Vels Institute of Science and Technology and Advanced studies (VISTAS)

M.Sc Organic Chemistry Degree Course

Courses of Study and Scheme of Assessment

(Minimum Credits to be earned: 90)

M.Sc Organic Chemistry Course Components

Component	**I Sem**	**II Sem**	**III Sem**	**IV Sem**	**Total Credits**
Core Courses	14	16	14	16	60
Discipline Specific Elective(DSE	8	4	8	-	20
Skill enhancement Course(SEC)	2	2	2	-	6
SI	-	0	2	-	2
GE	-	-	-	2	2
Total Credits	**24**	**22**	**26**	**18**	**90**

M.Sc. Organic Chemistry CURRICULUM
Total number of Credits: 90

			Hours/Week				Maximum Marks		
		SEMESTER 1							
	Code No	Course	Lecture	Tutorial	Practical	Credits	CA	SEE	TOTAL
Core	21CMSO11	Organic Chemistry – I	4	0	0	4	40	60	100
Core	21CMSO12	Inorganic Chemistry– I	4	0	0	4	40	60	100
Core	21CMSO13	Physical Chemistry-I	4	0	0	4	40	60	100
Core	21PMSO11	Organic Chemistry Practical I – Practical I	0	0	4	2	40	60	100
DSE		Discipline Specific Elective -1	4	0	0	4	40	60	100
DSE		Discipline Specific Elective -2	4	0	0	4	40	60	100
SEC		Soft Skill I/Sector Skill Course	2	0	0	2	40	60	100
			22	**0**	4	**24**			
		SEMESTER II							
Core	21CMSO21	Organic Chemistry – II	4	0	0	4	40	60	100
Core	21CMSO22	Analytical Techniques	4	0	0	4	40	60	100
Core	21CMSO23	Physical Chemistry-II	4	0	0	4	40	60	100
Core	21PMSO21	Physical Chemistry Practical - Practical II	0	0	4	2	40	60	100
Core	21PMSO22	Inorganic Chemistry Practical - Practical III	0	0	4	2	40	60	100
DSE		Discipline Specific Elective - 3	4	0	0	4	40	60	100
SEC		Soft Skill 2/ Sector Skill Course	2	0	0	2	40	60	100
			18	**0**	**8**	**22**			
		SEMESTER III							
Core	21CMSO31	Organic Chemistry III	4	0	0	4	40	60	100
Core	21CMSO32	Organo metallics and photochemistry	4	0	0	4	40	60	100
Core	21CMSO33	Organic Spectroscopy	4	0	0	4	40	60	100
Core	21PMSO31	Organic Chemistry Practical II - Practical IV	0	0	4	2	40	60	100
DSE		Discipline Specific Elective - 4	4	0	0	4	40	60	100
DSE		Discipline Specific Elective - 5	4	0	0	4	40	60	100
SI	21IMSO31	Internship	0	0	4	2	40	60	100
SEC		Soft Skill 3/ Sector Skill Course	2	0	0	2	40	60	100
			22	**0**	8	**26**			
		SEMESTER IV							
Core	21CMSO41	Synthetic organic chemistry	4	0	0	4	40	60	100
GE		Generic Elective	2	0	0	2	40	60	100
Core	21RMSO41	Project work	0	0	24	12	40	60	100
			6	**0**	**24**	**18**			
		Over all Total	68	**0**	**44**	**90**			

List of Discipline Specific Elective Courses

S.No.	Subject title
1	Separation Techniques
2	Organic name reactions and synthesis of reagents
3	Analytical Techniques
4	Fundamentals of Biochemistry
5	Synthesis of APIs and manufacture
6	Stereo chemistry and reaction mechanism
7	Macromolecular Chemistry
8	Nuclear and photochemistry
9	Bioinorganic Chemistry
10	Pharmaceutical Formulation Technology – I
11	Pharmaceutical Chemistry
12	Natural products
13	Chemical & Instrumental Methods of Drug Analysis
14	Electro analytical and Separation Techniques
15	Enzyme technology and related entrepreneurial skills
16	Novel materials and green industrial catalysis
17	Pharmaceutical Formulation Technology – II
18	Electrochemistry and group theory
19	Strategic Management of Pharma Industry
20	Electrochemistry and spectroscopy

LIST OF SKILL ENHANCEMENT ELECTIVE COURSES (SEC)

S.No.	Subject Title
1.	Soft skill – I
2.	Soft skill – II

LIST OF GENERIC ELECTIVE COURSES (GEC)

S.No.	Subject Title
1.	Green Chemistry
2.	Cheminformatics
3.	Food Chemistry and Adulteration

Syllabus
Core Course

21CMSO11 ORGANIC CHEMISTRY – I 4 0 0 4

Course Objective: 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 12

Optical activity and chirality.Classification of chiral molecules as asymmetric and dissymmetric.Identification of enantiotopic, homotopic, diastereotopichydrogens and prochiral carbons in compounds containing up to ten carbons only.Stereospecific and stereo selective reactions. A brief study of dissymmetry of allenes, spiranes ,biphenyl compounds. 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) Eg.Erythro and threo compounds.Asymmetric synthesis.Crams's rule.Geometrical isomerism. E,Z nomenclature of olefins. Geometrical and optical isomerism (if shown) of disubstitutedcyclopropane, cyclobutane and cyclopentanes.

