications to inorganic systems.

UNIT II Amperometric Titrations **15**

Amperometric titrations – theory, apparatus, types of titration curves, successive titrations and indicator electrodes – Applications. Cyclic voltammetry - theory, application to inorganic systems. Coulometry.

UNIT III Analytical Techniques – II **10**

Complexometric Titrations: Chelating agents; types of EDTA titrations; direct and back titrations; replacement titrations; masking and demasking reagents. Determination of hardness of water.

UNIT IV Radio analytical methods **10**

Radio analytical methods: Types of Radio analytical methods and advantages, Isotope dilution analysis, Radiometric Titrations, Radio immuno assay, Neutron activation analysis-Principal and application

UNIT V Analytical Techniques – III **10**

Atomic absorption spectroscopy: Theory, Atomizers, Flame and Electro thermal, Radiation sources, Instrumentation, spectral and chemical interferences, application. Thermal methods: DTA and TGA –application.

TOTAL: 60 hours

Outcomes:

- To get a basic idea about polarography, its theory and applications
- To use the polarographic technique for studying the chemical equilibria and rates of reactions in solutions
- To get basic knowledge about amperometry and its applications in various titration curves
- To study about applications of cyclic voltammetry in electron transfer reactions
- To get an outline about the types as ligands for chelating agents and various types of complexometric titrations
- To learn about estimation of hardness of water through complexometric titrations
- To know about the various radio analytical methods for learning the reaction rates, the age of the materials, to develop tracers for various organs and tissues
- To obtain a detailed knowledge about Atomic absorption spectroscopy for studying the concentration of various elements

- To study about the stages of thermal degradation patterns of materials using TGA and DTA techniques

TEXT BOOKS:

1. Willard Merrit, Dean and Settle, "Instrumental methods of analysis", 6rd Edition, CBS Publ, 1986.
2. A. I. Vogel, "Textbook of Qualitative Inorganic Analysis", 3rd Edition, ELBS. 1976.

REFERENCE BOOK:

1. D.A.Skooog and D.M.West, Fundamentals of Analytical Chemistry, 4th Edition, ld Reinhord and Winston, Publication, 1982.

		L	T	P	C
15MOC007	**PHYSICAL CHEMISTRY-II**	**4**	**0**	**0**	**4**

Objectives:

To learn the basic concept of electro chemistry mechanism of electrode reaction. Symmentry elements points and material representation. Selection rules of Raman spectra.

UNIT I Electro Chemistry-I 15

Mean ionic activity and mean ionic activity coefficient – concepts ionic strength. Nernst equation- redox system- electrochemical cell- Electrolytic conductance- Kohlraush's law and its applications, ionic equlibria. Debye- Huckel theory of strong electrolytes – Determination of activity coefficient by electrical method –Debye-Huckel limiting law qualitative and quantitative verification – Limitation of Debye –Huckel theory at appreciable concentration – Huckel equation – Debye- Huckel –Bronsted equation.

UNIT II Electro Chemistry-II 10

Electrode –electrolyte interface – adsorption at electrified interface- electrical double layer – Electrocapillary phenomenon – Lippmann Equation – Structure of double layers – Helmholtz – Perrin- Guoy-Chapman and Stern model of electrical double layers.

UNIT III Mechanism of electrode reaction 10

Mechanism of electrode reaction – Polarisation and overpotential – the Butler Volmer equation for one step and multi step electron transfer reaction – Significance of exchange current density and symmetric factor-transfer coefficient and its significance – Mechanism of the hydrogen and oxygen evolution reactions.

UNIT IV Group theory-I 10

Symmetry elements and symmetry operations – Mathematical rules for the formation of a group- Definition and classification of Point groups – Identification and determination – Matrix representations- Reducible and irreducible representations- Similarity transformation -

Orthogonality theorem and its consequences – Character table- Construction of Character table for C_{2V} and C_{3V} point group.

UNIT V Group theory-II 15

Determination of symmetry of hybrid orbitals-Symmetry of hybrid orbitals in non linear molecules (H_2O,CH_4,XeF_4,BF_3,SF_6 and NH_3). Molecular vibrations -Direct product representation-Determination – IR and Raman activity of vibrational modes in non linear molecules (H_2O, CH_4,XeF_4,BF_3,SF_6 and NH_3). Mutual exclusion principle. Symmetry selection rules of infrared and Raman Spectra. Selection rules for electronic transitions. Symmetry of molecular orbitals and electronic states of HCHO. Selection rules for electronic transitions of HCHO.

TOTAL: 60hours

Outcomes:

- To learn the concepts of the activity coefficients and electrochemical cell.
- To study the theory of Debye Huckel rule, limitations and its applications.
- To know the structure of electrical double layers of Helmholtz, perrin-guoy-chapman.
- To know the adsorption of electrolyte interface.
- To practice the mechanism of hydrogen and oxygen evolution reaction.
- To study the Butler Volmer equation for one step and multi step electron transfer reaction
- To study symmetry elements and symmetry operations
- To know the orthogonality theorem and its consequences
- To learn the determination of IR and Raman activity of vibrational modes in non linear molecules
- **To study** selection rules for electronic transitions.

TEXT BOOKS:

1. J.O.M. Bokris and A.K.N. Reddy, “Electrochemistry, VoIs I and II”, Plenum, New York, 1977.
2. P. Delahay, “Electrode Kinetics and Structure of Double layer”, Interscience, New York 1965.
3. K. V.Raman, Group theory and its applications to Chemistry, Tata McGrawHill, New Delhi, 1990.

REFERENCE BOOKS:

1. J. Robbins, Ions in Solution-An Introduction in electrochemistry, Clarendon press, Oxford, 1993.
2. D.R. Crow, Principles and Applications of Electrochemistry, Chapman and Hall, 1991
3. S. Glasstone, Introduction to Electrochemistry, Affiliated East West Press, New Delhi. 1960.

		L	T	P	C
15MOC008	**PRACTICAL –II PHYSICAL CHEMISTRY**	**0**	**0**	**5**	**3**

Objectives:

To determine relative strength of acids, rate constant & order of reactions PKa value of a weak acid potentiometric titration and conductometric titration.

Non Electrical experiments

1. Determination of relative strength of the given 2 acids catalysed by methyl acetate.
2. Determination of temperature coefficient & energy of activation of hydrolysis of methyl acetate.
3. Construction of Phase diagram for a simple binary system.
4. Determination of rate constant & order reaction between $K_2S_2O_8$ & KI
5. Study the primary salt effect on the Kinetics of ionic reactions & test the Bronsted relationship ($K_2S_2O_8$ + KI)
6. Determination of equilibrium constant of the reaction between I_2 + KI by Partition method.
7. Study of adsorption of acetic acid by charcoal (Fruendlich isotherm)

Electrical Experiments

I. Potentiometric titrations

8. Strong acid Vs Strong Base
9. Weak acid Vs Strong Base
10. Mixture of acid Vs Strong Base
11. Halides Vs $AgNO_3$
12. Mixture of halides Vs $AgNO_3$
13. Redox Titration a. $FeSO_4$ Vs $K_2Cr_2O_7$ b. KI Vs $KMnO_4$
14. Determination of pKa of a weak acid using Henderson equation.

II. Conductometric titrations

15. Strong acid Vs Strong base.
16. Strong acid & weak acid Vs Strong base (Mixture of acids Vs Strong base)
17. Weak acid Vs Strong base
18. Determination of cell constant and verification of Debye-Huckel Onsager equation for strong electrolyte.
19. Determination of dissociation constant of weak electrolyte by conductivity method.

TOTAL: 90hours

Outcomes:

- To the preparation for each experiment by studying lab handouts and links therein
- To know about the safety requirements and lab skills to perform physico-chemical experiments
- An appreciation for modern problems and scientific controversies in physical chemistry
- How to design and perform experiments to determine the rate, order, and activation energy of chemical reactions by varying concentrations and/or temperature
- Methods to measure equilibrium concentrations and equilibrium constants for acid-base, solubility, and complexation reactions given initial concentrations of reactant
- To the preparation of buffer solutions at a required pH, given a choice of solutions of acid/conjugate base pairs
- To determination of the molar mass of an unknown nonelectrolyte and an unknown electrolyte from a freezing point depression experiment
- To know the principle and mechanism of Conductormetric and potentiometric titrations

TEXT BOOKS:

1. P.S.Raghavan, B.Vishwanathan, Practical Physical Chemistry, Viva books Private Limited, New Delhi, 2005.
2. B.D. Khosla and V.S. Garg,Senior Practical Physical Chemistry, R. Chand and Co., New Delhi, 1998.

REFERENCE BOOKS:

1. A. Findary, T.A. kitchner Practical physical chemistry, Longmans, Green and Co., 1997.
2. J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. Richett, Experiments in Physical Chemistry, Pergamon Press, 2007.

		L	T	P	C
15MOC009	**PRACTICAL -III INORGANIC CHEMISTRY**	**0**	**0**	**5**	**3**

Objectives:

To learn the estimation of ions by complex metric and colorimetric method semi micro analysis of salts.

I. Volumetric Estimations :

1. Estimation of Zinc
2. Estimation of Magnesium
3. Estimation of Calcium
4. Estimation of Nickel

II. Colorimetric analysis:

5. Estimation of iron
6. Estimation of nickel
7. Estimation of manganese
8. Estimation of copper.

III.Qualitative analysis:

9. Analysis of Salt mixture- I (W, Se, Pb, Cu)
10. Analysis of Salt mixture- II (Te, Th, Al, Fe)
11. Analysis of Salt mixture- III (Ti, Zr, Mn,Co)
12. Analysis of Salt mixture- IV (Ce, V, Ni, Zn)

TOTAL: 90 hours

Outcomes:

- To know about the volumetric and gravimetric analysis of cations and anions.
- Making informed choices among post-graduate opportunities for work or further Education
- The communication of the results of scientific experiments in oral reports and written reports
- The chemical literature and to read and understand technical literature related to the discipline
- How to maintain high standards of professional and scientific ethics
- How to predict the outcome and mechanism of some simple organic reactions, using a basic understanding of the relative reactivity of functional groups
- How to use the scientific method to create, test, and evaluate a hypothesis
- How to characterize products by physical and spectroscopic methods.

TEXT BOOKS:

1) Jeyavathana Samuel, Chemistry Practical Book, G.G.Printers, Chennai, 2012.
2) Vickie.M.Williamson, M.Larry Peck, Lab manual for General Chemistry, Cengage Learning India Private Limited, New Delhi, 2009.

REFERENCE BOOK:

1) Dr. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis, National Publishing Company, Chennai, 3rd edition, 1974.

		L T P C
15MOC010	**INTERNSHIP**	**0 0 0 2**

Objectives:

To gain practical experience by working in a professional organic chemistry -related environment. To demonstrate an ability to work independently and utilize principles of organic chemistry to solve real-world problems.

Course Requirements

- Students wishing to receive credit for internship are required to find, apply for, and be selected for a chemistry or materials related internship position with an organization of their choice. They will then need to seek permission by the Department Chair to register for the appropriate internship course.
- The student must complete at least 90 hr of work during the semester for each hour of academic credit awarded, and these work hours must be completed during the term (odd or even semester vacation) in which the student is registered for the internship course.
- After the student has completed the internship, the student must submit the final evaluation report of the internship experience and 20 minute presentation to department at conclusion of semester. The Department Chair and class instructor will allot the marks for the internship evaluation report.

Outcomes:

- To know the various types of industries.
- To learn the procedure of identifying, approaching, applying and getting approval of internship from a leading industry.
- To witness the entire work area of the industry.
- To understand the nature of job involved in the various sector of the industry.
- To adapt with the working people.
- To identify the manufacturing procedures and technical skills involved.
- To understand the complete mechanism of the reactions involved in the manufacturing areas at different sectors.
- To correlate the manufacturing procedures with simple laboratory synthesis.
- To learn the environment aspects, pollution their control involved in the manufacturing unit.

- To prepare a final evalution report and presentation for the internship carried out for minimum 30 days.

		L	T	P	C
15MOC011	**ORGANIC CHEMISTRY-III**	**5**	**0**	**0**	**4**

Objectives:

To learn about basic concept of UV, IR, NMR and Mass spectroscopy and their application. Organic photo chemistry pericyclic reaction and sigma tropic reaction.

UNIT I Physical Methods of Structure Determination 20

Principle and applications of ultraviolet Woodward Fisher Rule (only application) and infra-red spectroscopy in organic structure determination. Nuclear magnetic resonance spectroscopy. Proton chemical shift, spin-spin coupling, coupling constants and applications to organic structures ^{13}C resonance spectroscopy (elementary treatment).

