ಮಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ
MANGALORE UNIVERSITY
(Accredited by NAAC with 'A' Grade)

ಕ್ರಮಾಂಕ/No. MU/ACC/CR6/CBCS-PG(SLB)/2017-18/A2

ಕುಲಸಚಿವರ ಕಚೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ - 574 199
ಕರ್ನಾಟಕ, ಭಾರತ
Office of the Registrar
Mangalagangothri - 574 199
Karnataka, India

ದಿನಾಂಕ/Date : 8/5/2017

NOTIFICATION

Sub: *III & IV semester Choice Based Credit System syllabus of* M.Sc. in Chemistry degree programme.

Ref: 1) This office Notification No. MU/ACC/CR7/CBCS-PG(SLB)/2016-17/A2, dated: 17-8-2016.
2) Academic Council decision dated 3-2-2017 vide Agenda No. 3:11 (2016-17)

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In continuation to this office Notification cited under ref. (1) above, the syllabus of III & IV semester M.Sc. in Chemistry degree programme which approved by the Academic Council at meeting held on 3-2-2017 is hereby notified for implementation with effect from the academic year 2017-18 and onwards (for students of 2016-17 batch and onwards).

REGISTRAR

To:

1) The Chairman of the Department concerned/ The Coordinator of the degree programme concerned.
2) The Principal of the college concerned.
3) The Registrar [Evaluation], Mangalore University.
4) The Chairman of the Board of Studies concerned.
5) The Superintendent [ACC], Office of the Registrar, Mangalore University.
6) Guard file.

Mangalore University

Department of Studies in Chemistry

M. Sc. Degree Programmes

(CHOICE BASED CREDIT SYSTEM – SEMESTER SCHEME)

Syllabi for M.Sc., Courses in

ORGANIC CHEMISTRY

(From the Academic Year 2016-17 onwards)

Mangalore University

M. Sc. Degree Programme in Organic Chemistry:

CHOICE BASED CREDIT SYSTEM (CBCS) SEMESTER SCHEME

C O U R S E P A T T E R N AND S C H E M E OF E X A M I N A T I O N

(Year 2016-2017 onwards)

PREAMBLE

Revision of Syllabi for the Two years Master Degree (Choice Based Credit System-Semester Scheme) Pogrammes in Chemistry, Applied Chemistry, Organic Chemistry and Analytical Chemistry.

PG BOS in Chemistry has revised and prepared the Syllabi (CBCS based) for all the Four Courses -Chemistry, Applied Chemistry, Organic Chemistry and Analytical Chemistry in its meeting held on 24th July 2014 and the University implemented it from the same academic year. Now the University has asked the PG BOS in Chemistry to revise the syllabi by giving certain Guidelines (Ref:-No: MU/ACC/CR.38/ CBCS (PG)/2015-16 dt.05-05-2016 bse on UGC letter) for all the four Courses (Programmes) to offer Hard Core, Soft Core and Open Elective course papers with credits to each course amounting to 92 credits for the entire programme.

Accordingly, the PG BOS in Chemistry prepared the syllabi for all the four programmes. It has prepared course pattern by proposing 12 Hard Core theory courses (3 in each semester) and 5 practical courses (in 3rd and 4th semester), one Project work (in 4th Semester with 4 credits)with a provision to have One Project Work in lieu of one of the practicals in 4th semester in each programme with 3 credits each(project work - 4 credits) with total of **55 Credits**). BOS is offering 3, 2, 2 and 3 (Total 10 courses) Soft core courses respectively in 1st , 2nd, 3rd and 4th semesters of a programme. Student shall opt any 2, 1, 1 and 2(Total 6 courses) courses respectively in 1st , 2nd , 3 rd, 4th Semesters. All the soft core papers are of 3 credits. Programma consists of 6 Soft Core practical courses (3 courses each in 1st and 2nd semesters of the Programme with 2 credits each) with a total of **30 credits** (6 theory x 3 credits + 6 practicals x 2 credits). BOS has also proposed 2 open electives (1 each in 2nd& 3rd Semesters of the programme) with 3 credits each (**6 credits)**. All together **total credits** come to 91from teaching. I have prepared a draft course pattern by considering all the points mentioned in the above said letter from the Registrar and placing it before the BOS meeting.