UNIT-II Aliphatic Nucleophilic Substitution reactions 12

S_N1, S_N2 and S_Ni mechanisms –Neighbouring group participation –reactivity, structural and solvent effects- substitutuion 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, Claisen and Dieckmann condensations.

UNIT-III Aromatic Substitution Reaction – II 12

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

UNIT-IV Aromaticity 12

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

UNIT-V Aromatic Substitution Reaction–I 12

Electrophilic Substitutions-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. Electrophilic substitution of furan, pyrrole, thiophene, pyridine and pyridine -N-oxide.

TOTAL: 60 h

Course 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

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, New Delhi, Fourth edition, 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.

Web Link:

https://chem.libretexts.org/Bookshelves/General_Chemistry/Book%3A_Structure_and_Reactivity_in_Organic_Biological_and_Inorganic_Chemistry_(Schaller)/IV%3A__Reactivity_in_Organic_Biological_and_Inorganic_Chemistry_2/04%3A_Aliphatic_Nucleophilic_Substitution

https://en.wikibooks.org/wiki/Organic_Chemistry/Chirality/Optical_activity#:~:text=Optical%20activity%20describes%20the%20phenomenon,molecules%20through%20which%20it%20passes.

21CMSO12 INORGANIC CHEMISTRY - I 4 0 0 4

Course Objective: To learn about bonding in boranes, 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 12

Boron hydrides: Polyhedral boranes–preparation and structure, carboranes-classification preparation and structure and metallocarboranes-preparation and structure. Metal Clusters: binuclear compounds-preparation and structure, multiple metal-metal bonds Inorganic Polymers: Polysilanes and Silicones. Poly sulphur – nitrogen compounds.

Unit II Reaction Mechanism of Complexes

Kinetics and mechanism of reactions in solution – labile and inert complexes – Ligand displacement reactions in octahedral and square planar complexes – acid hydrolysis, base hydrolysis and anation reactions – trans effect – theory and applications

Unit III Coordination Chemistry 12

Principles - Studies of coordination compounds in solution – detection of complex formation in solution – Stability constants – stepwise and over-all formation constants – simple methods (Potentiometric, pH metric and photometric methods) of determining the formation constants - Factors affecting stability –statistical and chelate effects – Forced configurations.

Unit IV Theories of Coordination 12

Crystal field theory and its limitations, d-orbital splitting, 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.

Unit V Organic Reagents in Inorganic Chemistry 12

Chelation, factors determining the stability of chelates (effect of ring size, oxidation state of the metal, coordination number of the metal); Use of the following reagents in analysis: (a) Dimethylglyoxime (in analytical chemistry) (b) EDTA (in analytical chemistry and chemotherapy) (c) 8-Hydroxyquinoline (in analytical chemistry and chemotherapy) (d) 1,10-Phenanthroline (in analytical chemistry and chemotherapy) (e) Thiosemicarbazones (in analytical chemistry and chemotherapy) (f) Dithiazone (in analytical chemistry and chemotherapy

TOTAL: 60h

Course 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

TEXT BOOKS:

1. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, W.B. Saunders Co., 1977.
2. J.E. Huheey, Inorganic Chemistry Harper & Row publisher, Singapore, 3rd Edition, 1983.
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, A Wiley – Inter science Publication, John –Wiley & Sons, USA, 4th Edition, 2009.

REFERENCE BOOKS:

1. F.Basolo and R.G.Pearson, Mechanism of Inorganic Reactions, John Wiley, New York, 1967.
2. J. E. Huheey, E. A. Keiter, R. L. Keiter and Okhil K Medhi, "Inorganic Chemistry: Principles structure and reactivity",. Pearson Education, 4th Edition, 2011.
3. J. D. Lee, Concise Inorganic Chemistry, 5thEdn. Wiley-India Edition, 2009.

Web Link:

http://web.mit.edu/5.03/www/readings/polyhedral_boranes/006_cluster_bonding.pdf

https://iubmb.onlinelibrary.wiley.com/doi/pdf/10.1016/0307-4412%2877%2990005-X

21CMSO13 PHYSICAL CHEMISTRY-I 4 0 0 4

Course Objective:

- To understand the fundamental aspects of classical thermodynamics and chemical potential.
- To learn the important aspects of statistical thermodynamics and chemical potential. To study the simultaneous reaction, fast reaction, reaction in solution and the effect of temperature on reaction rate.

UNIT – I Classical thermodynamics 12

Definition - Fugacity: Determination of Fugacity- By Graphical method, General method, From equation of state, Approximate calculation method-Variation of Fugacity with temperature and pressure. Fugacity of solids and liquids.The concepts of activity and activity coefficients and their determinations. Influence of temperature and pressure on variation of activity and activity coefficients. **Chemical potential -** Partial molar properties -their significance and determination of these quantities. Variation of chemical potential with temperature and pressure. Alternative definition of chemical potential.

UNIT – II Statistical thermodynamics 12

Concept of thermodynamic probability – distribution of distinguishable and non distinguishable particles. Maxwell – Boltzmann, Fermi – Dirac and Bose- Einstein statistics- Comparison - Partition function –Partition function and thermodynamic function,vmolar partition function, third law of thermodynamic and partition function application of partition function to monoatomic gases, Sackurtetrod equation, partition function for diatomic molecules, - heat capacity of solids (Einstein and Debye models).

UNIT – III Chemical Kinetics-I 12

Simultaneous reaction- A detail study of reversible reaction-First order opposed first order, first order opposed second order reactions-. Effect of temperature on reaction rate Theories of reaction rates- Collision theory of bimolecular gaseous reaction, ACT of bimolecular reactions, Lindemann theory of unimolecular reactions. Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions.