UNIT II Mass Spectroscopy 20

Mass spectrometry and its applications optical rotatory dispersion and its applications. Cotton effect, axial haloketone rule and octant rule. Problem solving using spectral data. (for molecules with a maximum number of C_{10})

UNIT III Organic Photochemistry 15

Photochemical excitation-rate of the excited molecules –Jablonski diagram-study of photochemistry of ketone-photo reduction-photo cyclo addition-Paterno-Buchi reaction-di-pi-methane rearrangement–Pericyclic reactions-classification–orbital symmetry-Woodward Hoffman rules-Analysis of electrocyclic, inter conversion of hexatrienes to cyclohexadienes. Cyclo addition and sigmatropic reactions-correlations diagram for butadiene-cyclobutene system. Structure of butylene, a fluxional molecule –Cope and Claissen rearrangements

UNIT IV Heterocycles, Terpenoids and Steroids Synthesis 10

Imidazole, oxazole, thiazole, flavones, isoflavones, anthocyanins, pyrimidines (cytocine and uracil only) and purines (adenine, guanine only). Synthesis of parent and simple (alkyl or aryl substituted derivates are expected).

UNIT V Synthesis of vitamin A1 10

Synthesis of vitamin A1 (Reformatsky and Wittig reaction methods only) Conversion of cholesterol to progesterone, estrone and testosterone. Elucidation of structure of cholesterol (by chemical degradation)

TOTAL: 75hours

Outcomes:

- To learn about the Principle and applications of ultraviolet and Woodward Fisher
  - Rule
- To understand the infra-red spectroscopy in organic structure determination

- To know about the Nuclear magnetic resonance spectroscopy. Proton chemical shift, spin-spin coupling, coupling constants and applications to organic structures ^{13}C resonance spectroscopy
- To learn the Mass spectrometry and its applications
- To learn about the optical rotatory dispersion and its applications
- To study the concepts of Cotton effect, axial haloketone rule and octant rule
- To learn the Photochemical excitation and Jablonski diagram
- To know about the study of photochemistry of ketone-photo reduction-photo cyclo addition
- To know the detail study of Pericyclic reactions and Cyclo addition and sigmatropic reactions
- To study the synthesis of Heterocycles, Terpenoids and Steroids
- To learn the Synthesis of vitamin A1, Conversion of cholesterol to progesterone, estrone and testosterone and elucidation of structure of cholesterol

TEXT BOOKS:

1. F. A. Carey, Richard J. Sundbreg, "Advanced Organic Chemistry", 4th Edition, Plenum Press, New York, 2001.
2. I.L. Finar, "Organic Chemistry", vol 2, Longmans Green & Co. 3rd edition, 1964.

REFERENCE BOOKS:

1 J.Dyer, "Application of absorption spectroscopy of organic compounds", Prentice-Hall, Michigan, 1965.
2. R.M. Silverstein, G.C. Bassler, Spectrometric identification of Organic compounds, Monsil John Wiley and Sons, New York, 1974.

		L	T	P	C
15MOC012	**ORGANO METALLIC AND PHOTOCHEMISTRY**	**5**	**0**	**0**	**4**

Objectives:

To know about alkyls and arene complexes, organiometallic reaction, Wilkinson's catalysis, hydroformylation of olefins using cobalt or rhodium catalysts and photo electro chemistry.

UNIT I Alkyls and Arene complexes 15

Alkyls and Arene complexes; metalation, bonding in metal carbonyls and nitrosyls, chain and cyclic donors, olefin, acetylene and allyl systems, synthesis, structure and bonding metallocenes.

UNIT II Organometallic reactions 15

Organometallic reactions - Association, Carbonylation, decarbonylation, Insertion, Elimination and rearrangement. Examples, mechanisms and application.

UNIT III Catalysis 15

Catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (oxoprocess), oxidation of olefins to aldehydes and ketones (Wacker process) polymersiation (Zeigler-Natta catalyst);

UNIT IV Cyclo Oligomerisation of Acetylene 15

Cyclo oligomerisation of acetylene using nickel catalyst (Reppes' catalyst)-Synthetic Gasoline-Mobil reaction. Examples, mechanisms and synthetic application

UNIT V Inorganic Photochemistry 15

Photo redox reactions and photo substitution reactions in coordination chemistry - photovoltaic and photo galvanic cells. Photo electro chemistry, aspects of solar energy conversion.

TOTAL: 75hours

Outcomes:

- To learn about the Alkyls and Arene complexes
- To understand the bonding in olefin, acetylene and allyl systems
- To know about the concepts of synthesis, structure and bonding in metallocenes
- To familiarize the Organometallic reaction mechanisms and its applications
- To learn about the Catalysis, hydrogenation of olefins and oxoprocess
- To study the concept of oxidation of olefins and polymerization
- To learn the cyclooligomerisation of acetylene
- To know about the Synthetic Gasoline-Mobil reaction mechanism and its applications
- To know the detail study of Photo redox reactions and photo substitution reactions
- To study the photovoltaic and photo galvanic cells
- To learn the Photo electro chemistry and aspects of solar energy conversion

TEXT BOOKS:

1. J.E. Huheey, Inorganic Chemistry – Principles, Structure and Reactivity: Harper Collins, New York, 4th Edition, 1993.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry- A Comprehensive Text, John Wiley and Sons, 5th Edition, 1998.

REFERENCE BOOK:

1. K. F. Purcell and J.C. Kot, Inorganic Chemistry, WB Saunders Co., USA, 1977.

		L	T	P	C
15MOC013	**ORGANIC SPECTROSCOPY**	**5**	**0**	**0**	**4**

Objectives:

To learn about UV and Visible Spectroscopy, Infrared spectra, ^{13}C Nuclear Magnetic Resonance & mass spectroscopy and their application in determining the molecular structure.

UNIT I UV and Visible Spectroscopy 15

Introduction – the energy of excitation. The absorption laws, measurement of the spectrum – choice of solvent – selection rules and intensity – Chromospheres – solvent effects – Conjugated dienes, polyenes, ketones and aldehydes.$\pi - \pi^*$ transitions, n - π^* transition, ∞,β- unsaturated ketones, acids, esters, nitriles, amides. The benzene ring, the substituted benzene ring – polycyclic aromatic hydrocarbons the effect of steric hindrance to co planarity.

UNIT II Mass spectroscopy 20

Introduction – Instrumentation – High resolution and low resolution mass spectra – Determination of molecular formula – Molecular peaks rule. M^+ ion. Natural isotope abundance analysis – fragmentation process – nitrogen rule, metastable ions, metastable peaks, retro Diels – Alder fragmentation – McLafferty rearrangement, loss of odd electron, neutral fragments from molecular ions – Factors which influence fragment abundance – Mass spectra of various functional groups containing compounds to be studied: aromatic, aliphatic hydrocarbons, ketones, acids, esters, amides, ethers, alcohols, amine and nitriles.

UNIT III Infrared spectra 10

Introduction – Preparation of samples and examination in an infrared spectrometer – The infrared spectrum – the use of the table of characteristic group frequencies – correlation charts. Absorption frequencies of triple bond and cumulative double bonds – the aromatic overtone and combination – Region 2000 – 1200 cm^{-1} . Absorption frequencies' of the double bond region – Groups absorbing in the finger print region – identification of functional groups.

UNIT IV Proton and carbon – ^{13}C Nuclear Magnetic Resonance 20

The spinning nucleus – The effect of an external magnetic field, precessional motion, precessional frequency, energy transitions. Theory of NMR – Measurement of chemical shifts – Internal standards – Units used in NMR. Factors influencing chemical shift – electronegativity, shielding and deshielding, Van der Walls deshielding, Anisotropic effects – Correlation data, use of correlation tables. Influence of restricted rotation. Chemically equivalent and magnetically equivalent protons. Solvents used in NMR – Choice of solvent – solvent shifts – concentration and temperature effects. Integrals – Spin spin splitting – The splitting of NMR signals – Theory of spin-spin splitting. Magnitude of coupling, coupling constants. Proton exchange reactions. Factors influencing geminal coupling – vicinal coupling – Hetero annular coupling, Deuterium exchange.

UNIT V Nuclear Overhauser Effect 10

Improving the NMR spectrum – shift reagents. Effect of changing the magnetic field. Nuclear overhauser effect, spin tickling. Problems (Problems involving UV, IR and NMR to be solved) Carbon – 13 NMR: Principle, spin decoupled spectra, single frequency off resonance decoupled (SFORD) spectra, chemical shift values, problems.

TOTAL: 75hours

Outcomes:

- To learn about the Mean ionic activity and mean ionic activity coefficient and concepts ionic strength
- To understand Nernst equation and Kohlraush's law and its applications
- To know about the concepts of Debye- Huckel theory of strong electrolytes, Debye-Huckel limiting law, Huckel equation and Debye- Huckel –Bronsted equation
- To familiarize the Electrode –electrolyte interface, electrical double layer, Electrocapillary phenomenon and Lippmann Equation
- To learn about the Polarisation and overpotential and the Butler Volmer equation
- To study the concept of transfer coefficient and its significance – Mechanism of the hydrogen and oxygen evolution reactions
- To learn the Einstein's theory of transition probability and rotation spectroscopy
- To know about the Vibrational spectroscopy, Vibrational coupling overtones and Fermi resonance. Raman Spectra
- To know the detail study of NMR Spectroscopy
- To study the a brief discussion of Fourier transform resonance Spectroscopy

TEXT BOOKS:

1. Robert M.Silverstein, Clayton Bassler and Terence C.Morril, Spectrophotometer Identification of Organic Compounds, 6th Edition, John Wiley & Sons, New York, 2002.
2. Donald L.Pavia, Gary M.L.Lampman, George S. Kriz, James R. Vyvyan, Spectroscopy, Cengage Learning India Private Ltd., 2007.

REFERENCE BOOKS:

1. H. H. Willard, L. L. Meritt, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, Wadsworth, New York, 7thedition, 1986.
2. John R. Dyer, Applications of absorption spectroscopy of Organic Compounds, Prentice Hall, London, 1987.

		L	T	P	C
15MOC014	**ORGANIC CHEMISTRY-II**	**0**	**0**	**6**	**3**

Objectives:

To learn about the estimation methods for glucose, Phenol etc. and preparation by multistage method.

I. Estimations

1. Estimation of Glucose
2. Estimation of Phenol
3. Estimation of Ethyl Methyl ketone
4. Estimation of Ascorbic acid
5. Estimation of Aniline

6. Iodine value on an Oil (Hanus method)

MULTI STAGE PREPARATIONS

1. *para*-Nitro Benzamide for *para*-Nitro toluene
2. *ortho*-Chloro Benzoic acid from Phthalic anhydride
3. *para*-Bromoaniline from Aniline
4. *para*-Nitroaniline from Aniline
5. Sulphanilamide from Acetanilide
6. *m*-Nitroaniline from Nitrobenzene

TOTAL: 90 hours

Outcomes:

- To know about the estimate the Glucose
- To learn the estimation of Phenol
- To study the estimation of the ethyl methyl ketone
- To estimate Ascorbic acid
- To estimate the Aniline
- To estimate Iodine value on an Oil (Hanus method)
- To prepare *para*-Nitro Benzamide for *para*-Nitro toluene
- To prepare *ortho*-Chloro Benzoic acid from Phthalic anhydride
- To prepare *para*-Bromoaniline from Aniline
- To prepare *para*-Nitroaniline from Aniline
- To prepare Sulphanilamide from Acetanilide
- To prepare *m*-Nitroaniline from Nitrobenzene

TEXT BOOKS:

1. N.S. Gnanapragasam, G. Ramamurthy, Organic Chemistry Lab Manual, S.Vishwanath Printers & Publishers Pvt. Ltd.,Chennai, 2010.
2. Vogel, Text book of Inorganic quantitative analysis, Longman Sc & Tech, 4 edition, 1980.

REFERENCE BOOKS:

1. Dougles A. Skoog, Principles of Instrumental Analysis, 3rd Edition, 1997.
2. Arthur I. Vogel, A Text Book of Practical Organic Chemistry, Longman Sc & Tech, 4th edition, 19

		L	T	P	C
15MOC015	**SYNTHETIC ORGANIC CHEMISTRY**	**5**	**0**	**0**	**4**

Objectives:

To learn electro cyclic reactions, sigma topic rearrangement, Introduction to photochemistry, cyclisation reaction and ring opening of 1, 3 Butadiene, 1, 3, 5 hexatriene systems, synthon, C-C, C = C bond formation by various method reagents in organic synthesis.

UNIT I Electro cyclic reactions 15

Electro cyclic reactions – definition, classification, M.O treatment, FMO- PMO - correlation diagram treatment with example. Application of electro cyclic reactions in organic synthesis. Cyclo addition reactions – classification – definition.