Detailed syllabi for 1st and 2nd Semesters are prepared and enclosed, whereas the syllabi for the 3rd and 4th Semesters will be prepared in forthcoming BOS meeting.

Course/credit pattern:

Semester Credits	Hard Core(H)(T)	Soft Core (S)(T)	Elective E)(T)	Practical	Tutorial	Total Credits
First	9	6	--	6 (S)	--	21
Second	9	3	3	6 (S)	--	21
Third	9	3	3	9 (H)	--	24
Fourth	9	6	--	10(H)	--	25
Total	36	18	6*	12(S) + 19(H)	--	91

Total Credits from all the Four Semesters (1^{st} , 2^{nd} , 3^{rd} and 4^{th}) : 21+21+24+25 = 91

Total Hard Core credits = 36 (T) + 19 (P) = 55 = 60.4%

Total Soft Core credits = 18 (T) + 12(P) = 30 = 33.0%

*Open Elective Credits = 6 = 6.6% (Not to considered for calculating the

CGPA) H= Hard Core, S= Soft Core, P =Pratical/Project

Consolidated Curse core and title
Programme: M.Sc. in Organic Chemistry

1st Semester **2nd Semester**

Course Code	Course Title	Course Code	Course Title
OC H 401	Inorganic Chemistry	OC H 451	Advanced Inorganic Chemistry
OC H 402	Organic Chemistry	OC H 452	Advanced Organic Chemistry
OC H 403	Physical Chemistry	OC H 453	Advanced Physical Chemistry
OC S 404 Or OC S 405	Inorganic Spectroscopy and Analytical Techniques Or Environmental Chemistry	OC S 454 Or OC S 455	Organic Spectroscopic Techniques Or Chemistry of Bio-molecules
OC S 406	Molecular Spectroscopy and Diffraction Techniques	OC E 456	Environmental, Electro- and Polymer Chemistry
OC P 407	Inorganic Chemistry Practicals-1	OC P 457	Inorganic Chemistry Practicals-II
OC P 408	Organic Chemistry Practicals-1	OC P 458	Organic Chemistry Practicals-II
OC P 409	Physical Chemistry Practicals-1	OC P 459	Physical Chemistry Practicals-II

3rd Semester **4th Semester**

OC H 501	Organic Reaction Mechanism	OC H 551	Organic Synthetic Methods
OC H 502	Synthetic Reagents and Spectroscopic Techniques	OC H 552	Medicinal Chemistry
OC H 503	Advanced Heterocyclic Chemistry	OC H 553	Natural Products Chemistry
OC S 504 Or OC S 505	Organic Photochemistry & Pericyclic Reactions Or Bioorganic Chemistry	OC S 554	Synthetic Polymers, Dyes and Pesticides
OC E 506	Analytical and Green Chemistry	OC S 555 Or OC S 556	Separation Techniques and Organometallic Chemistry Or Organic Synthetic Strategies and Petrochemicals
OC P 507	Organic Chemistry Practicals-III	OC P 557	Organic Chemistry Practicals-VI
OC P 508	Organic Chemistry Practicals-IV	OC P 558	Organic Chemistry Practicals-VII
OC P 509	Organic Chemistry Practicals-V	OC P 559	Project Work & Dissertation

Detailed distribution of Course &Credits:

Programme**: Organic Chemistry:**

1st Semester

Course Code	Course Title	No of UNITs	Evaluation IA + Exam	Teaching hr week	Sem	Exam Hrs	Credits
OC H 401	Inorganic Chemistry	3	30 + 70	3	45	3	3
OC H 402	Organic Chemistry	3	30 + 70	3	45	3	3
OC H 403	Physical Chemistry	3	30 + 70	3	45	3	3
OC S 404 Or OC S 405	Inorganic Spectroscopy and Analytical Techniques Or Environmental Chemistry	3 3	30 + 70 30 + 70	3 3	36 36	3	3
OC S 406	Molecular Spectroscopy and Diffraction Techniques	3	30 + 70	3	36	3	3
OC P 407	Inorganic Chemistry Practicals-1	4 Hrs	30 + 70	4		4	2
OC P 408	Organic Chemistry Practicals-1	4 Hrs	30 + 70	4		4	2
OC P 409	Physical Chemistry Practicals-1	4 Hrs	30 + 70	4		4	2