UNIT – IV Chemical Kinetics-II 12

Kinetics of Chain reactions- general treatment of chain reactions – chain length - Rice Herzfeld mechanism – explosion limits. Kinetics of reaction in solutions- Reactions in solutions – Effect of pressure, dielectric constant and ionic strength on reactions in solutions- Kinetic isotope effects. Study of fast reaction – relaxation methods – temperature and pressure jump method – stopped flow and flash photolysis methods.

UNIT – V Chemical Kinetics-III 12

Catalysis- Characterstic of catalytic Reaction- Types of Catalysis-Homogenous catalysis- Acid base catalysis – Mechanism of acid base catalysed reactions. Enzyme Catalysis-Characteristics of enzyme catalysis- Mechanism of Enzyme Catalysis. Heterogeneous catalysis- Theories of catalysis, Promoters and its explanation catalytic poisoning and its explanation, negative catalytsis and its explanations.

TOTAL: 60h

Course 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

TEXT BOOKS:

1. K.J. Laidler, Chemical Kinetics, Harper and Row, New York, 3rd edition, 1987.
2. Rajaram J. and Kuriacose J.C. – Kinetics and Mechanism of Chemical Transformation, McMillan India Ltd., New Delhi, first edition, 1993.

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.

Web Link:

https://www.bcp.fu-berlin.de/en/chemie/chemie/forschung/PhysTheoChem/agkeller/_Docs/StatTD18/Script.pdf

https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Kinetics/04%3A_Reaction_Mechanisms/4.03%3A_Chain_Reactions_I#:~:text=Chain%20reactions%20usually%20consist%20of,until%20the%20reactants%20are%20exhausted.&text=When%20chain%20carriers%20react%20with,are%20called%20chain%20termination%20reactions.

21PMSO11 ORGANIC CHEMISTRY PRACTICAL I– PRACTICAL I 0 0 4 2

Course Objective: 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: 30 h

Course Outcome:

- To familiarize the solubility nature of organic substances of different functional group.
- To learn the pilot separation of bimixture.
- 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

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, 4th 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, 1978.

Web link:

http://www.rsc.org/suppdata/books/184973/9781849739634/bk9781849739634-chapter%201.pdf

http://www.orgsyn.org/demo.aspx?prep=CV1P0372

21CMSO21 ORGANIC CHEMISTRY – II 4 0 0 4

Course Objective: 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 and carbon-hetero multiple bonds 12

Electrophilic, nucleophilic and neighbouring group participation mechanism-Addition of halogen and nitrosyl chloride to olefins. Hydration of olefins and acetylenes. Hydroboration, Hydroxylations, Michael addition, Robinson annulation reaction, Diels Alder reaction,1,3-dipolar additions.

Carbenes and their addition to double bonds-SimmonSmith reaction, Mannich, Stobbe, Darzen, Wittig, Wittig – Horner, Tebbe and Benzoin reactions. Stereochemical aspects to be studied wherever applicable. Nitrene : methods for generating nitrenes and their reactions.

UNIT – II Elimination Reactions 12

E_1, E_2 and E_1cB mechanism- E_1, E_2 and E_1cB Spectrum—orientation of the double bond –Hoffmann and Saytzeff rule s- competition between elimination and substitution. Typical elimination reactions – dehydration, dehydrohalogenation and dehalogenation.Stereochemistry of E_2 eliminations in cyclohexane systems.Mechanism of pyrolytic elimination.Chugaev and Cope eliminations.

UNIT – III Molecular Rearrangements 12

A detailed study with suitable examples of the mechanism of the following rearrangements: Pinacol-pinacolone(examples other than tetra methyl ethylene glycol)-Wagner-Meerwein , Demjanov, dienone – phenone, Favorskii ,Wolff,Lossen , Baeyer – Villiger , Dakin Rearrangement, Wolf, Stevens (in cyclic systems) and Von Richter rearrangements.

UNIT – IV Oxidation and Reduction 12

Mechanisms – study of the following oxidation reactions–oxidation of alcohols using chromium (Jones oxidation, Collins &Sarrett reagents, PCC & PDC) -use of DMS (Corey-Kim Oxidation), DMSO in oxidizing alcohols (Pfitzner-Moffatt Oxidation, Kornblum Oxidation, Swern Oxidation), Dess-Martin Oxidation- oxidation of alkene to carbonyl (OsO_4, $Pb(OAc)_4$, Ozonolysis) ,Sharpless asymmetric dihydroxylation, SeO_2. Reductions : selectivity in reduction of 4-T- Butyl cyclohexanone using selectrides hydride reductions – synthetic importance of Clemmenson and Wolff- Kishner reductions- modifications of Wolff-Kishner reduction – Birch reduction , MPV reduction.

UNIT – V Conformational Analysis 12

Conformation of some simple 1,2disubstituted ethane derivatives. Conformational analysis of disubstitutedcyclohexanes and their stereochemical features (geometric and optical isomerism (if shown) by these derivatives). Conformation and reactivity of substituted cyclohexanols (oxidation and acylation), cyclohexanones (reduction) and cyclohexane carboxylic acid derivatives (esterification and hydrolysis) Conformation and stereochemistry of *cis* and *trans*decalin and 9-methyldecalin.

TOTAL: 60 h

Course 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, nitrenesetc
- To obtain an outline about elimination reactions and rules used to study elimination reactions

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.