UNIT II Sigma topic rearrangement 20

Sigma topic rearrangement – Hydrogen migration [1, 3], [1, 5] & [1, 7] definition, classification, FMO-PMO treatment and correlation diagram. Hydrogen migration in cyclic system like cyclopentadiene, Indene cyclohepta trienes. Sigma topic rearrangement involving methyl group and chiral groups. Sigmatopic rearrangements in cope & Claisen reactions – FMO & PMO treatment. Degenerates molecules, Fluxional molecules, application of sigma topic rearrangement in organic synthesis

UNIT III Photo chemistry 15

Photo chemistry – Introduction to photochemistry.cyclisation reaction and ring opening of 1, 3 Butadiene, 1, 3, 5 hexatriene systems. Jablonski diagram - Norish I & Norish II reaction, quantum yield. Primary & Secondary, photochemical reactions, Rearrangement – Paterno – Buchi reaction. Barton reaction di-pi methane rearrangement, Photo reduction of ketones.

UNIT IV Synthon, C-C, C = C bond formation by various method 10

Synthon, C-C, C = C bond formation by various method. (Aldol, Michael, Peterson, Shapiro, Wittig, Benzoin, Robinson annulations, Deick Mann condensation.Synthesis of enamines and their applications.

UNIT V Reagents in organic synthesis 15

Reagents in organic synthesis: metal hydrides, Lithium dimethyl cuprates, LDA, 1, 3 dithione, trimethyl silyl iodide, 9BBN, DCC.
Synthesis of cubane, 5- hexenoic acid, Bicyclo [4, 1, 0] heptanes -2-one.

TOTAL: 75hours

Outcomes:

- To know about the stereochemical problems in relation to chemical transformations
- To know synthetically the processes relevant organic-chemical reactions and be able to discuss the mechanism of these reactions
- To correlate the chemical structure of biomolecules to reactivity: Functional groups, acid-base properties, Biochemical as well as synthetic routes
- To learn to discuss the similarities and differences between transformations of
- biomolecules in living systems (aquatic environment) and in vitro, e.g. industrial
- synthesis
- To learn to describe how some course concepts are applied within the biomolecular –
- and pharmaceutical fields
- To learn how the chemical properties and reactivity can influence environmental and
- economical descicions by giving examples
- Plan and carry out fundamental organic transformations of significance for organic Synthesis
- Discuss stereochemical problems related to chemical transformations
- To carry out simpler risk assessment, in-session laboratory documentation and oral/written presentation of the contents and results of laboratory sessions

TEXT BOOKS:

1. R.O.C. Norman, Organic Synthesis, Chapman and Hall, New York, 2nd edition, 1980.
2. S.M. Mukherji, S.P. Singh, Organic Reaction Mechanism, MacMillan India Ltd., Chennai, 3rd edition 1984.
3. Francis A. Carey, Richard J. Sunderg, Advanced Organic Chemistry Part A and B, Plenum Press, 3rd Edition, 1990.
4. Francis A. Carey, Richard J. Sunderg, Advanced Organic Chemistry Part A and B, Plenum Press, 3rd Edition, 1990.

REFERENCE BOOKS:

1. Jerry March,Advanced Organic Chemistry, Wiley Eastern Limited, 4th edition, New Delhi, 1999.
2. John Mc. Murray,Organic Chemistry, Cengage Learning, 8th edition,2011.
3. T.L. Gilchrish and C.W. Rees, Carbenes, Nitrenes and Arynes , Thomas Nelson and Sons Ltd., London,1969.

Syllabus
Discipline Specific Elective Courses (DSE)

		L	T	P	C
15MOC101	**SEPARATION TECHNIQUES**	**4**	**0**	**0**	**3**

Objectives:

To learn the various methods of separations like thin layer chromatography, High performance thin layer chromatography, Gas-liquid chromatography and columns packing.

UNIT I Chromatographic Techniques 12

Adsorption and partition chromatography- definition of terms- Techniques and applications - Column, Paper, Thin Layer Chromatography.

UNIT II High Performance Thin Layer Chromatography 12

High Performance Thin Layer Chromatography, Retention Factor, Two dimensional Paper Chromatography, Reverse phase paper chromatography.

UNIT III Gas Liquid Chromatography 12

Chromatography: Gas-liquid Chromatography, Principles, Retention Volumes, Instrumentation, Carrier Gas, Columns, Stationary Phase, types of Detectors, Thermal Conductivity, Flame Ionization, Electron Capture, Retention time, Application of G.L.C.

UNIT IV High Performance Liquid chromatography 12

High Performance Liquid chromatography: Scope, Column efficiency, Instrumentation, Pumping Systems, Columns, Column packing, Detectors, Applications.

UNIT V Ion exchange and gel – permeation chromatography 12

Ion exchange and gel–permeation chromatography. Standard deviation and correlation coefficient. Various types Ion exchange and gel–permeation chromatography.

TOTAL: 60 hours

Outcomes:

- To learn about the definition of Adsorption and partition chromatography
- To understand the Column, Paper, Thin Layer Chromatography
- To know about the High Performance Thin Layer Chromatography
- To familiarize the two dimensional Paper Chromatography, Reverse phase paper Chromatography
- To learn about the Gas-liquid Chromatography
- To learn the applications of Gas-liquid Chromatography
- To know about the High Performance Liquid chromatography

- To know the detail study of Various types Ion exchange and gel–permeation chromatography

TEXT BOOKS:

1. J. Huheey, Inorganic Chemistry, Harper and Collins, NY IV Edition, 1983.
2. H.J. Arnikar, Nuclear Chemistry, Wiley Eastern Co. II Edition, 1987.
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry- A Comprehensive Text, John Wiley and Sons,V Edition,1998.

REFERENCE BOOKS:

1. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, Vann no strand Co., New York, 1974.
2. D.F. Shrivers, P.W. Atkins and C.H. Langfor, Inorganic Chemistry,Freeman, New York, 1990.

L T P C
4 0 0 3

15MOC102 ORGANIC NAME REACTIONS AND SYNTHESIS OF REAGENTS

Objectives:

To learn the mechanism of condensation, oxidation and reduction. Synthetic application of reagents.

UNIT I Organic Reactions – I 12

Condensation reactions of the following; Aldol, Claisen ester condensations. Cannizzaro reaction, Dieckmann cyclisation, Reformatsky reaction, Dakin reaction, Etard reaction, HVZ reaction, Umpolung synthesis and Stephen reaction.

UNIT II Organic Reactions – Oxidations 12

Barton reaction, Jones oxidation, Oppenauer oxidation and Michel addition. Detailed mechanism for the above reactions examples and synthetic application.

UNIT III Organic Reactions – Reductions 12

Basic concept of reduction. Birch reduction, Clemmenson reduction, Meerwin P.V reduction, rosenmund reduction. Mechanism for the above reactions, examples and synthetic application.

UNIT IV Organic Reagents- I 12

Synthesis and applications of the following reagents: 9-Borabicyclo(3.3.1)nonane (9-BBN), n-butyl lithium, ceric ammonium nitrate (CAN), DCC, Grignard reagent, LDA, Gilman reagent, NBS and PCC.

UNIT V Organic Reagents- II 12

Use of the following reagents in organic synthesis and functional group transformations- complex metal hydrides, Hilmans reagent, lithium dimethyl cuprate,, dicyclohexyl carbodimide,1,3-dithiane, woodward and provost hydroxylation, selenium dioxide, crown ethers and Peterson's synthesis, Wilkinson's catalyst, Baker yeast.

TOTAL: 60hours

Outcomes:

- To learn about the Aldol, Claisen ester condensations, Cannizzaro reaction, Dieckmann cyclisation and Reformatsky reaction
- To understand the Dakin reaction, Etard reaction, HVZ reaction, Umpolung synthesis and Stephen reaction
- To know about the Barton reaction, Jones oxidation, Oppenauer oxidation and Michel addition
- To familiarize the different types of reduction reaction
- To learn about the synthesis and applications of the organic reagents like 9-Borabicyclo(3.3.1)nonane (9-BBN) and n-butyl lithium
- To learn the synthesis and applications of the organic reagents like ceric ammonium nitrate (CAN), DCC, Grignard reagent, LDA, Gilman reagent, NBS and PCC
- To know about the complex metal hydrides, Hilmans reagent, lithium dimethyl cuprate and dicyclohexyl carbodimide,1,3-dithiane
- To know the detail study of woodward, provost hydroxylation, selenium dioxide, crown ethers and Peterson's synthesis, Wilkinson's catalyst and Baker yeast

TEXT BOOKS:

1. R.O.C. Norman, Principles of Organic Synthesis, Chapman and Hall, London, 2nd 1980.
2. Francis A. Carey, Richard J. Sundberg,Advanced Organic Chemistry-Part BReactions and Synthesis,Plenum Press, 3rdEdition,1990.

REFERENCE BOOKS:

1 S.M. Mukherji and S.P. Singh, Organic Reaction Mechanism, Macmillan India Ltd., 1990.
2 P.S. Kalsi, Textbook of Organic Chemistry, Macmillan India Ltd., 1999.

		L	T	P	C
15MOC103	**ANALYTICAL TECHNIQUES**	**4**	**0**	**0**	**3**

Objectives:

To learn about several methods of analytical techniques. Basic concept about UV -visible spectroscopy, infrared spectroscopy, raman spectra, nuclear magnetic resonance and electron spin resonance and mass spectrometry and their applications.

UNIT I Techniques of UV- Visible spectroscopy and Infrared Spectroscopy 12

Colourimetric analysis and UV- Visible spectroscopy: Beer Lambert's law, Principles of single and double beam instruments – applications for analysis of inorganic and organic samples. Infrared spectrophotometric analysis – principle and instrumentation and molecular structure determination.

UNIT II Raman Spectra and Nuclear Magnetic Resonance 12

Raman Spectra – principle, basic instrumentation – structural analysis. Nuclear Magnetic Resonance – Principle, instrumentation, structure determination, NMR of ^{1}H,^{13}C, ^{31}P, ^{19}F.

UNIT III Electron Spin Resonance and Mass 12

Electron Spin Resonance – Principle, instrumentation, applications to coordination compounds. Mass Spectrometry – Principle, basic instrumentation, fragmentation patterns – organic molecular structural determination.

UNIT IV Thermogravimetric Analysis 12

Thermo gravimetric and differential thermal analysis, DSC thermometric titrations, differential scanning colourimetry – basic instrumentation and applications.

UNIT V Atomic Absorption and Photoelectron Spectroscopy 12

Atomic absorption spectroscopy: Theory, Atomizers, Flame and Electro thermal. Radiation sources, Instrumentation, spectral and chemical interferences, application. Photoelectron spectroscopy (UV and X-Ray) –photo electron spectra Koopman's theorem, fine structure in PES, chemical shift and correlation with electronic charges.

TOTAL: 60hours

Outcomes:

- To learn about the Colourimetric analysis
- To understand the UV spectroscopy
- To know about the Barton reaction, Jones oxidation, Oppenauer oxidation and Michel addition
- To familiarize the different types of reduction reaction
- To learn about the Infrared spectrophotometric analysis principle and instrumentation and molecular structure determination
- To learn the principle, instrumentation and applications of Raman Spectra

- To know about the principle, instrumentation and applications of NMR Spectra
- To know the detail study of the Electron Spin Resonance and Mass Spectra

TEXT BOOKS:

1. D.A.Skoog and D.M.West, Fundamentals of Analytical Chemistry, IV Edition, Old Reinhord & Winston, Publication, 1982.
2. B.K. Sharma, Instrumental methods of Chemical analysis, Goel Publishing House, 24th Edition, 2005.
3. Gurdeep R. Chatwal, Sham K. Anand, Instrumental Methods of Chemical Analysis, Himalaya Publication, 1979.

REFERENCE BOOKS:

1. Willard Merrit, Dean and Settle, Instrumental methods of analysis, 6th Edition, CBS Publ, 1986.
2. A. I. Vogel, Textbook of Qualitative Inorganic Analysis, 3rd Edition, ELBS, 1976. Old Reinhord & Winston, Publication, 1982.

	L	T	P	C
15MOC104 FUNDAMENTALS OF BIOCHEMISTRY	**4**	**0**	**0**	**3**

Objectives:

To learn about monosaccharides linear and ring structures of ribose, glucose, fructose and mannose physical and chemical properties of glucose and fructose. Properties and bilogical role of protein nucleic acids and classification vitamins.

UNIT I Chemistry and Metabolism of Carbohydrates 12

Definition, Classification and biological role of carbohydrates. Monosaccharides Linear and ring structures (Haworth formula) of ribose, glucose, fructose and mannose (structural determination not required) physical and chemical properties of glucose and fructose. Disaccharides: Ring structures (Haworth formula) – occurrence, physical and chemical properties of maltose, lactose and sucrose. Glycolysis of carbohydrates.