Total credits from 1St Semester**: 21** (Hard Core-9, Soft Core-12)

2nd Semester

Course Code	Course Title	No of UNITs	Evaluation IA+ Exam	Teaching hr week	Sem	Exam Hrs	Credits
OC H 451	Advanced Inorganic Chemistry	3	30 + 70	3	45	3	3
OC H 452	Advanced Organic Chemistry	3	30 + 70	3	45	3	3
OC H 453	Advanced Physical Chemistry	3	30 + 70	3	45	3	3
OC S 454 Or OC S 455	Organic Spectroscopic Techniques Or Chemistry of Bio-molecules	3 3	30+70 30 + 70	3 3	36 36	3	3
OC E 456	Environmental, Electro- and Surface Chemistry	3	30 + 70	3	36	3	3
OC P 457	Inorganic Chemistry Practicals-II	4 Hrs	30 + 70	4		4	2
OC P 458	Organic Chemistry Practicals-II	4 Hrs	30 + 70	4		4	2
OC P 459	Physical Chemistry Practicals-II	4 Hrs	30 + 70	4		4	2

3rd Semester

Course Code	Course Title	No of UNITs	Evaluation IA +Exam	Teaching hr week	Sem	Exam Hrs	Credits
OC H 501	Organic Reaction Mechanism	3	30 + 70	3	45	3	3
OC H 502	Synthetic Reagents and Spectroscopic Techniques	3	30 + 70	3	45	3	3
OC H 503	Advanced Heterocyclic Chemistry	3	30 + 70	3	45	3	3
OC S 504 Or OC S 505	Organic Photochemistry & Pericyclic Reactions Or Bioorganic Chemistry	3 3	30 + 70 30 + 70	3 3	36 36	3	3
OC E 506	Analytical & Green Chemistry	3	30 + 70	3	36	3	3
OC P 507	Organic Chemistry Practicals-III	6 Hrs	30 + 70	6		6	3
OC P 508	Organic Chemistry Practicals-IV	6 Hrs	30 + 70	6		6	3
OC P 509	Organic Chemistry Practicals-V	6 Hrs	30 + 70	6		6	3

Total Credits = **24** (Hard Core-18, Soft Core-3 and Elective-3)

4th Semester

Course Code	Course Title	No of UNITs	Evaluation IA + Exam	Teaching hr week	Sem	Exam hrs	Credits
OC H 551	Organic Synthetic Methods	3	30 + 70	3	45	3	3
OC H 552	Medicinal Chemsitry	3	30 + 70	3	45	3	3
OC H 553	Natural Products Chemistry	3	30 + 70	3	45	3	3
OC S 554	Synthetic Polymers, Dyes and Pesticides	3	30 + 70	3	36	3	3
OC S 555 Or OC S 556	Separation Techniques and Organometallic Chemistry Or Organic Synthetic Strategies and Petrochemicals	3 3	30 + 70 30 + 70	3 3	36 36	3	3
OC P 557	Organic Chemistry Practicals -VI	6 Hrs	30 + 70		6	6	3
OC P 558	Organic Chemistry Practicals -VII	6 Hrs	30 + 70		6	6	3
OC P 559	Project Work & Dissertation	8 Hrs	30 + 70		8	--	4

Total Credits = **25** (Hard Core-18, Soft Core-6 + Seminar- 1)

Total Credits: 21+21+24+25 = 91.

Question Paper Setting:

A. BASIS FOR INTERNAL ASSESSMENT: Internal assessment marks in theory papers shall be based on two tests. The tests may be conducted 8 and 14 weeks after the start of a semester. Average of two test marks will be considered as internal assessment marks. Practical internal assessment marks shall be based on test and records. 20 marks for experiment and 10 marks for record. The practical tests may be conducted 12 weeks after the start of a semester. Internal Assessment marks on Project work-Dissertation is based on Two seminars of 45 minutes duration each carrying 15 marks. The Seminar is to be delivered in 3rd semester on the subject and 4th semester on their project work.