Web link:

http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000660/M010300/ET/s000005ch-p000660-m010300-et-v1.pdf

https://nptel.ac.in/content/storage2/courses/104101005/downloads/LectureNotes/chapter%206.pdf

21CMSO22 ANALYTICAL TECHNIQUES 4 0 0 4

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

UNIT I Analytical Techniques –I 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 Analytical Techniques – II 12

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 12

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 12

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 h

Course 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

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, ld Reinhord and Winston, Publication, /4th Edition, 1982.

Web Link:

https://www.brainkart.com/article/Amperometric-Methods--Instrumentation_30875/

https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Book%3A_Physical_Methods_in_Chemistry_and_Nano_Science_(Barron)/01%3A_Elemental_Analysis/1.04%3A_Introduction_to_Atomic_Absorption_Spectroscopy

21CMSO23 PHYSICAL CHEMISTRY-II 4 0 0 4

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

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 Mechanism of electrode reaction 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 Group theory-I 12

Symmetry elements and symmetry operations – – concept of Group and its properties, Group multiplication tables -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 – Mülliken symbols, reduction formula, direct sum and direct products. Character table - Construction of Character table for C_{2V} and C_{3V} point group.

UNIT V Group theory-II 12

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 - symmetry aspects of 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 h

Course 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.

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.

Web Link:

http://www.gdcboysang.ac.in/About/droid/uploads/Electrochemistry.pdf

https://ocw.mit.edu/courses/chemical-engineering/10-626-electrochemical-energy-systems-spring-2014/lecture-notes/MIT10_626S14_S11lec13.pdf

21PMSO21 PHYSICAL CHEMISTRY PRACTICAL - PRACTICAL II 0 0 4 2

Course Objective: 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: 30 h

Course 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

TEXTBOOKS:

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.

Web Link:

https://www.nitt.edu/home/academics/departments/chem/programmes/btech/curriculum/sem4/cl214/Lab%20Manual.pdf

https://dergipark.org.tr/tr/download/article-file/651595

21PMSO22 INORGANIC CHEMISTRY PRACTICAL - PRACTICAL III 0 0 4 2

Course Objective: 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: 30 h

Course 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

TEXTBOOKS:

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.

Web Link:

https://en.wikipedia.org/wiki/Qualitative_inorganic_analysis

https://www.learncbse.in/analyse-given-salt-acidic-basic-radicals/

21CMSO31 ORGANIC CHEMISTRY-III 4 0 0 4

Course Objective:

- To study the Basic concepts of Pericyclic reactions.
- To know about the general aspects of organic photochemistry.
- To learn about Heterocycles, terpenoids, steroids and cholesterol.

UNIT-I Introduction to photochemistry 12

Basic concepts of organic photochemistry: Thermal versus photochemical reactions – electronic excitations – n – π^* and π – π^* transitions, singlet and triplet energy states – comparison of energies, lifetimes and reactivates; allowed and forbidden transitions; fluorescence, phosphorescence and internal conversion – intersystem crossing; Jablonski diagram; quantum yields and their determination; sensitization and quenching

UNIT-II Organic Photochemistry 12

Photochemical reactions of saturated ketones – Norrish Type I and Norrish Type II reaction; photoreduction of ketone, photoaddition reactions, PaternoBuchi reaction. Photochemistry of simple olefins – cis – trans isomerization, 1,3-dienes, 1,4- dienes, di – pi methane rearrangement, 1,5 – dienes – sigmatropic rearrangement. Photooxidation – Formation of peroxy compounds – oxidative couplings – Barton reaction. Photo rearrangements : Photo – Fries rearrangement and Photo rearrangement of 2,5 – Cyclohexadienones.

UNIT-III Pericyclic Reactions 12

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, and Terpenoids 12

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). Synthesis of vitamin A1 (Reformatsky and Wittig reaction methods only).

UNIT-V Steroids 12

Classification with examples, nomenclature of steroids; Structure, Conversion of cholesterol to progesterone, estrone and testosterone.Elucidation of structure of cholesterol (by chemical degradation).

Total: 60 h

Course Outcomes:

- To learn about the Principle and applications of ultraviolet and Woodward Fisher Rule
- To understand theinfra-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 theMass spectrometry and its applications
- To learn about the optical rotatory dispersion and its applications

TEXT BOOKS:

1. F. A. Carey, Richard J. Sundbreg, Advanced Organic Chemistry, Plenum Press, New York, 4th Edition 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.

Web Link:

https://www.philadelphia.edu.jo/academics/ajaber/uploads/CHEM%20540-061-Fluorescence%20and%20phoephorescence-All.pdf

https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Electronic_Spectroscopy/Jablonski_diagram

21CMSO32 ORGANO METALLIC AND PHOTOCHEMISTRY 4 0 0 4

Course Objective: 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 12

18/16-electron rule- 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 - isolobal Analogy-Organometallic Clusters

UNIT II Organometallic reactions 12

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

UNIT III Catalysis 12

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), Monsanto acetic acid process, polymersiation (Zeigler-Natta catalyst);

UNIT IV Cyclo Oligomerisation of Acetylene 12

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

UNIT V Inorganic Photochemistry 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 h

Course 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 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

Web Link:

https://pdfcoffee.com/basic-principles-of-organic-chemistry-pdf-free.html

https://datapdf.com/open-shell-organometallics-as-a-bridge-between-acs-publicati.html

21CMSO33 ORGANIC SPECTROSCOPY 4 0 0 4

Course objective: 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 12

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 12

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 12

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 12

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 12

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: 60 h

Course 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

TEXT BOOKS:

1. Robert M.Silverstein, Clayton Bassler and Terence C.Morril, Spectrophotometer Identification of Organic Compounds, John Wiley & Sons, New York, 6th Edition, 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.