UNIT II Chemistry and MetabolismofAmino acids and Proteins 12

Amino acids: Various classification, essential amino acids, physical properties (amphoteric nature and isoelectric point) reactions. Proteins: Classifications (based on shape, composition and solubility), physical properties. Primary structure – End group analysis (N – terminal analysis – Edman's method, dansyl chloride method; C – terminal analysis – hydrazinolysis and bio-chemical mehods). Biological functions of proteins, Deamination, transamination reactions, Urea cycle.

UNIT III Chemistry and Metabolismof lipids 12

Definition, classification – simple lipids (fatty acids), compound lipids and derived lipids, Properties: saponification number, Acetyl number. Cholesterol (structure not needed), biological importance and chemical properties. Bile acids – functions. Biological functions of lipids.

UNIT IV Nucleic Acids 12

Purine and pyrimidine bases, nucleosides, nucleotides, polynucleotides, DNA structure – various types, RNA structure – various types. Biological functions of DNA and RNA, Genetic code.

UNIT V Vitamins 12

Vitamins: Definition, classification – water – soluble vitamins ($B_{v,}$ B_2, B_3, B_6, B_{12} and vitamin – C) and fat- soluble vitamins (A, D, E and K) – occurrence, structure, deficiency diseases, biochemical rules and daily requirements.

TOTAL: 60hours

Outcomes:

- To learn about the definition, classification and biological role of carbohydrates
- To understand the Amino acids and Proteins
- To know about the Definition, classification – simple lipids
- To familiarize the Biological functions of lipids
- To learn about the Infrared spectrophotometric analysis principle and instrumentation and molecular structure determination
- To learn the Purine and pyrimidine bases
- To know about the nucleosides, nucleotides, polynucleotides
- To know the detail study of the definition, classification of Vitamins

TEXT BOOK:

1. J. L. Jain, Sunjay Jain and Nitin Jain "Fundamentals of biochemistry", 6th edition, S. Chand and company Ltd., 2005.

REFERENCE BOOKS:

1. U. Satyanarayana and U. Chakarapani, Essential of biochemistry, 2nd edition, Books and allied (p) Ltd. (2007).
2. C. B. Powar and G. R Chatwal, Biochemistry, Himalaya publishing house, 5th edition 2006.

		L	T	P	C
15MOC105	**SYNTHESIS OF APIS AND MANUFACTURE**	**4**	**0**	**0**	**3**

Objectives:

To learn the importance of pharmaceutical Industry. Stages of process research and development for drug. Application of phase transfer catalysts in pharmaceutical industry for drug synthesis

Unit I Process Chemistry in Pharmaceutical Industry – An overview 12

Introduction, top 200 prescription drugs by worldwide sales ; Top ten drugs in the US market constituting 10% of worldwide sales – Premarin, Synthroid, Lipitor, Prilosec, Hydrocone, Albuterol, Norvasc, Claritin, Timox and Prozac ($ one billion). Background of process chemistry – role of process chemistry

Unit II Strategy of Process Research & Development in Pharma Industry 12

Process research and development of PenicillinG CAS Reg. No.[61-33-6](antibacterial); fosinopril CAS Reg. No.[98048-97-6](antihypertensive) ; Rabeprazole CAS Reg. No.[117976-89-3] (antiulcerative) Time based competition – portfolio management – stages of process research and development.

Unit III Combinatorial chemistry 12

Introduction – Drug Optimization – Drug discovery – Solid Phase Technique – parallel synthesis – Mixed Combinatorial Synthesis – Deconvolution – Structure Determination and limitations – Drug design / Drug discovery.

Unit IV Phase transfer catalysis and Asymmetric synthesis 12

Application of phase transfer catalysts in pharmaceutical industry for drug synthesis – enantioselective synthesis of chiral 2-hydroxycarboxylic acids and esters – asymmetric catalysis – eg. Asymmetric hydrogenation – L-Dopa process ; Sharpless asymmetric epoxidations eg. Synthesis of Fluoxetine enantiomers

Unit V Polymorphism and Process safety in Drug synthesis 12

Polymorphism – solid state – crystallization – recrystallization of drug molecules eg. Isolation techniques and characterization of polymorphs of Venlafaxine hydrochloride[99300-78-4] Clopidogrel bisulphate [135046-48-9] and Lorazepam[846-49-1] (any two) Chemical Process safety – Principles and Practice-guidelines and norms-Green chemistry.

TOTAL: 60hours

Outcomes:

- To learn about the worldwide sales of Premarin, Synthroid, Lipitor, Prilosec, Hydrocone, Albuterol, Norvasc, Claritin, Timox and Prozac
- To understand the background of process chemistry and role of process chemistry
- To know about the process research and development of PenicillinG

- To familiarize the process research and development of fosinopril CAS and Rabeprazole CAS
- To learn about the Infrared spectrophotometric analysis principle and instrumentation and molecular structure determination
- To learn the drug optimization and drug discovery techniques
- To know about the Drug design
- To know the detail study of the Polymorphism and green chemistry

TEXT BOOKS:

1. K. G. Gadamasetti and Marcel dekker, Process chemistry in Pharmaceutical industry Ed. Inc., New York, USA, 1999.
2. W W Bannwarth and B. Hinzen, "Combinatorial chemistry", Wiley, VCH, 2006.

REFERENCE BOOKS:

1. R G Cooper, S J Edgett and E J Kleinschmidt, "Portfolio Management for new products", Published by Perseus, 2001.
2. A W Czarnik, A practical guide to Combinatorial chemistry, ACS, 1998.

		L	T	P	C
		4	0	0	3

15MOC106 STEREO CHEMISTRY AND REACTION MECHANISM

Objectives:

To learn about general consideration of molecular asymmetry and dissymmetry, configuration metals of determinations mechanisms of reactions and rearrangement.

UNIT I Stereochemistry **12**

Stereochemistry; a) General consideration of molecular asymmetry and dissymmetry. Configuration – absolute and relative methods of determination,Chemical transformation, asymmetric synthesis.

UNIT II Coupling Reactions **12**

Chiral auxiliaries, chiral reagents and catalysts, Enantiomeric excess,Quasiracemates Atropisomerism of biphenyls. Coupling reactions – Hock coupling – Suzuki coupling – Tin coupling – Transaction metal catalyses coupling reaction.

UNIT III Retrosynthetic Analysis **12**

Basic principles and terminology of retro synthesis , synthesis of aromatic compounds, one group an disconnections, one group C-C and two group C-C Disconnection and amine.

UNIT IV Alkene synthesis **12**

Various methods of Alkene synthesis, important strategies of ret rosy group transposition, important functional group interconversions.

UNIT V Green Chemistry **12**

Non conventional Techniques in organic synthesis-Green chemistry-Microwave assisted reaction-U.S Catalyzed reaction. Reaction in ionic organic liquids-Solid state melts reaction.

TOTAL: 60 hours

Outcomes:

- To know the basic concepts and terms involved in stereochemistry
- To study about the important stereochemical like chiral reagents and catalysts
- To get a basic idea about coupling reactions and to study some important coupling reactions in detail
- To study about the outline of retrosynthetic analysis with some examples
- To learn about the ret rosy group transposition and important functional group interconversions in alkene synthesis
- To study some of the techniques used in green chemistry for synthesis of various Compounds

TEXT BOOKS:

1. P. S. Kalsi, Stereochemistry Conformation and Mechanism, New Age International Publication, 2005.
2. Eliel, Stereochemistry of Carbon Compounds, Tata Mc Grawhill Education, 1975.
3. E.S. Gould, Mechanism & structure in organic Chemistry, Holt, Rinehart & Winston, New Delhi, 1963.

REFERENCE BOOKS:

1. Morrison and Boyd, Organic Chemistry, Pearson Education Inc, 6th Edition, 1992.
2. I.L. Finar, Organic Chemistry,Longmans Green & Co., 3rd Edition,1964.

		L T P C
15MOC107	MACROMOLECULAR CHEMISTRY	4 0 0 3

Objectives:

To learn the basic concepts of polymers. Polymerization methods, measurement of molecular weight and size, glassy solids, polymer crystallization manufacture and application of resins and plastics.

UNIT I Basic concepts of polymers 12

Monomer, Repeat unit, degree of polymerization. Classification of polymers, Stereochemistry of polymer, nomenclature of stereo regular polymers.Chain polymerization, free radical polymerization and ionic polymerization.

UNIT II Types of Polymerisation 12

Coordination polymerization; Ziegler Natta catalyst. Step polymerization, ring opening polymerization.Co polymerization, random, block and graft co polymers- preparation.
Polymerisation techniques; bulk, solution, suspension and emulsion polymerization.

UNIT III Molecular Weight and Glass Transition Temperature 12

Measurement of molecular weight and size; number average and weight average molecular weights.Glass transition temperature, concepts of glass transition temperature and associated properties.

UNIT IV Glassy Solids and Polymer Crystallization 12

Glassy solids and glass transition, factors influencing glass transition temperature (Tg).
Crystallinity in polymers; Polymer crystallization, structural and other factors affecting crystallisability, effect of crystallinity on the properties of polymers.

UNIT V Types of Polymers and Polymer Degradation 12

Synthetic resins and plastics; Manufacture and applications of polyethylene, PVC, Teflon, poly styrene, polymethylmethacrylate, poly urethane, phenol – formaldehyde resins, urea-formaldehyde resins and epoxy polymers.
Polymer degradation: Types of degradation- thermal, mechanical, photo, hydrolytic and oxidative degradations.Additives for polymers: Fillers, plasticizers, thermal stabilizers, photo stabilizers, anti oxidants and colourants.

TOTAL: 60 hours

Outcomes:

- To study some of the basic terminologies in polymers
- To learn about the different mechanisms involved in the polymer preparation
- To learn about the different polymerization techniques
- To study about the two different molecular weight concept in polymers
- To study in detail about the glass transition temperature and the factors affecting it

- To know about the types of polymers with some specific examples of each
- To get an idea about the polymer degradation and the factors affecting it

TEXT BOOKS:

1. Fred. W. Billmeyer, Text Book of Polymer Science, John Wiley & Sons, 3rd Edition, 2007.
2. R. V. Gowariker, Polymer Science, New Age International Publication, 2006.

REFERENCE BOOKS:

1. R. J. Young and P. A. Powell, Introduction to Polymers, CRC Press, 3rd Edition, 1991.
2. A. Ravve, Principles of Polymer Chemistry, Springer New York, 3rd Edition, 2012.

		L	T	P	C
15MOC108	**NUCLEAR AND PHOTOCHEMISTRY**	**4**	**0**	**0**	**3**

Objectives:

To learn about nuclear isomerism, internal conversion, detection and determination of activity by cloud chamber, determination of radio activity, application of tracers and Inorganic Photochemistry.

UNIT I Electron Capture Detectors 12

Orbital electron capture: nuclear isomerism, internal conversion, detection and determination of activity by cloud chamber, nuclear emulsion, bubble chamber, G.M., Scintillation and Cherenkov counter.

UNIT II Nuclear fission and fusion reactions 12

Nuclear fission and fusion reactions as energy sources: direct reactions, photonuclear and thermo nuclear reactions. Components of nuclear reactors – the breeder reactor – nuclear reactors in India

UNIT III Tracer study in Analytical Chemistry 12

Applications of tracer in study of reaction mechanism and in analytical chemistry – neutron activation analysis – isotope dilution analysis –

UNIT IV Carbon dating 12

Various types and applications of Carbon dating - radioactive tracer in the diagnosis and treatment in field of medicine

UNIT V Photo redox reactions and photo substitution reactions 12

Photo redox reactions and photo substitution reactions in coordination chemistry – Photovoltaic and photo galvanic cells. Photo electro chemistry, aspects of solar energy conversion

TOTAL: 60 hours

Outcomes:

- To get a basic idea about orbital electron capture
- To know about different electron capture detectors
- To learn about the different types of nuclear reactions
- To study about the components of nuclear reactors
- To monitor the reaction mechanisms with the help of tracers
- To study the application of radioactive carbon as tracers in medical diagnosis
- To learn about the redox and substitution reactions in the presence of light for coordination compound

TEXT BOOKS:

1. G.S. Manku, Inorganic Chemistry, TMG Co., 1984.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry- A Comprehensive Text, John Wiley and Sons, V Edition, 1998.

REFERENCE BOOKS:

1. D.F. Shrivers, P.W. Atkins and C.H. Langfor, Inorganic Chemistry, CH Langford, 1990
2. N.N. Greenwood and Earnshaw, Chemistry of the Elements, Pergamon Press New York, 1984.