B. THEORY QUESTION PAPERS PATTERN: The Syllabus of each hard core course shall be grouped into three UNITs of 15 teaching hours and that of soft core and open Elective shall be of three UNITs of 12 teaching hours. Question Papers in all the four semesters shall consist of Two Parts- Part A and Part-B. Part A shall contain Nine (09) very short answer objective type questions carrying 2 marks each, drawn equally from all the three UNITs of the syllabus. All the nine subdivisions are to be answered. Part B shall contain Six (06) brief and/or long answer questions carrying 13 marks each drawn from all the three UNITs of the syllabus (2 questions per UNIT). There may be a maximum of three sub-divisions per question, carrying 3 or more marks per sub-division. Four (04) out of Six (06) questions are to be answered.

C. PRACTICAL EXAMINATION PATTERN: Practical Examination course papers out of 70 marks 15 marks shall be allotted for Viva voce and 55 marks for practical proper. In the 4th semester there shall project work/dissertation in lieu of one of the practicals for all the programmes (Chemistry, Applied Chemistry, Organic Chemistry and Analytical Chemistry) consisting of 70 marks. The Project work may be conducted either in the department or in an Institution or Industry. Project report shall be valued for 70 marks.

OBJECTIVES OF THE SYLLABUS

The revised syllabus is designed to provide a flexible structure within which students can choose the topic of their interest in addition to a specific knowledge. The syllabus takes into account the requirements for higher education to improve the quality of education and student competency level on par with national and international institutions. The syllabus is structured in such a way so as to ensure that students become aware of the practical applications of scientific knowledge to build careers in the scientific field.

The syllabus aims to enable students to:

- Prepare the students for employment and for further studies by acquiring the knowledge and understanding of chemical principles.
- Appreciate, understand and use the scientific method in the solving of problems. Develop the ability to disseminate chemical information effectively.
- Acquire good laboratory skills and practice safety measures when using equipment and chemicals as well as the safe disposal of chemical waste.

- Apply chemical knowledge to everyday life situations and develop inquisitiveness in order to continue the search for new ways in which the resources of our environment can be used in a sustainable way.

PROGRAMME OUTCOMES

- Master of Science in Chemistry basically aims at the training of students with a detailed knowledge base in Chemistry of potential utility in academia as well as Industry through advanced course work and laboratory work in the department and a project work in industries or premier institutions.
- To qualify NET/GATE/SET/Civil Services and other competitive examinations.
- For exploring global level research opportUNITies for doctoral and post-doctoral studies.
- For professional employment in different domains such as academics, industries, analytical laboratories, scientific organizations, entrepreneurship, administrative positions etc.
- For enhancing the connectivity between academic and industrial institutions.

PROGRAMME SPECIFIC OUTCOMES

- Students will equip themselves with up-to-date knowledge in the field of frontier areas of chemistry.
- Attain confidence to take up R & D positions in teaching, higher education institutions, public sector & private companies.
- Get motivated to take up higher studies.
- Will be able to use their knowledge in day to day life and work for betterment of society.
- Understand the social responsibility of chemistry in educating general public about protection of environment against pollution.
- Knowledge & Confidence to clear nation level competitive examinations.
- To make use of the chemistry knowledge to analyze real samples like food samples, biological samples, pharmaceutical products and environmental samples.
- To propose/develop lost effective and novel methods of synthesis of bioactive compounds/nanomaterials and in turn to design target oriented drugs to treat different diseases.
- To propose/develop simple and accurate analytical methods as alternatives for the existing standard/official methods for the analysis of complex matrices/clinical samples.

- To develop energy storage materials and fuel cells.

FIRST SEMESTER

OC H 401: INORGANIC CHEMISTRY

COURSE OUTCOMES:

- Students will learn the basics of ionic and covalent bonding, lattice energy, hydration energy,
- This course enables the students to understand VSEPR theory and MOT theory.
- This course will Enlighten the students to understand Noble gas chemistry, Graphitic compounds, HSAB Concept,
- Theories of redox indicators and sampling techniques.

UNIT- I: **[15 Hours]**

Ionic bond: Properties of ionic substances, coordination number of an ion, structures of crystal lattices- NaCl, CsCl, ZnS and rutile. Lattice energy- Born Lande equation, Born-Haber cycle, Uses of Born-Haber type of calculations. Ionic radii, methods of determining ionic radii, factors affecting ionic radii, radius ratio rule, covalent character in ionic bonds, hydration energy and solubility of ionic solids.