Web Link:

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http://studymaterial.unipune.ac.in:8080/jspui/bitstream/123456789/7371/1/uv%20spectrosscopy%20MSC%20Handore%20K.pdf

21PMSO31 ORGANIC CHEMISTRY PRACTICAL II – PRACTICAL IV 0 0 4 2

Course Objective: 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
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: 30 h

Course 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

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, 4th 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, 1978.

Web Link:

http://www.orgsyn.org/demo.aspx?prep=CV1P0392

https://patents.google.com/patent/US3423475A/en

21IMSO31 **INTERNSHIP** **0 0 4 2**

Course Objective: 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.

Course 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.

21CMSO41 SYNTHETIC ORGANIC CHEMISTRY 4 0 0 4

Course Objective: 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 12

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 12

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 cycloheptatrienes.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 12

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 12

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 12

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

TOTAL: 60 h

Course 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

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, New Delhi, 4th Edition, 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.

Web Link:

https://www.masterorganicchemistry.com/2020/03/16/electrocyclic-reactions/

http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/organic_chemistry_iii/29.electrocyclic_reactions/et/4823_et_et.pdf

21RMSO41 **PROJECT WORK** **0 0 24 12**

Course Objective: 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.

Syllabus

Discipline Specific Elective Courses

(DSE)

SEPARATION TECHNIQUES 4 0 0 4

Course Objective: 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 h

Course 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 thetwo dimensional Paper Chromatography, Reverse phase paper Chromatography
- To learn about the Gas-liquid Chromatography

TEXTBOOKS:

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.

Web Link:

https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Instrumental_Analysis/Chromatography/Gas_Chromatography

https://www.knauer.net/Application/Applications_KNAUER_web_2020_07.pdf

ORGANIC NAME REACTIONS AND SYNTHESIS OF REAGENTS 4 0 0 4

Course Objective: 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, dicyclohexyl carbodimide,1,3-dithiane, wood ward and provost hydroxylation, selenium dioxide, crown ethers and Peterson's synthesis, Wilkinson's catalyst, Baker yeast.

TOTAL: 60 h

Course 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

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 B Reactions 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.

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http://www.chemgapedia.de/vsengine/vlu/vsc/en/ch/2/vlu/oxidation_reduktion/red_meerwein.vlu.html

ANALYTICAL TECHNIQUES 4 0 0 4

Course Objective: To learn about several methods of analytical techniques. Basic conceptabout UV-visible spectroscopy, infrared spectroscopy, raman spectra, nuclear magnetic resonance and electron spin resonance and mass spectrometryand their applications.

UNITI 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: 60 h

Course 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

TEXTBOOKS:

1. D.A.Skoog and D.M.West, Fundamentals of Analytical Chemistry, Old Reinhord& Winston, Publication, 4th Edition, 1982.
2. B.K. Sharma, Instrumental methods of Chemical analysis, Goel Publishing House, 24thEdition, 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, CBS Publication, 6th Edition, 1986.

2. A.I.Vogel, Textbook of Qualitative Inorganic Analysis, OldReinhord & Winston, Publication, 3rd Edition, 1976. 1982.

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https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Book%3A_Physical_Methods_in_Chemistry_and_Nano_Science_(Barron)/04%3A_Chemical_Speciation/4.04%3A_UV-Visible_Spectroscopy
https://blogs.maryville.edu/aas/atomization-source/

FUNDAMENTALS OF BIOCHEMISTRY 4 0 0 4

Course Objective:

- To study the metabolism of carbohydrates, aminoacids, proteins and lipids.
- To understand the functions of DNA and RNA.
- To know about 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. metabolism of Fructose and Galactose.

Disaccharides: Ring structures (Haworth formula) – occurrence, physical and chemical properties of maltose, lactose and sucrose - Glycolysis of carbohydrates.

UNIT – II Chemistry and Metabolism of Amino 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.

Biological functions of proteins, Deamination, transamination reactions, Urea cycle.

UNIT – III Chemistry and Metabolism of 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.

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. role of vitamins in the metabolism.

TOTAL : 60 h

Course Outcomes:

- To define, classify and biological role of carbohydrates.
- To know about the glycolysis of carbohydrates.
- To learn the essentials of amino acids in biology.
- To familiarize the biological functions of proteins.
- To understand the various types of lipids along with their properties.

TEXT BOOKS:

1. G.R. Agarwal and O. P. Agarwal, Text book of Biochemistry, Goel publishing House, 1984.
2. L. Styrer, Biochemistry, Free man & Co., New York, 1994.

REFERENCE BOOKS:

1. R.K. Murray, P.A., Mayes, D.K. Granner and V.W. Rodwell, Harper's Biochemistry, (Lange Medical Book), 1990
2. B.L. William and K. Wilson, Principles and Techniques of practical Biochemistry, Edward Arnold, London, 1990.

Web link:

https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/carbhyd.htm

https://library.med.utah.edu/NetBiochem/pupyr/pp.htm

SYNTHESIS OF APIS AND MANUFACTURE 4 0 0 4

Course Objective: 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 – enantio selective 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] Clopidogrelbisulphate [135046-48-9] and Lorazepam[846-49-1] (any two)Chemical Process safety – Principles and Practice-guidelines and norms-Green chemistry.