		L T P C
15MOC109	**BIOINORGANIC CHEMISTRY**	**4 0 0 3**

Objectives:

To learn about basic concepts of structure and functionality, membranes, structure, function transport properties, aspects of electrochemical phenomena of biological system, enzyme, co enzyme, nitrogen fixation and photosynthesis.

UNIT I Thermodynamics and biology 12

Thermodynamics and biology – Basic concepts of structure and functionality – membranes – structure, function transport properties, aspects of electrochemical phenomena – active transport, ionophores, biological energy storage and Phosphate hydrolysis.

UNIT II Essential and trace metal ions 12

Essential and trace metal ions. Coenzymes – Vitamin B coenzymes, carboxy peptidase and Superoxide dismutase. Heme – enzyme – Peroxidase and catalases.

UNIT III Structure Oxygenation and Stereochemistry 12

Oxygen carriers – Hemeproteins – Hemoglobin, myoglobin – Structure Oxygenation and Stereochemistry – Bohr effect. Non-heme oxygen carriers – Hemerythrin and hemocyanin-Iron storage and transport proteins.

UNIT IV Nitrogen fixation 12

Nitrogen fixation – Introduction, types of nitrogen fixing micro organisms. Nitrogenase enzyme – Metal clusters in nitrogenase – redox property – Dinitrogen complexes – transition metal complexes of dinitrogen – nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia. Biological redox systems:Cytochromes – Classification, cytochrome a, b and c Cytochrome P-450. Iron – sulphur proteins – rubredoxin and ferredoxin. Photosynthesis and chlorophyll's.

UNIT V Bio analytical Chemistry 12

Bio analytical Chemistry-Toxicity & medicine-Toxicity of Hg, Cd, Zn, Pb, As, Sb. Anti cancer agents. Metal ion poisoning: Failure of metal ion control systems, role of metal ion. Diagnosis and treatment – use of radio isotopes. Pollution studies: Effluents and treatment. Inorganic plant nutrition and indicator plants for mineral exploration.

TOTAL: 60 hours

Outcomes:

- To study about the basics of transport properties and electrochemical phenomena
- To know about the various metal ions present in our body
- To learn about the different enzymes participating in the chemical reactions inside the body and their functions
- To study about the different oxygen carriers present in the body with their structure and stereochemistry
- To study in detail about nitrogen fixation reactions and microorganisms involved in nitrogen fixation reactions

- To know about the biological redox systems and their classifications
- To create awareness about metal toxicities, their detection and permissible levels in the body

TEXT BOOKS:

1. M.Satake and Y.Mido, "Bioinorganic Chemistry", Discovery Publishing House, New Delhi 1996.
2. G. N. Mugherjee and Arabinda Das, Elements of Bioinorganic Chemistry, McGraw Hill, 1993.

REFERENCE BOOKS:

1. G.Eichron, Inorganic Bio-chemistry, Vol. I and II, Elsevier, 1973.
2. J.E. Huheey, Inorganic Chemistry - Principles, Structure and Reactivity; 4th Edition, Harper Collins, New York, 1993.

		L	T	P	C
15MOC110	**PHARMACEUTICAL FORMULATION TECHNOLOGY I**	**4**	**0**	**0**	**3**

Objectives:

To learn the need for formulation, PA, EMF redox potential and physicochemical properties evolving into in vivo bioavailability. To know about drug stability, milling and packaging

UNIT I Introduction **12**

Need for formulation; History of formulation; Challenges in early formulations; Drug substance to drug product with reference to formulating for the patient; Physical and chemical properties of Formulation.

UNIT II Physicochemical Principles **12**

Solutions ; pH, EMF and redox potentials ; physicochemical properties evolving into in vivo bioavailability; Absorption, Dissolution, Permeability, Distribution, Metabolism, Excretion; Complexation,; Modifies release dosage forms; profile of common formulations; colloidal systems, Rheology; Drug stability and ICH Guidelines for stability testing.

UNIT III Pharmaceutical Operations-I **12**

Extraction; Drying ; Evaporation; Distillation; Filtration/Centrifugation ; Size reduction and handling of solids in the powder form.

UNIT IV Pharmaceutical Operations-II **12**

Antisolvent and reactive crystallization; Melting approaches to particle size; Wet milling and dry milling; packaging.

UNIT V Profile of Formulations **12**

Tablets, capsules, solution and suspension formulation; Modified release formulation; Parenteral Formulation; Inhaled formulations/aerosols, Topicals.

TOTAL: 60hours

Outcomes:

- To study about the concept of formulation, its physical and chemical properties
- To get knowledge about different properties affecting the in vivo bioavailability of drugs
- To know about the stability testing parameters from ICH guidelines
- To learn about the different pharmaceutical operations during drug synthesis
- To learn about the different pharmaceutical operations after drug synthesis till formulation
- To study about the different types of drug formulation

TEXT BOOK:

1. S. K. Jain and V. Soni, "Bentley's Textbook of Pharmaceutics an Adaptation", Elsevier, 2012.

REFERENCE BOOK:

1. C. B. Gupta and S. S. Khanka, Entrepreneurship and Small Business Management, Sultan Chand and Sons, NewDelhi, 2012

		L	T	P	C
15MOC111	**PHARMACEUTICAL CHEMISTRY**	**4**	**0**	**0**	**3**

Objectives:

To know about the classification and synthesis drugs, antibiotics, enzymes phase transfer catalysis. Vitamins – Introduction, water, fat soluble vitamins. Details of vitamin A, C, B_1, B_2, B_6.

Unit I Classification of Drugs **12**

Classification of drugs-CNS drugs types function and metabolism general and local anesthetics. Sedatives and hypnotics: types function and metabolism. Narcotics and analgesics function and metabolism.

Unit II Antibiotics **12**

Classification of Antibiotics – structure and synthesis; Chloromphenicol, pencillins and streptomycin and applications.

Unit III Enzyme Concept 12

Enzymes, co-enzymes, theory. Michaelis-Menten's equation and verification by graphical methods-Eadie plot and Lineweaver-Burk plot. Enzyme catalysis, Enzyme specificity, Enzyme mechanism.Enzyme Inhibition- Competitive inhibition, Un-competitive inhibition and Non-competitive inhibition.

Unit IV Phase transfer catalysis 12

Phase transfer catalysis, ionic liquids. Miscellaneous catalysis. Use of crown ethers.

Unit V Vitamins 12

Introduction, water soluble and fat soluble vitamins. Details of vitamin A, C, B_1, B_2, B_6,

TOTAL: 60 hours

Outcomes:

- To familiarize the basic classification of drugs
- To learn about the structure and synthesis of antibiotics
- To know the classification of enzymes
- To understand the protein and peptide drugs
- To learn the principles of phase transfer catalysis
- To know about the uses of crown ethers
- To familiarize the water and fat soluble vitamins
- To know the functions of vitamin A, C, B1, B2 and B6 in the body
- To know the structure and vitality of vitamins and problems related to deficiency of Vitamins

TEXT BOOKS:

1. William O. Foye, Thomas L. Lemke, David A. Williams, Principles of Medicinal Chemistry, Lippincott Williams & Wilkins, 4th Edition, 1995.
2. Wilson & Gisvold's Textbook of Organic Pharmaceutical and Medicinal Chemistry, John.M. Beale and John. H. Block, Lippincott Williams & Wilkins, 10th Edition, 1998.

REFERENCE BOOKS:

1. M. E. Wolf, Burger's Medicinal Chemistry and Drug Discovery: Therapautic Agents,WileyBlackwell; 5th Edition edition,1997.
2. Ashutosh Kar, Medicinal Chemistry, New Age International Publication, 4th Edition, 2005.

		L	T	P	C
15MOC112	**NATURAL PRODUCTS**	**4**	**0**	**0**	**3**

Objectives:

To learn about nomenclature, Structure and physiological action of Alkaloids, steroids, trepans, carbohydrates Classification, structural elucidation by chemical degradation and synthesis of camphor.

UNIT I Alkaloids 12

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants.

UNIT II synthesis of Alkaloids 12

Structure, stereochemistry, synthesis of the following: Ephedrine, Atropine, Quinine and Morphine.

UNIT III Steroids 12

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon, stereochemistry, isolation, structure determination and interconversions of steroids.Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone and bio synthesis of cholesterol

UNIT IV Terpenoids 12

Terpenoids-Classification, Isoprene rule, Structural elucidation by chemical degradation and synthesis of camphor, Squalene, and Abetic acid.

UNIT V Carbohydrates 12

Carbohydrates –Oligosaccharides, trisaccharides glycosides. Structural Elucidation of Starch and cellulose, Primary concept.

TOTAL: 60 hours

Outcomes:

- To know the basic classification and role of alkaloids
- To learn the structural elucidation and degradation of alkaloids
- To gain knowledge about the synthesis and structure of alkaloids
- To know about the stereochemistry of alkaloids
- To understand the isolation and structural determination of alkaloids
- To learn about terpenoids and its classification
- To study isoprene rule
- To elucidate the structure of camphor
- To study about squalene and abetic acid

- To learn carbohydrates and its types
- To elucidate the structure of starch and cellulose

TEXT BOOKS:

1. R.O.C. Norman, Chapman and Hall, Principles of Organic Synthesis, London, 1980.
2. E.S. Gould, Structure and mechanism in Organic Chemistry, Henry Holt and Co. New York, 1957.
3. Francis A. Carey and Richard J. Sundberg, Advanced Organic Chemistry-Part B, 3rd Edition, 1990.
4. S.M. Mukherji and S.P. Singh, Organic Reaction Mechanism, Macmillan India Ltd., 1990.

REFERENCE BOOK:

1. Michael. B. Smith, Organic Synthesis, Elsevier Inc, Third Edition, 2010.

L T PC

15MOC113 CHEMICAL&INSTRUMENTAL METHODS OF DRUG ANALYSIS 4003

Objectives:

To learn the basic theory of – Beer Lambert's law – limitations of the law, Differential Thermal Analysis and Differential Scanning Calorimetry, Molecular vibration, instrumentation and mechanics of measurement and Applications of NMR spectrometry in characterization of chemical structure using spectra of simple organic compound.

UNIT I UV-visible Spectrophotometry 12

Theory – Beer Lambert's law – limitations of the law, Design and working of single beam and double beam spectrophotometry. Applications of UV absorption spectrometry in qualitative analysis and quantitative analysis.

UNIT II Differential Thermal Analysis 12

Differential Thermal Analysis and Differential Scanning Calorimetry. Polymorphism/XRD – analysis.

UNIT III IR-Spectrometry 12

Theory - Molecular vibration, instrumentation and mechanics of measurement – sample preparation –IR Spectrometry,. FTIR and use in structural elucidation .

UNIT IV NMR Spectrometry 12

Theory, spin-spin coupling, chemical shift, magnetic equivalence – spin-spin decoupling – shift reagents instrumentation. Applications of NMR spectrometry in characterization of chemical structure using spectra of simple organic compound as examples. Principles, Instruments and applications of C^{13} NMR.

UNIT V Mass Spectrometry 12

Theory, fragmentation pattern, ionization techniques; electron bombardment, chemical ionization, field desorption, fast atom bombardment. Different analysers, Interpretation of mass spectra, Determination of molecular weight and molecular formula and applications of mass spectrometry

TOTAL: 60 hours

Outcomes:

- To learn to Apply various analytical techniques to drug analysis and control, e.g. spectroscopic, chromatographic, etc
- To know various analytical methods assessing the purity of formulations
- To gain knowledge about the synthesis and structure of alkaloids
- To know stability of pharmaceutical products, active ingredients, excipients and compounds like preservatives, taste and smell improving agents
- To learn to examine the reliability of various techniques in Pharmaceutical Analysis, including statistical processing
- To demonstrate an understanding of the theory and applications of the most common basic methods of pharmaceutical analysis (NMR spectroscopy, protein x-ray crystallography, mass spectrometry, CD spectroscopy, Atomic Absorption, and chromatographic techniques, GLC, HPLC and HPLC-MS, and computational methods to drug analysis)
- To provide an understanding of and skills in advanced methods of separation and analysis
- To provide practical experience in selected instrumental methods of analysis
- To extend skills in procedures and instrumental methods applied in analytical tasks
- To expand skills in the scientific method of planning, developing, conducting, reviewing and reporting experiments

TEXT BOOKS:

1. Y. R. Sharma, Elementary Organic Absorption Spectroscopy, S. Chand & Co., 2nd edition New Delhi,1996.
2. Robert M.Silverstein, Clayton Bassler and Terence C.Morril, Spectrophotometric Identification of Organic Compounds, 6th Edition, John Wiley & Sons,New York, 2002.