Covalent bond: valence bond theory, resonance, hybridisation, Bent's rules and energetics of hybridization, Deduction of molecular shapes – VSEPR theory.

M.O.theory, application to homo- and hetero-diatomic and -triatomic molecules.

UNIT -II: **[15 Hours]**

Alkali and alkaline earth metal complexes of crown ethers, cryptands and calixarenes and their biological significance.

Halogens and Noble gas chemistry –interhalogens, psuedohalogens, polyhalide ions, oxyhalogen species, xenon oxides and fluorides. Oxy- and peroxy acids of N, P and S. Graphitic compounds, carbides, pure silicon, silica and silicates, zeolites.

HSAB concept. super acids. Reactions in non-aqueous media: Liquid ammonia, anhydrous sulphuric acid, glacial acetic acid, anhydrous HF, bromine trifluoride, liquid sulphur dioxide and dinitrogen tetroxide. Reactions in molten salts.

UNIT- III: **[15 Hours]**

Precipitation phenomena: precipitation from homogeneous solutions, organic precipitants in inorganic analysis. Solvent extraction of metal ions, nature of extractant, distribution law, partition coefficients, types of extractions and applications.

Theories of redox indicators, titration curves, feasibility of redox titrations.

Chelometric titrations- titration curves with EDTA, feasibility of EDTA titrations, indicators for chelometric titrations, selective masking and demasking techniques, industrial applications of masking.

Sampling techniques, preparation of samples for analysis. Nature of errors, statistical treatment of errors, the t- and F-tests, significant figures, rejection of data.

REFERENCES:

1. J.E Huheey, Keiter, Keiter and Medhi: Inorganic Chemistry (4th ed.), Pearson Education, 2006.
2. Shriver, Atkins and Langford : Inorganic Chemistry (3rd edn.) OUP, 1999.
3. J.D. Lee: Concise Inorganic Chemistry, (5th edn.) Blackwell Science, 2000.
4. B.E. Douglas, D. McDaniel & A Alexander: Concepts & Models of Inorganic Chemistry, Wiley 2001
5. W.W. Porterfield: Inorganic chemistry – A Unified Approach, Elsevier, 2005.
6. R.A. Day and A.L. Underwood : Quantitative Analysis, 5th Ed. (Prentice Hall, India), 1998.

OC H 402: ORGANIC CHEMISTRY

COURSE OUTCOME:

- Enable the students to learn the bonding in organic systems, various aspects of aromaticity, electronic effects, acidity and basicity of organic compounds.
- To gain knowledge on methods of determination of reaction mechanism, various reaction intermediates and aliphatic nucleophilic substitution reactions.
- To understand the detailed aspects of optical and geometrical isomerism.

UNIT–I: **[15 Hours]**

Bonding in organic systems: Theories of bonding-Valence and molecular orbital approaches. Resonance, hyper-conjugation and tautomerism, Huckel molecular orbital theory and its application to simple systems- ethylene, allyl, cyclopropyl, butadienyl, cyclopentadienyl, pentadienyl, hexatrienyl, heptatrienyl systems. Calculation of the total energy and M.O. coefficients of the systems. 5 hrs

Aromaticity: Concept of aromaticity, Huckel's rule, Polygon rule, Homo-aromatic, non aromatic and anti-aromatic systems. Aromaticity in benzenoid and non-benzenoid molecules. Annulenes & hetero-annulenes. Physical methods to study aromaticity-UV, IR & ^{1}H NMR. 4 hrs

Bonds weaker than covalent: Addition compounds, crown ether complexes, cryptands, inclusion compounds, catenanes, fluxional molecules. 3 hrs

Structure and reactivity: Effects of hydrogen bonding, resonance, inductive and hyperconjugation on strengths of acids and bases. 3 hrs

UNIT-II: **[15 Hours]**

Methods of Determining Reaction Mechanism: Kinetic and non-kinetic methods, Identification of products, detection of intermediates, isotopic labeling, stereochemical evidences, cross-over experiments, Limitation of reactions, kinetic evidences and kinetic isotopic effects. 5 hrs

Reaction Intermediates: Generation, structure, stability, reactivity, detection, trapping and reactions of classical and non-classical carbocations, carbanions, free radicals, carbenes, nitrenes and arynes. Singlet oxygen-generation and reactions with organic molecules. 5 hrs