TOTAL: 60 h

Course 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

TEXT BOOKS:

1. K. G.Gadamasettiand 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 product, Perseus Publcation, 2001.
2. A W Czarnik, A practical guide to Combinatorial chemistry, ACS, 1998.

Web link:

http://downloads.lww.com/wolterskluwer_vitalstream_com/sample-content/9781609133450_Lemke/samples/Chapter_01.pdf
http://www.phasetransfer.com/PTCIssue18.pdf

STEREO CHEMISTRY AND REACTION MECHANISM 4 0 0 4

Course Objective: 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-I **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.

UNIT – IV Retrosynthetic Analysis-II **12**

Retro-synthetic approach of Amine and alkene synthesis, Robinson annulations, Micheal addition and important functional group interconversions.

UNIT – V Synthetic Methodology **12**

Protection, of functional groups (hydroxyl, amino, carboxyl, and carbonyl groups, Terminal alkyne).Illustration of protection and deprotection in synthesis

TOTAL: 60 h

Course 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 Compounds

TEXT BOOKS:

1. P. S. Kalsi, Stereochemistry Conformation and Mechanism, New Age International Publication, 2005.
2. Eliel, Stereochemistry of Carbon Compounds, Tata McGrawhill 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.

Web Link:

https://www.massey.ac.nz/~gjrowlan/stereo2/lecture4.pdf

https://www.masterorganicchemistry.com/2018/12/10/the-robinson-annulation/

MACROMOLECULAR CHEMISTRY 4 0 0 4

Course Objective: To learn the basic concepts of polymers. Polymerization methods, measurement of molecular weight and size,glassy solids, polymer crystallizationmanufacture and application of resins and plastics.

UNIT –I Basic Concepts of Polymers. 12

Monomer, Repeating unit, degree of polymerization.Classification of polymers, Stereochemistry of polymer, nomenclature of stereo regular polymers. Types of polymerization - Chain polymerization, free radical polymerization; ionic polymerization; Coordination polymerization and Ziegler Natta catalyst.

UNIT- II Types of Polymerisation 12

Step polymerization, ring opening polymerization. Co polymerization, random, block and graft co polymers- preparation. Plastics – Types of plastics - Rubber – Natural and synthetic rubber - Vulcanisation of rubber**.**

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 h

Course 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

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.

Web Link:

https://vssut.ac.in/lecture_notes/lecture1541230922.pdf

https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/polymers.htm

NUCLEAR AND PHOTOCHEMISTRY 4 0 0 4

Course Objective: To learn about nuclearisomerism, 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 diagnosisand treatment in field of medicine

UNITV 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 h

Course 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

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, 5th 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.

Web Link:

https://oregonstate.edu/instruct/ch374/ch418518/CHAPTER%209%20GAMMA%20RAY%20DECAY-rev.pdf
https://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=1192&context=ameslab_iscreports

BIOINORGANIC CHEMISTRY 4 0 0 4

Course Objective: 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 h

Course 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

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.

Web Link:

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https://febs.onlinelibrary.wiley.com/doi/pdfdirect/10.1111/j.1432-1033.1990.tb15272.x

PHARMACEUTICAL FORMULATION TECHNOLOGY - I 4 0 0 4

Course Objective: 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: 60 h

Course 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 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 ofPharmaceutics 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

Web Link:

https://www.ncbi.nlm.nih.gov/books/NBK253956/

https://www.crystallizationsystems.com/our-products?gclid=Cj0KCQjw8IaGBhCHARIsAGIRRYpZ4M8bKA_TkWXZXCxy7nq91X5FBT4XkY4Odo39JcSILEJzeGkY1mAaAkvHEALw_wcB

PHARMACEUTICAL CHEMISTRY 4 0 0 4

Course Objective: To know about the classification and synthesis drugs, antibiotics, enzymes phase transfer catalysis. Vitamins – Introduction, water, fat soluble vitamins. Details of vitaminA, 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: typesfunction 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 h

Course 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

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.

Web Link:

https://annamalaiuniversity.ac.in/studport/download/engg/pharm/resources/pharmd_3Y_3.5_medicinal%20Chemistry.pdf

https://worldwidescience.org/topicpages/m/michaelis-menten+enzyme+kinetic.html

NATURAL PRODUCTS 4 0 0 4

Course Objective: 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.

UNITII 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 inter conversions of steroids. Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone and bio synthesis of cholesterol

UNITIV 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 h

Course 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

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.

Web link:.

https://chem.libretexts.org/Courses/Eastern_Mennonite_University/EMU%3A_Chemistry_for_the_Life_Sciences_(Cessna)/17%3A_Lipids/17.4%3A_Steroids

https://www.webmd.com/vitamins/ai/ingredientmono-1631/androsterone-%5Bfast-facts%5D

CHEMICAL&INSTRUMENTAL METHODS OF DRUG ANALYSIS 4 0 0 4

Course Objective: To learn the basictheory 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 h

Course 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

TEXT BOOKS:

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

Web Link:

https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3A_Basic_Principles_of_Organic_Chemistry_(Roberts_and_Caserio)/09%3A_Separation_Purification__Identification_of_Organic_Compounds/9.11%3A_Nuclear_Magnetic_Resonance_Spectroscopy

https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/spectrpy/nmr/nmr1.htm

ELECTRO ANALYTICAL AND SEPARATION TECHNIQUES 4 0 0 4

Course Objective: 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 h

Course 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

TEXT BOOKS:

1.J. Huheey, Inorganic Chemistry, Harper and Collins, 4th Edition, New York, 1983.
2.H.J. Arnikar, Nuclear Chemistry, Wiley Eastern Co. 2nd Edition, 1987.
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry- A Comprehensive Text, John Wiley and Sons, 5th 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, Wiley Interscience, 2nd Edition, 2001.