REFERENCE BOOKS:

1. A.H.Beckett and J.B.Stenlake, Practical Pharmaceutical Chemistry, Part-I and II, the Athlone Press, London, CBS Publisher, Delhi, 4th Edition, 1998.
2. H.H.Willard, L.L.Meritt, J.A.Dean and F.A.Settle, Instrumental Methods of Analysis, Wadsworth, New York, 7thedition, 1986.
3. John R.Dyer, Applications of absorption spectroscopy of Organic Compounds, Prentice Hall, London, 1987.

LT P C

15MOC114 ELECTRO ANALYTICAL AND SEPARATION TECHNIQUES 4 0 0 3

Objectives: To learn about the theory and instruments like Polarography, Adsorption and partition chromatography, High Performance Liquid chromatography, Gas-liquid Chromatography and Thin layer Chromatography application

UNIT I Analytical Techniques 12

Polarography – theory, apparatus, DME, Diffusion, Kinetic and catalytic currents, Current - voltage curves for reversible and irreversible system, qualitative and quantitative applications to inorganic systems

UNIT II Amperometric titrations 12

Amperometric titrations – theory, apparatus, types of titration curves, successive titrations and indicator electrodes – Applications. Cyclic voltammetry - theory, application to inorganic systems-Coulometry.

UNIT III Introduction to Chromatography 12

Adsorption and partition chromatography, definition of terms, techniques and chemical concept of column, paper, TLC and HPTLC

UNIT IV Separation Technique-I 12

Chromatography: Gas-liquid Chromatography, Principles, Retention Volumes, Instrumentation, Carrier Gas, Columns, Stationary Phase, Detectors, Thermal Conductivity, Flame Ionization, Electron Capture, Application of G.L.C.

UNIT V Separation Technique-II 12

High Performance Liquid chromatography: Scope, Column efficiency, Instrumentation, Pumping Systems, Columns, Column packing, Detectors, Applications. Ionexchange and gel – permeation chromatography.

TOTAL: 60 hours

Outcomes:

- To learn the calculation of the half-cell potential and overall cell potential
- To know how to select the particular solvent for extraction of analytes from complex mixtures
- Develop and design the mobile phase for separation of analytes from the excipient mixture
- To understand the basic principles of various electroanalytical techniques
- To explain the principles of the most important liquid and gas chromatography as well as electro-migration techniques
- To learn some technical knowledge of, and some practical experience with, analyses in gas and liquid chromatography, and in capillary electrophoresis

- To develop skills in procedures and instrumental methods applied in analysis tasks
- To understand principles and their practical application in publications describing chromatography or electro-migration techniques;

TEXT BOOKS:

1. J. Huheey, "Inorganic Chemistry", Harper and Collins, IV Edition, New York, 1983.
2. H.J. Arnikar, "Nuclear Chemistry", Wiley Eastern Co. II Edition, 1987.
3. F.A. Cotton and G. Wilkinson, "Advanced Inorganic Chemistry- A Comprehensive Text" John Wiley and Sons, V Edition, 1998.

REFERENCE BOOKS:

1. K. F. Purcell and J.C. Kot, Inorganic Chemistry, WB Saunders Co., USA, 1977.
2. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, Van Nostrand Co., New York 1974.
3. Lloyd R. Snyder, Joseph J. Kirkland & Joseph L. Glajch, Practical HPLC Method development, 2nd Edition, Wiley Interscience, 2001.

		L	T	P	C
15MOC115	**ENZYME TECHNOLOGY AND RELATED ENTREPRENEURIAL SKILLS**	**4**	**0**	**0**	**3**

Objectives: To know about isolation and purification of enzymes and enzymes catalysis, Kinetics of enzyme catalysed reactions in solution, Immobilization techniques for enzymes and Reactor design and analysis for immobilized enzyme reactors.

UNIT I Basic concepts of Bioinorganic Chemistry 12

Thermodynamics and biology – Basic concepts of structure and functionality – membranes – structure, function transport properties, aspects of electrochemical phenomena – active transport, ionophores, biological energy storage and Phosphate hydrolysis.

UNIT II Enzymes 12

Essential and trace metal ions.Coenzymes – Vitamin B coenzymes, carboxy peptidase and Superoxide dismutase. Heme – enzyme – Peroxidase and catalases.

UNIT III Heme Proteins 12

Oxygen carriers – Hemeproteins – Hemoglobin, myoglobin – Structure Oxygenation and Stereochemistry – Bohr effect. Non-heme oxygen carriers – Hemerythrin and hemocyanin-Iron storage and transport proteins.

UNIT IV Nitrogen fixation and biological redox reactions 12

Nitrogen fixation – Introduction, types of nitrogen fixing micro organisms. Nitrogenase enzyme – Metal clusters in nitrogenase – redox property – Dinitrogen complexes – transition metal complexes of dinitrogen – nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia. Biological redox systems:Cytochromes – Classification, cytochrome a, b and c Cytochrome P-450. Iron – sulphur proteins – rubredoxin and ferredoxin. Photosynthesis and chlorophyll's.

UNIT V Bio analytical Chemistry 12

Bio analytical Chemistry,Toxicity & medicine,Toxicity of Hg, Cd, Zn, Pb, As, Sb,Anti cancer agents,Metal ion poisoning: Failure of metal ion control systems, role of metal ion Diagnosis and treatment – use of radio isotopes,Pollution studies: Effluents and treatment Inorganic plant nutrition and indicator plants for mineral exploration.

TOTAL: 60hours

Outcomes:

- To describe carbohydrate structure on the mono-, oligo-, and polysaccharide organisational levels
- To describe the biosynthesis and enzymatic degradation of biomass carbohydrates important in industrial processes and products
- To describe lignin structure, biosynthesis, and enzymatic degradation
- To explain the key structural and energetic factors which give rise to increased enzyme stability important for industrial application
- To summarize current processes involved in industrial enzyme production, from protein production to purification and formulation
- To describe methods for selection and optimisation of industrial enzymes using genetic and biochemical techniques
- To describe the priciplesprinciples and methods of metabolic engineering of (micro)organisms to produce industrial chemicals
- To compare and contrast the historical uses of enzyme technology with current applications in a diverse range of industries

TEXT BOOKS:

1. K.F. Purcell, and J.C. Kotz, Inorganic Chemistry the University of Michigan, 2010.
2. G. N. Mugherjee and Arabinda Das, Elements of Bioinorganic Chemistry, U. N. Dhur & Sons Pvt. Ltd., 1993.
3. M. Satake and Y. Mido, Bioinorganic Chemistry, Discovery Publishing House, New Delhi, 1996.

REFERENCE BOOKS:

1. G. Eichron, “Inorganic Bio-chemistry”, Vol. I and II, Elsevier, 1973.
2. J. Huheey, “Inorganic Chemistry”, Harper and Collins, IV Edition, New York, 1983.

		L T P C
15MOC116	**NOVEL MATERIALS AND GREEN INDUSTRIAL CATALYSIS**	**4 0 0 3**

Objectives: To learn about some important functional materials and novel materials, properties of metallic clusters, characterization techniques, catalysts in chemical transformation of functional and novel materials.

Unit 1 Introduction to Functional and Nanomaterials 12

An overview-, materials, molecular materials, functional materials, nanomaterial's classification /properties and industrial applications.

Unit II Properties of Metallic clusters 12

Supported metallic clusters, Catalysts preparation method, physical and chemical properties. Catalysis mechanism uses and synthetic applications

Unit III Characterization 12

Tools for Structural Characterization of novel materials by UV-Visible spectroscopy, Infrared spectroscopy, Nuclear magnetic resonance spectroscopy and mass spectrum

Unit IV Metal Oxides 12

Various types of Metal oxides and basic concept of metal oxides, Supported metal oxides, Industrial catalysis (Synthesis Gas and Hydrogen).

Unit V Catalysts in chemical transformation 12

Ammonia Synthesis, Methanol and Fischer – Tropsch Synthesis, Hydrocarbon Transformations, Environmental Catalysis.

TOTAL: 60hours

Outcomes:

- To demonstrate the understanding of materials, their classifications and applications
- To understand the Basics of metallic clusters, preparation, properties and applications of metallic clusters
- To study the application of different types of spectroscopy
- To visualize the metal oxides and the basic concept of metal oxides
- To understand the industrial catalysis processes
- To know synthesis gas and hydrogen
- To get a clear knowledge about synthesis of ammonia, methanol

- To understand Fischer – Tropsch Synthesis process
- To get a clear idea about environmental catalysis and hydrocarbon transformations

TEXT BOOK:

1. Harry R. Allcock, Introduction to Materials Chemistry, Wiley Interscience Publisher.

REFERENCE BOOK:

1. Bradley D. Fahlman, Materials Chemistry 2nd ed. Springer Publisher, 2011.

		L	T	P	C
15MOC117	**PHARMACEUTICAL FORMULATION TECHNOLOGY - II**	**4**	**0**	**0**	**3**

Objectives:

To learn about basic principles of Pharmaceutical Formulation Technology. To learn about the standard pharmaceutical practice, role of microbiology in formulations, pilot plant manufacturing and entrepreneurial aspects.

Unit I Standard Pharmaceutical Practice 12

Pharmacopoeias; Formularies; Pharmaceutical calculations and prescriptions; Preparations-oral, external, ocular; New drug delivery system; Radio isotopes.

Unit II Role of microbiology in formulations 12

Principles; Disinfection; Sterilization, microbial contamination and control; Sterility testing; Antibiotics; Blood products and plasma substitutes.

Unit III Pilot plant manufacturing 12

Pilot plant techniques and objectives; Personnel requirement; GMP perspectives; Analytical method transfer to quality assurance; Mixing/Blending; Drug uniformity; Excipient uniformity;

Unit IV Manufacturing Techniques 12

Wet granulation, binder addition, drying and milling, dry blending and compression, milling and tablet compression; Coating techniques; Contract manufacture;

Unit V Entrepreneurial aspects 12

Concept of entrepreneurship; Competency and functions of entrepreneur; Women entrepreneurs; Entrepreneurship vis-à-vis Intrapreneurship; Small business management; Role of entrepreneurship in economic development

TOTAL: 60hours

Outcomes:

- To know about pharmacopoeias, their classifications and applications
- To understand the new drug delivery system
- To study radioactive isotopes
- To familiarize the microbial contamination and control; Sterility testing
- To understand the principles of sterilization and disinfection
- To get a clear knowledge Pilot plant techniques and objectives and personnel requirements
- To understand analytical method transfer to quality assurance and Mixing/Blending
- To get a clear idea about Drug uniformity and Excipient uniformity
- To study wet granulation, binder addition and drying, milling
- To understand Competency, functions of entrepreneur and women entrepreneurs

TEXT BOOK:

1 S. K. Jain and V. Soni, Bentley's Textbook of Pharmaceutics, An Adaptation- Elsevier, 2012.

REFERENCE BOOK:

1. C. B. Gupta and S. S. Khanka, Entrepreneurship and Small Business Management, Sultan Chand & Sons, New Delhi, 2012.

		L	T	P	C
15MOC118	**ELECTROCHEMISTRY AND GROUP THEORY**	**4**	**0**	**0**	**3**

Objectives:

To learn about Mean ionic activity and mean ionic activity coefficient, Electrode, Symmetry elements and Character table- Construction of Character table for C_{2V} and C_{3V} point group.

UNIT I Electro Chemistry-I 12

Mean ionic activity and mean ionic activity coefficient – concepts ionic strength. Nernst equation- redox system- electrochemical cell- Electrolytic conductance- Kohlraush's law and its applications, ionic equlibria. Debye- Huckel theory of strong electrolytes – Determination of activity coefficient by electrical method –Debye-Huckel limiting law qualitative and quantitative verification – Limitation of Debye –Huckel theory at appreciable concentration – Huckel equation – Debye- Huckel –Bronsted equation.

UNIT II Electro Chemistry-II 12

Electrode –electrolyte interface – adsorption at electrified interface- electrical double layer – Electrocapillary phenomenon – Lippmann Equation – Structure of double layers – Helmholtz – Perrin- Guoy-Chapman and Stern model of electrical double layers.Mechanism of electrode reaction – Polarisation and overpotential – the Butler Volmer equation for one step and multi

step electron transfer reaction – Significance of exchange current density and symmetric factor-transfer coefficient and its significance – Mechanism of the hydrogen and oxygen evolution reactions.

UNIT III Group Theory- I 12

Symmetry elements and symmetry operations – Mathematical rules for the formation of a group- Definition and classification of Point groups – Identification and determination – Matrix representations- Reducible and irreducible representations- Similarity transformation - Orthogonality theorem and its consequences.