Aliphatic Nucleophilic Substitution Reactions: Mechanism and scope of aliphatic nucleophilic substitution reactions-S_N1, S_N2 and S_Ni. Stereochemistry of nucleophilic substitution reactions, allylic nucleophilic substitution reactions, Walden inversion, neighbouring group participation & anchimeric assistance. Factors influencing the rates of nucleophilic substitution reactions. 5 hrs

UNIT-III: Stereochemistry [15 Hours]

Optical Isomerism: Conformation and configuration of molecules, projection formulae, Fischer, Saw-horse, Newman and Flying wedge representations. Interconversion of these formulae. Absolute configuration (D,L) and (R,S) systems. Elements of symmetry, Psedoassymmetric centres, chirality, molecules with more than one chiral centre, threo and erythro isomers, methods of resolution, stereospecific and stereoselective synthesis, asymmetric synthesis, Cram's and Prelog's rules. Optical activity in the absence of chiral carbon-biphenyls, allenes and spiranes. Conformational analysis of cycloalkanes and decalins. Effect of conformation on reactivity. Acyclic & cyclic systems-Substituted cyclohexanes, cyclohexanones, cyclohexanols, Curtain-Hammet Principle. Stereochemistry of compounds containing nitrogen, sulphur and phosphorus. 12 hrs

Geometrical Isomerism: Cis-trans isomerism resulting from double bonds, monocyclic compounds & fused ring systems. E,Z-notations, determination of configuration of geometrical isomers, syn & anti isomers. 3 hrs

REFERENCES:

1.Organic Chemistry-P.Y.Bruice (Pearson Education Pvt. Ltd.,New Delhi),2002.

2.Stereochemistry,Conformation and Mechanism-P.S.Kalsi (Wiley Eastern,New Delhi)1993.

3.Stereochemistry of Carbon Compounds-E.L.Eliel (Tata McGraw Hill, New. Delhi) 1994.

4.Advanced Organic Chemistry-Reactions, mechanisms & structure-J.March (Wiley, NY)2000.

5.Organic Chemistry-Vol. -1,2 &3-Mukherji, Singh and Kapoor. (Wiley Eastern,) 1994.

6.A guide book of mechanisms in Organic Chemistry-P.Sykes (Orient- Longman) 1985.

7.Organic Chemistry-R.T. Morrison and R.N. Boyd (Prentice Hall, New Delhi) 1994.

8.Organic Chemistry 4th Edn.–S.H. Pine et al (McGraw-Hill, London) 1987.

9.Advanced Organic Chemistry- R.A. Carey and R.J. Sundberg (Plenum, New York)1990.

10.Modern Concepts of Advanced Organic Chemistry-R.P. Narein (Vikas, Delhi) 1997.

11.A Text book of Organic Chemistry-Tewari, Vishnoi and Mehrotra (Vikas, New Delhi)1998.

12.A Text book of Organic Chemistry-3rd Edn.-R.K. Bansal, (New Age, New Delhi) 1997.

13.Organic Chemistry-3rd Edn- F.A. Carey (Tata McGraw Hill, New Delhi) 1996.

14.Stereochemistry by K. Mislow.

15. Organic Chemistry-H. Pine (Hendrickson, Cram and Hammond,Mc Graw Hill, New York) 1987.

16. Organic Chemistry-I.L. Finar (ELBS Longmann, Vol. I) 1984.

OC H 403 : PHYSICAL CHEMISTRY

COURSE OUTCOME:

- To understand the theoretical basis of catalysis, corrosion and various complex reactions which find relevance in biological processes and are of industrial importance.
- The students are introduced to the modern techniques developed for the practical applications of these concepts in different areas of science and technology.
- This course will enable the students to handle issues related to corrosion in the day to day life and in industrial reactors;enzyme mediated reactions in biochemistry, biotechnology and pharmaceutical chemistry etc.

UNIT-I: Catalysis [15hours]

Catalysis: Homogeneous Catalysis–equilibrium and steady state treatments, activation energies of catalysed reactions. Acid - base catalysis (general and specific), protolytic and prototropic mechanisms, catalytic activity and acid strength measurements. Kinetics of enzyme catalysed mechanisms – Michaelis – Menten mechanism. Effect of pH, temperature and inhibitors. 6hrs.