Web Link:

https://www.chemguide.co.uk/analysis/chromatography/gas.html

https://lab-training.com/hplc/

ENZYME TECHNOLOGY AND RELATED ENTREPRENEUREAL SKILLS 4 0 0 4

Course Objective

To learn biological aspects, metalloenzyms, oxygen carriers, nitrogen fixation, photosynthesis and cytochrome, and bioanalytical aspects.

Unit I Introduction to biochemistry, function and applications 12

Nature and functions of enzyme, Coenzyme/ Cofactor.Classification of enzyme. Assay methods and units. Examples of applications of enzymes in industry, analytical techniques, medicine and Pharmaceuticals.

Unit II Kinetics and mechanism of enzyme catalysis 12

Enzyme catalysis and controlling factors. Kinetics of enzyme catalyzed reactions in solution. Immobilized enzyme reaction kinetics.Effect of mass transfer resistance.

Unit III Enzyme production on large scale technology 12

Isolation and purification of enzymes, protein fractionation methods.

Unit IV Immobilization technology and development 12

Immobilization techniques for enzymes. Characteristics and uses for immobilized enzyme systems

Unit V Industrial bioreactors utilizing isolated enzymes and biosensors development and applications 12

Reactor design and analysis for immobilized enzyme reactors. Applications in biosensors.Some modern developments for enzymes in organic synthesis.

Total: 60 h

Course Outcomes:

- To learn about the Nature and functions, classification of enzyme, Coenzyme and Cofactor
- To learn about the applications of enzymes in industry, analytical techniques, medicine and Pharmaceuticals
- To understand the enzyme catalysis and controlling factors
- To learn about the kinetics of enzyme catalyzed reactions in solution
- To understand the immobilized enzyme reaction kinetics

Text Book

1. J. L Jain, S. Jain , N. Jain, Fundamentals of Biochemistry, S.Chand & Company, 2009.

Reference Books

1. A.Wiseman, Handbook of Enzyme Biotechnology, Ellis – Horwood, 1983.
2. T. Devasena, Enzymology, Oxford University Press, 1st Edition 2010.

Web Link:

https://biologydictionary.net/coenzyme/

http://dedicaciontotal.udelar.edu.uy/adjuntos/produccion/465_academicas__academicaarchivo.pdf

NOVEL MATERIALS AND GREEN INDUSTRIAL CATALYSIS 4 0 0 4

Course Objective: 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: 60 h

Course 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

TEXT BOOK:

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

REFERENCE BOOK:

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

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PHARMACEUTICAL FORMULATION TECHNOLOGY - II 4 0 0 4

Course Objective: 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: 60 h

Course 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

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, NewDelhi, 2012.

Web Link:

https://www.biospace.com/article/releases/role-of-microbiology-in-the-pharmaceutical-medical-device-and-cosmetic-industries-/

http://www.pharmpress.com/files/docs/ftcomp_sample.pdf

ELECTROCHEMISTRY AND GROUP THEORY 4 0 0 4

Course Objective: 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.

UNITI 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.

UNITII 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.

UNITIII 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.

UNITIV 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).

UNITV 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 h

Course 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

TEXT BOOKS:

1. Ramakrishnan and M.S Gopinathan, Group Theory in Chemistry, Vishal PublishingCo.,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, Vol 1 & 2, Plenum, New York, , 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.

Web Link:

http://www.sfu.ca/~aroudgar/Tutorials/OLD/Electrochemistry-09-2004/Lecture_8-10.pdf.pdf

http://www.imim.pl/PHD/www.imim-phd.edu.pl/contents/Lectures/Electrochemistry%20for%20materials%20science_BELTOWSKA_3.pdf

STRATEGIC MANAGEMENT OF PHARMA INDUSTRY 4 0 0 4

Course Objective: 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 h

Course 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

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.

WebLink:

https://www.taxmanagementindia.com/visitor/detail_article.asp?ArticleID=6854
https://www.wipo.int/ip-outreach/en/ipday/2017/innovation_and_intellectual_property.html

ELECTROCHEMISTRY AND SPECTROSCOPY 4 0 0 4

Course Objective: 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.

UNITI 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.

UNITII 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.

UNITIII 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.

UNITIV 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: 60 h

Course 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

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.

Web Link:

http://www.sfu.ca/~aroudgar/Tutorials/OLD/Electrochemistry-09-2004/Lecture_8-10.pdf.pdf
http://www.imim.pl/PHD/www.imim-phd.edu.pl/contents/Lectures/Electrochemistry%20for%20materials%20science_BELTOWSKA_3.pdf

Syllabus
Generic Elective Courses
(GE)

SOFTSKILLS – I 2 0 0 2

Course Objective:

- To enable participants Business Communication Skills
- To enhance participants E-mail writing skills
- To impart Leadership and Team Bonding skills

Credit Hours

1. **READING COMPREHENSION AND VOCABULARY** **06**
   Filling the blanks – Cloze Exercise – Vocabulary building – Reading and answering Questions.