UNIT IV Group theory-II 12

Character table- Construction of Character table for C_{2V} and C_{3V} point group. Determination of symmetry of hybrid orbitals-Symmetry of hybrid orbitals in non linear molecules (H_2O,CH_4,XeF_4,BF_3,SF_6 and NH_3).

UNIT V Group theory-III 12

Molecular vibrations -Direct product representation-Determination – IR and Raman activity of vibrational modes in non linear molecules (H_2O, CH_4,XeF_4,BF_3,SF_6 and NH_3). Mutual exclusion principle. Symmetry selection rules of infrared and Raman Spectra. Selection rules for electronic transitions. Symmetry of molecular orbitals and electronic states of HCHO. Selection rules for electronic transitions of HCHO.

TOTAL: 60 hours

Outcomes:

- To learn concept of ionic activity and ionic strength
- To derive Nernst equation and redox system
- To study Debye Huckel theory, Kohlraush's law and Debye- Huckel –Bronsted equation
- To learn Electrode –electrolyte interface and electrical double layer, Electrocapillary phenomenon
- To derive Lippmann Equation, Helmholtz – Perrin, Guoy-Chapman and Stern model of electrical double layers
- To study the mechanism of electrode reaction and the Butler Volmer equation
- To learn mathematical rules for the formation of a group and Point groups
- To Construct the Character table for C_{2V} and C_{3V} point group and to determine the symmetry of hybrid orbitals
- To study the molecular vibrations
- To determine IR and Raman activity of vibrational modes in non linear molecules
- To study the symmetry selection rules of infrared and Raman Spectra and rules for electronic transitions

TEXT BOOKS:

1. Ramakrishnan and M.S Gopinathan, Group Theory in Chemistry, Vishal Publishing Co., 1988.
2. K.V.Raman, Group theory and its applications to Chemistry, Tata McGrowHill, 1990.

REFERENCE BOOKS:

1. J.O.M.Bokris & A.K.N.Reddy, Electrochemistry, Plenum, New York,Vol 1 & 2, 1977.
2. P. Delahay, Electrode kinetics & Structure of double layer, Interscience, New York,1965
3. Robbins, Ions in solution, An introduction in electrochemistry, Clarendon press, Oxford, 1993.

		L	T	P	C
15MOC119	**STRATEGIC MANAGEMENT OF PHARMA INDUSTRY**	**4**	**0**	**0**	**3**

Objectives:

To know about Pharma industry-Specifics, Importance and role in health sector, the Global scenario and Positioning of Indian Pharma industry, technology opportunity for innovation, project evaluation, intellectual property protective and business strategy.

Unit I Introduction and Technology Evolution 12

Pharma industry-Specifics, Importance and role in health sector; the Global scenario and Positioning of Indian Pharma industry; Specific challenges of the Pharma industry versus the general industrial matrix; Understanding technological change; Need for technology strategy as step towards innovation and competitive advantage; Defining technological innovation and benefits. Technology S-curves and management; Number of firms in the industry, Process obsolescence and Reverse Engineering; Innovative synthetic routes and atom economy dovetailing aspects of Green chemistry; Technology adoption and diffusion; Forecasting demand and confronting substitution.

Unit II Opportunity for Innovation 12

Technological, Political and Regulatory changes, Diversification, Demographic changes; Research and Development (R&D); Investment in R&D and return on investment – a profit centre; Linking of Research and Development for leverage; Cost reduction exercises.

Unit III Project evaluation 12

Managing uncertainty, Analytical hierarchy process, Net Present Value(NPV), Internal Rate of Return(IRR), scenario analysis and decision tree; Portfolio Management, customer-friendly solutions; Product pricing ; Market segmentation and market research.

Unit IV Intellectual Property Protection 12

Role of IP protection in knowledge era; Patents- process and Product and the patenting process; Lead molecule development and cost; ANDA; Patent litigation; Non-disclosure agreement; Expiry of patents and generic drugs marketing and issues in IP.

Unit V Business strategy 12

Networking; Joint venturing; Licensing; Contract manufacturing; Outsourcing; Human resource management of technical professionals- R&D personnel, Product Development team, Cross-Functional team, Internal communication, Organization structure- decentralizing R&D, acquisitions.

TOTAL: 60 hours

Outcomes:

- To study the importance and role in health sector and the Global scenario and Positioning of Indian Pharma industry
- To learn the Specific challenges of the Pharma industry versus the general industrial matrix and to understand the technological change
- To learn the process of obsolescence and Reverse Engineering and dovetailing aspects of Green chemistry
- To know the Technological, Political and Regulatory changes and Research and Development (R&D)
- To study the Analytical hierarchy process, Net Present Value(NPV), Internal Rate of Return(IRR), scenario analysis and decision tree
- To familiarize the Market segmentation and market research
- To understand the role of IP protection in knowledge era and patents
- To learn networking, Joint venturing and Licensing
- To know Contract manufacturing, Outsourcing and human resource management of technical professionals
- To get an idea about team, Internal communication, Organization structure and decentralizing R&D

TEXT BOOK:

1. Scott Shane, Technology Strategy for Managers and Entrepreneurs, Dorling Kindersley India Pvt. Ltd, 2009.

REFERENCE BOOK:

1. C.B.Gupta and S.S.Khanka, Entrepreneurship and Small Business Management-, Sultan Chand & Sons, New Delhi, 2012.

		L	T	P	C
15MOC120	**ELECTROCHEMISTRY AND SPECTROSCOPY**	**4**	**0**	**0**	**3**

Objectives: To know about mean ionic activity and mean ionic activity coefficient, Electrode –electrolyte interface, Interaction of matter with radiation and Equation of motion of spin in magnetic fields –Chemical shift – spin-spin coupling –NMR of simple AX and AMX type molecules.

UNIT I Electro Chemistry-I **12**

Mean ionic activity and mean ionic activity coefficient – concepts ionic strength. Nernst equation- redox system- electrochemical cell- Electrolytic conductance- Kohlraush's law and its applications, ionic equlibria. Debye- Huckel theory of strong electrolytes – Determination of activity coefficient by electrical method –Debye-Huckel limiting law qualitative and quantitative verification – Limitation of Debye –Huckel theory at appreciable concentration – Huckel equation – Debye- Huckel –Bronsted equation.

UNIT II Electro Chemistry-II **12**

Electrode –electrolyte interface – adsorption at electrified interface- electrical double layer – Electrocapillary phenomenon – Lippmann Equation – Structure of double layers – Helmholtz – Perrin- Guoy-Chapman and Stern model of electrical double layers.

UNIT III Electro Chemistry-II **12**

Mechanism of electrode reaction – Polarisation and overpotential – the Butler Volmer equation for one step and multi step electron transfer reaction – Significance of exchange current density and symmetric factor-transfer coefficient and its significance – Mechanism of the hydrogen and oxygen evolution reactions.

UNIT IV Spectroscopy-I **12**

Interaction of matter with radiation – Einstein's theory of transition probability – rotation spectroscopy of a rigid rotor – non- rigid rotor – di atomic and poly atomic molecules. Vibrational spectroscopy – harmonic Oscillator – anhormonicity – Vibrational spectra of poly atomic molecules- Vibrational frequencies - group frequencies – Vibrational coupling overtones – Fermi resonance. Raman Spectra.

UNIT V Spectroscopy-II **12**

Equation of motion of spin in magnetic fields –Chemical shift – spin-spin coupling –NMR of simple AX and AMX type molecules –calculation of coupling constants- ^{13}C, ^{19}F, ^{31}P NMR spectra – applications – a brief discussion of Fourier transform resonance Spectroscopy.

TOTAL: 60hours

Outcomes:

- To learn concept of ionic activity and ionic strength
- To derive Nernst equation and redox system

- To study Debye Huckel theory, Kohlraush's law and Debye- Huckel –Bronsted equation
- To learn Electrode –electrolyte interface and electrical double layer, Electrocapillary phenomenon
- To derive Lippmann Equation, Helmholtz – Perrin, Guoy-Chapman and Stern model of electrical double layers
- To study the mechanism of electrode reaction and the Butler Volmer equation
- To understand interaction of matter with radiation and Einstein's theory of transition probability
- To learn rotation spectroscopy of a rigid rotor and non- rigid rotor
- To derive the Equation of motion of spin in magnetic fields and Chemical shift
- To study the spin-spin coupling, NMR of simple AX and AMX type molecules

TEXT BOOKS:

1. S. Glasstone, "Introduction to Electrochemistry", Affiliated East West Press, New Delhi, 1960.
2. D. R. Crow, "Principles and Applications to Electrochemistry", Chapman and Hall, 1991.

REFERENCE BOOKS:

1. P. H. Rieger, Electrochemistry, chapman and hall, New York, 1994.
2. G. Aruldas, Molecular Structure and spectroscopy, Prentice Hall, 2002.
3. G. M. Barrow, Introduction to Molecular Spectroscopy, McGrw Hill, New York, 1962.

Syllabus
Generic Elective Courses
(GE)

		L T P C
15SSK151	**SOFT SKILL I**	**1 0 1 2**

Objectives: The ability to create an open environment for communication. An understanding of other people communication styles and needs. To create an environment for open discussion and ongoing dialogue is crucial for communication success.

Unit I Reading Comprehension and Vocabulary 08

Definitions of reading - types of reading - oral reading – silent reading - reading process - classification of reading - nature of reading - Filling in the blanks - Close Exercises - Vocabulary building - Reading and answering question

Unit II Listening and Answering Question 08

Listening process – speaker – hearer - types of listening - transitional listening -critical listening - recreational listening - listening for appreciation - selective listening - intensive listening- extensive listening - listening and sequencing sentences - filling in the blanks – listening and answering questions

Unit III Group Discussion 08

Introduction - Why GD Part of a selection process - Structure of a GD-Strategies in GD - Team work – body language - Debating various points of views - interaction with peers.

Unit IV Conversations 08

Introducing oneself and others, narrating events - making telephonic conversation - Giving instruction - Giving instruction- Expressing purposes and functions- obligation and preferences, Accepting offers and Counselling Face to face Conversations

Unit V Self – Introduction and Role Pla 08

Introduction self and greetings- asking for information- offerings- requisitions- inviting – vocabulary building- asking for description

TOTAL: 40hours

Outcomes:

- Cloze exercises provide support to build vocabulary
- Sense of logic develops from sequencing sentences
- Group discussion infuses team spirit and sense of competition
- Face to face and telephone conversation builds up self confidence
- Self introduction and role play facilitate cultivation firmness of mind and empathy
- Comprehension enhances creative skills
- Listening regenerates transformation empathetically
- Implementation of assertive thoughts can be acquired through writing skills
- Body language enhances personality grooming
- Reading enhances stylish accent productivity

TEXT BOOKS:

1. Barun K. Mitra, “Personality Development and Soft Skills”. Oxford University Press. New Delhi. 2011.
2. S.P. Sharma, “Personalilty Development”, Pustaq Mahal. New Delhi. 2010.

REFERENCE BOOKS:

1. Meenakshi Raman and Sangeetha Sharma, “Technical Communication”, Oxford University Press. New Delhi, 2009.
2. A.S. Hornby: "Oxford Advanced Learner's Dictionary of Current English", Oxford University Press, 2007

		L T P C
15SSK152	**SOFT SKILL II**	**1 0 1 2**

Objectives: To provide basic information about presentation skill and train the students for letter writing, creation of resume and develop the interview skills. To provide information about the Process, types and patterns of communication.

Unit I Presentation Skills **08**

General presentation methods and developing presentation skill

Unit II Soft skills (Time Management, Stress Management and Body Language) **08**

Time management: Importance, Plan and Execution, Default reason and rectification methods

Stress Management: Stress Impacts over Efficiency and how to manage.

Body Language: Its importance and need

Unit III Resume / Report / Letter Writing **08**

Resume: Basic components of a resume, Preparation of a resume, Types of resume

Report: How to prepare reports, reports components and structure

Letter writing: types of letters, framing letters, basic structure, how to draft a letter

Unit IV Frequently asked Questions **08**

Unit V: Interview Skills **08**

Aims of Interview expectations and how to fulfill, developing skills

TOTAL: 40hours

Outcomes:

- Self introduction and role play facilitate cultivation firmness of mind and empathy
- Group discussion infuses team spirit and sense of competition
- Listening regenerates transformation empathetically
- Cloze exercises provide support to build vocabulary
- Implementation of assertive thoughts can be acquired through writing skills
- Body language enhances personality grooming
- Reading enhances stylish accent productivity
- Face to face and telephone conversation builds up self confidence
- Sense of logic develops from sequencing sentences
- Comprehension enhances creative skills

TEXT BOOKS:

1. Barun K. Mitra, "Personality Development and Soft Skills". Oxford University Press. New Delhi. 2011.
2. S.P. Sharma, "Personalilty Development", Pustaq Mahal. New Delhi. 2010.