2. **LISTENING AND ANSWERING QUESTIONS.** **06**
   Listening and writing – Listening and sequencing sentences – Filling in the blanks – Listening and answering questions.

3. **GROUP DISCUSSIONS** **06**
   Why GD part of a selection process – Structure of a GD – strategies in GD – Team Work – Body Language

4. **CONVERSATION.** **06**
   Face to face Conversation and Telephone conversation.

5. **SELF- INTRODUCTION AND ROLE PLAY** **06**

Total 30 Hours

Course Outcome

At the end of this course the students will be able to,

CO 1 Prioritize power of understanding and aids assimilation of vocables. Vocabulary to charge communication with educated words

CO 2 Develop comprehensive knowledge through listening leading to answering questions

CO 3 Build observation power and infuse self-confidence through group discussions

CO 4 Identify methodology for befitting constructional ability

CO 5 Experiments with inward looking and visualization of the 'otherness' of situations

Books Recommended

- Barun K. Mitra. Personality Development and Soft Skills. Oxford University Press. New Delhi.2011.
- S.P. Sharma. Personality Development. Pustaq Mahal. New Delhi. 2010.Meenakshi Raman and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi. 2009.
- Tiko, Champa & Jaya Sasikumar. Writing with a Purpose.OUP. New Delhi. 1979

Web Source:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://blog.smarp.com/top-5-communication-skills-and-how-to-improve-them
- https://blog.hubspot.com/service/phone-etiquette

SOFT SKILLS – II 2 0 0 2

Course Objective:

- To enable students to develop their communication skills effectively
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence through communication

1. PRESENTATION SKILLS **06**

Elements of an effective presentation – structure of presentation – voice modulation – Audience analysis – Body language

2. SOFT SKILLS **06**

Time Management – Articulateness – Assertiveness – Stress management

3. RESUME / REPORT PREPARATION / LETTER WRITING **06**

Structuring the resume / Report – Business letters – E-Mail Communication

4. INTERVIEW SKILLS **06**

Kinds of Interviews – Required by Skills – Corporate Culture – Mock Interviews

5. 30 FREQUENTLY ASKED QUESTIONS **06**

Total 30 Hours

Course Outcome

At the end of this course the students will be able to,

CO1 Illustrate the essential of presentation skills, thoughts, structure, voice modulation, audience analysis and body language

CO2 Utilize the psychological skills pertaining to time management, articulation, assertion and stress management

CO3 Construct methodology for preparation of resume, reports, business letters and email communication

CO4 Appraise learners with varied skills needed for expose to interviews

CO5 Categorize the nature of questions asked usually in interviews

Books Recommended

- Barun K.Mitra. Personality Development and soft skills. Oxford University Press. New Delhi. 2011.
- S P Sharma. Personality Development. Pustaq Mahal. New Delhi. 2010.
- Meenakshi Raman and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi. 2009.

Web Sources:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://www.businessnewsdaily.com/5836-top-interviewing-skills.html
- https://gdpi.hitbullseye.com/Group-Discussion.php

SOFT SKILLS III **2 0 0 2**

Course Objective:

- To enable students to develop their soft skills and Body Language
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence to excel at Interviews

	Credit Hours
UNIT–I	**06**
Powerful Presentation	
UNIT–II	**06**
Reinforcement	
UNIT–III	**06**
Using visual aids	
UNIT–IV	**06**
Types and Methods of Presentations	
UNIT–V	**06**
Obstacles to Presentation	
Total : 30 Hours	

Course Outcome:

- To develop participants social and professional skills
- To help participants manage time effectively
- To build a strong resume to suit corporate requirements
- To face interviews confidently
- To enhance their aptitude abilities

Books Recommended:

- Roz Townsend: Presentation Skills for the Upwardly Mobile, Emerald, Chennai.
- Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Publishing Company Limited, 2001.
- Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.

Web Sources:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://venngage.com/blog/presentation-skills/
- https://gdpi.hitbullseye.com/Group-Discussion.php

GREEN CHEMISTRY 2 0 0 2

Course Objective: 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 06

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 06

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 06

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 06

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 houseeffect - Global warming a serious threat - Important points

Unit V Future Trends in Green Chemistry 06

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: 30 h

Course 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

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

Web Link:

https://www.britannica.com/topic/environmentalism/History-of-the-environmental-movement

https://royalsocietypublishing.org/doi/10.1098/rsos.191378

CHEMINFORMATICS 2 0 0 2

Course Objective: 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 **06**

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 **06**

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 **06**

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 **06**

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 **06**

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: 30h

Course 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

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, 3rd Edition, 1990.

Web Link:

http://web.pdx.edu/~wamserc/C336S02/27notes.htm

http://courseware.cutm.ac.in/wp-content/uploads/2020/05/Structure-based-drug-design.pdf

FOOD CHEMISTRY AND ADULTERATION 2 0 0 2

Course Objective: To understand the basic information of food chemistry and adulteration.To appreciate the importance of food additives and pesticide control.To providean information about food preservatives.

Unit I Introduction 06

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 06

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 06

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 06

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 06

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: 30 h

Course 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

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 Preservation, 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, 2001.

Web Link:

https://www1.health.gov.au/internet/publications/publishing.nsf/Content/gug-family-toc~gug-family-foods~gug-family-foods-basic

https://www.dfda.goa.gov.in/images/PDF-DOCUMENTS/quciktestforsomeadullterantsinfood-fssaiinitiative.pdf