REFERENCE BOOKS:

1. Meenakshi Raman and Sangeetha Sharma, "Technical Communication", Oxford University Press. New Delhi, 2009.
2. A.S. Hornby: "Oxford Advanced Learner's Dictionary of Current English" Oxford University Press, 2007

		L T P C
15MOC151	**GREEN CHEMISTRY**	**2 0 0 2**

Objectives: To train the students to use eco-friendly approaches in synthesizing agro-based chemicals viz. insecticides, fungicides, herbicides, bactericides acaricides, weedicides. To emphasize green chemistry approach in crop protection which help to reduce global warming.

Unit I Introduction 08

Current status of chemistry and the Environment-Evolution of the Environmental movement: Public awareness - Dilution is the solution to pollution-Pollution prevention

Unit II Green Chemistry 08

Definition – Principles of Green Chemistry - Why is this new area of Chemistry getting to much attention - Why should chemist pursue the Goals of Green Chemistry - The roots of innovation – Limitations

Unit III Green Chemistry using Bio Catalytic Reactions 08

Introduction - Fermentation and Bio transformations - Production of Bulk and fine chemicals by microbial fermentation- Antibiotics – Vitamins - Bio catalyses synthesis of industrial chemicals by bacterial constructs - Future Tends.

Unit IV Green House Effect and Global Warming 08

Introduction - How the green house effect is produced - Major sources of green house gases - Emissions of CO_2 - Impact of green house effect on global climate - Control and remedial measures of green house effect - Global warming a serious threat - Important points

Unit V Future Trends in Green Chemistry 08

Green analytical methods, Redox reagents, Green catalysts; Green nano-synthesis, Green polymer chemistry, Exploring nature, Biomimetic, Proliferation of solvent-less reactions; Non-covalent derivatization, Biomass conversion, emission control.

TOTAL: 40hours

Outcomes:

- To understand the connection between common atoms and complex molecules
- To explain and analysing simple chemical reactions
- To distinguishing between recyclable and non-recyclable materials
- To assessing the potential impact of chemical reactions to environment and human health
- To understand the connection at the chemical level between all matter and will develop your inquiry based activities to explore best practices related to organic farming and resource management.
- To about the advance technology in green chemistry
- How they impact the human body, to develop your particular interests on the topic.
- To describe how Green chemistry and sustainability developments affect society, the environment and economic development
- To explain how Green chemistry and sustainability relates to problems of societal concern

TEXT BOOKS:

1. M. Lancaster, "Green Chemistry: an Introductory Text", RSC, 2002
2. Sheldon, Arends, Hanefeld, "Green Chemistry and Catalysis", Wiley, New York, 2007

REFERENCE BOOKS:

1. Anastas & Warner, Green Chemistry : Theory & Practice ,Oxford Univ. Press,New York, 1998
2. S. E. Park, J. S. Chang, S. H. Jhung, "The Role of Catalyst for Green Chemistry", Chemworld, Vol. 44 (8), 38, 2004

		L T P C
15MOC152	**CHEMINFORMATICS**	**2 0 0 2**

Objectives: Students completing this paper should be able to understand concepts of molecular chemistry that are basic to cheminformatics. This course will train the students to use QSAR, docking etc.

Unit I Mathematics Process **08**

Graph theory and molecular numerology; Logic, sets and functions; Algorithms, integers and matrices; Mathematical reasoning, induction and recursion; Counting; graphs, trees and sets, basic probability and statistics; Markov processes

Unit II Basics of Stereochemistry **08**

Basic Stereochemistry, Amino acids and Proteins and Properties; pKa, pH and ionization of acids and bases; Protein structure - Primary structure, Secondary structure - helix & sheet; Tertiary structure; Quaternary structure; covalent and non-covalent forces that maintain structures.

Unit III Chem Information **08**

History of scientific information communication-chemical literature-chemical information-chemical information search-chemical information sources-chemical name and formula searching-analytical chemistry-chemical history-biography-directories and industry sources

Unit IV Biological Databases **08**

Introduction; Experimental sources of biological data; Publicly available databases; Gene expression monitoring; Genomics and Proteomics; Metabolomics; Visualisation of sequence data; Visualization of structures using Rasmol or SPDB Viewer or CHIME; Genetic basis of disease; Personalised medicine and gene-based diagnostics.

Unit V Drug Design **08**

Introduction to drugs, structure-based drug design. QSAR and 3D-QSAR Methods. Pharmacophore Design, Ligand-Based Design and De Novo Drug Design Virtual screening/docking of ligands. Protein structure, Drug action & enzymes. Drug action & receptors. Prediction of Binding Modes, Protein–Ligand binding free energies, Fragment-Based Drug Design, ADMET prediction.

TOTAL: 40hours

Outcomes:

- To understand basis of group theory and its applications
- To study Logics, sets and functions
- To get a clear idea on the principles and theories of algorithms, induction Basics and process photosynthesis
- To understand the Basics of stereochemistry and structure of proteins
- To study History of science and chemical information
- To discuss the biological database and Gene expression
- To visualize the structure of different biological structures
- To understand the genetic basis of diseases

- To get a clear knowledge about drugs and their structure and functions
- To study drug actions and enzymes

TEXT BOOKS

1. P. Shanmughavel, “Principles of Bioinformatics”, Pointer publishers, 2005.
2. Arfken, "Mathematical Methods for Physicists" Academic Press, 1985

REFERENCE BOOKS

1. P. Shanmughavel, “Trends in Bioinformatics”, Pointer publishers, 2006.
2. Francis A. Carey and Richard J. Sundberg, “Advanced Organic Chemistry-Part A & B” Third Edition, 1990.

		L T P C
15MOC153	**INTRODUCTION TO NANOSCIENCE & NANOTECHNOLOGY**	**2 0 0 2**

Objectives: Impart the basic knowledge on nanoscience and technology. Understand the various process techniques available for the processing of nanostructured materials. Impart knowledge on the exotic properties of nanostructured materials at their nanoscale lengths. Acquire the knowledge above the various nanoparticles process methods and their skills. Study the reactive merits of various process techniques.

Unit I Introduction 08

Definition of a nano system – Basic concepts of nanoscience and technology - Scientific revolutions of nanotechnology - atomic & molecular size – Time and length at nanoscale - Scope of nanoscience and technology – Commercial Applications of Nanotechnology.

Unit II Nanostructures and Dimensions 08

Definition of Nanostructure materials - Classification of nanostructures - zero, one, two and three dimensional nanostructures. Size Dependency in Nanostructures -quantum size effects in nanostructures.

Unit III Nanomaterial Synthesis 08

Synthesis of nanomaterials - top down and bottom up approach -Method of nanomaterials preparation – Physical methods – Inert gas condensation and evaporation, chemical synthesis - sol-gel and chemical reduction – Biological methods – nanoparticles using plant extracts, bacteria, fungi etc.

Unit IV Nanomaterial Properties 08

Surface properties of nanoparticles - Surface to volume ratio- mechanical - optical, - electronic – magnetic - thermal and chemical properties of nanomaterials. Size dependent properties-size dependent absorption spectra - self-assembly in nanotechnology - Types of SAMs, Methods of self-assembly, Applications of self assembled monolayers

Unit V Applications of Nanomaterials 08

Applications of metal nanoparticles in technologically imperative fields like sensors, Nanomaterials for energy storage - Batteries and fuel cells - photovoltaic devices -solar cells optical memory devices - Quantum nanoelectronic devices -quantum computing.

TOTAL: 40 hours

Outcomes:

- To learn about the definition of a nano system and the basic concepts of nanoscience and technology
- To understand the Scientific revolutions of nanotechnology
- To know about the Scope of nanoscience and technology and commercial applications of Nanotechnology
- To familiarize the Classification of nanostructures, Size Dependency in Nanostructures and quantum size effects in nanostructures
- To learn about the Synthesis of nanomaterials
- To learn the surface properties of nanoparticles
- To know about the Methods of self-assembly and applications of self assembled monolayers
- To know the detail study of Applications of metal nanoparticles in technologically imperative fields

TEXT BOOKS:

1. C. P. Poole and J.F. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2003.
2. M. A. Ratner. and D. Ratner, "Nanotechnology: A Gentle Introduction to the Next Big Idea", Prentice Hall PTR, First Edition, 2002.
3. T. Pradeep, "Nano: The Essential Nanoscience and Nanotechnology", Tata McGraw hill, 2007.

REFERENCE BOOKS:

1. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications", Imperial College Press, 2004
2. C. N. R. Rao, A. Muller and A. K. Cheetham, "The Chemistry of nanomaterials: Synthesis, Properties and Applications", Wiley-VCH verlag GmBH & Co.KGA, 2004.

		L	T	P	C
15MOC154	**FOOD CHEMISTRY AND ADULTERATION**	**2**	**0**	**0**	**2**

Objectives: To understand the basic information of food chemistry and adulteration. To appreciate the importance of food additives and pesticide control. To provide an information about food preservatives.

Unit I Introduction **08**

Food: source, functions of food – food groups – food guide – basic five food groups, usage of the food guide – food in relation to health – objectives of cooking.

Water: Purification processes – Ion exchangers, reverse osmosis, activated charcoal treatment - Use of chlorination, ozone, and UV light disinfection. Specification of drinking water.

Unit II Constituents of Foods **08**

Carbohydrates: Classification, Principles involved in the analysis of carbohydrates – estimation of carbohydrates.

Proteins: amino acids – peptides - Analysis of proteins – Separation of amino acids by paper chromatography.

Minerals and vitamins: Sources, functions, deficiency of the following minerals (calcium, iron, iodine, fluorine, sodium and potassium (elementary treatment). Vitamins - classification, sources, Vitamins – A, D, E and K, C, B Complex, - B6 & B12.

Unit III Food Additives 08

Artificial sweeteners – saccharin, cyclomate, asparatame – food flavours – esters, aldehydes and heterocyclic compounds. Antioxidants. Food colours – changes in cooking..Restricted use. Spurious colours. Emulsifying agents, preservatives – leavening agents. Baking powder –Yeast. Taste enhancers – MSG-vinegar

Unit IV Pesticides Control 08

Spoilage of foods by insects and pests, loss in food quantity and quality Various pesticides used in agriculture and post-harvest storage, uses of pesticides for food grain application.

Unit V Food Adulteration 08

Common adulterants in different foods – milk and milk products, vegetable oils, and fats, spices and condiments, cereals, pulses, sweetening agents and beverages. Contamination with toxic chemicals – pesticides and insecticides. .

TOTAL: 40hours

Outcomes:

- To know about the basic criteria of food and water standards for consumption
- To get a basic idea about the chemical constituents of food
- To learn about the various food additives, their chemical composition and their permissible level of usage in foods.
- To know about the various organisms which spoil the crops pre and post harvest and their control using pesticides
- To know about the various food adulterants for different types of food and methods to detect those adulteration.

TEXT BOOKS

1. Owen R Fennema, “Food Chemistry”, Marcel Decker Inc., New York. 1996.
2. M. Swaminathan “Text Book on Food chemistry”, Printing and Publishing CO., Ltd. 1993.

REFERENCE BOOKS

1. B. Siva Sankar, “Food Processing and Preservatio”, Prentice – Hall of India Pvt. Ltd., New Delhi. 2002.
2. S. Ramakrishnan, K. G. Prasannam, R. Rajan, ”Principles - Text book of medical biochemistry”, Orient Longman Ltd. Third Edition, 2

		L T P C
15MOC016	**PROJECT WORK/REVIEW OF JOURNALS**	**0 0 22 8**

Objectives: To learn about the concept of project work. To know about designing new experiments and carry out the experiments. To know about the various characterization techniques used to characterize the synthesized compounds. To know about the necessities of literature survey and to learn about writing dissertation of project work.

Project Work/ Review

NOTE

1. Review of Chemical literature and documentation.
2. During the fourth semester the project work may be carried out either in industries/ National laboratories/R & D centers/in the university lab.

Outcomes:

- To identify the topic with the consideration feasibility.
- To learn the procedure of literature survey of the concered topic.
- To derive a plan for executing the work in the stipulated time with maximum efficiency and success.
- The intensive exposure to industry as a first time experience.
- Understanding different sectors of an industry and the functionaries of each sector.
- The importance of R&D section and the key role
- Understanding and learning various technical and safety aspects of the concerned topic related work.
- To learn the difference between conventional department laporatory and its nature of work and R & D laboratory of research instistitue or industry.
- To learn, adapt, and practice the extensive bench work in a research laboratory or industry.
- To prepare a dissertation report with complete follow up of research methodology.