Acidity functions: Hammett acidity function, Zucker–Hammett hypothesis, and Bunnett hypothesis. 2hrs

Surface Chemistry: A review of adsorption isotherms, uni- and bi- molecular reactions. Multilayer adsorption: BET equation – application in surface area determination. Harkin – Jura equation and application. Semiconductor catalysis, n- & p- type. Mechanism of surface reactions. Langmuir – Hinshelwood and Langmuir Rideal mechanisms. 7hrs

UNIT – II [15 hours]

Chemical Kinetics:

Composite reactions: Rate equation for composite reaction mechanisms (simultaneous and consecutive reactions, steady state treatment, rate determining steps and microscopic reversibility), Chain reactions (hydrogen-halogen reactions with comparison). Auto catalytic reactions (Hydrogen-Oxygen reaction) and Oscillatory reactions. 6hrs.

Reactions in solution: Solvent effects on the reaction rates, Factors determining reaction rates in solution, reaction between ions (effect of dielectric constant and ionic strength), substitution and correlation effects (Hammet and Taft equations-linear free energy relations.) Ion-dipole and dipole-dipole reactions (Pre exp factors and influence of ionic strength) and diffusion controlled reactions. 4 hrs.

Fast reactions-Introduction, Study of fast reactions by-flow, relaxation, molecular beam, and spectroscopic and analytical methods. 3hrs.

Theory of reaction rates- Temperature dependence and the Arrhenius theory of reaction rates, collision theory of bimolecular reactions, its importance and limitations. Introduction to transition state theory. 2hrs.

UNIT-III [15hours]

Electrochemistry of solutions: Ionic atmosphere-introduction, derivation and its effect on thetheory of conductivity. Walden`s rule. Debye-Huckel limiting law (DHL), its modification and verification. Bjerrum theory of ion association, triple ion formation and its significance. 4hrs.

Corrosion: Introduction, Importance and principles, Forms of corrosion (Galvanic, Atmospheric, stress, microbial and soil). Techniques of Corrosion rate measurement (instrumental and non-instrumental). EMF series &Galvanic series and their limitations. Thermodynamics (Pourbaix diagram). Concept of mixed potential theory and its importance in terms of Kinetics (Tafel and Evans diagram), effect of oxidizer and passivity of corrosion. Protection against corrosion (Design improvement, Anodic and cathodic protection, inhibitors, coating). 6 hrs.

Analytical Applications of Electrochemistry -Principles and Applications of Polarography, Cyclic voltammetry, Coulometry, Amperometry and chrono systems. 5hrs.

REFERENCES

1. Chemical Kinetics, K. J. Laidler, Pearson Education, Anand Sons(India) 3rd ed., 2008.
2. Fundamentals of Chemical Kinetics, M.R.Wright, Harwood Publishing, Chichesrer, 1999.
3. Kinetics & Mechanisms of Chemical Transformations, J Rajaram & J C Kuriacose, Macmillan, Delhi,42007.
4. Chemical &Electrochemical Energy Systems, R. Narayan & B. Viswanathan (University Press), 1998.
5. Industrial Electrochemistry, D. Peltcher & F. C. Walsh (Chapman & Hall)1990.
6. Principles and Applications of Electrochemistry–Crow (Chapman hall, New York) 2014
7. An Introduction to metallic corrosion and its prevention-Raj Narayan (Oxford-IBH, New Delhi), 1983.
8. Electrochemistry and Corrosion Science-Nebtor Ferez (Springer Pvt.Ltd.), Delhi, 2010.
9. Instrumental Methds of Chemical Analysis, Kudesia Sawhney, Pragati Prakasha(Meerut).

OC S 404 : SPECTROSCOPY AND ANALYTICAL TECHNIQUES

COURSE OUTCOME:

- Students will learn the basic principles and applications of ESR Spectroscopy, NQR Spectroscopy,
- Students can be familiarising with Mossbauer Spectroscopy, Photoelectron spectroscopy, Atomic absorption Spectroscopy, Emission Spectroscopy, Molecular Luminescence Spectroscopy and Light Scattering methods.
- The students will also trained in the field of Ion Exchange Chromatography, Exclusion Chromatography and Thermal methods
- Overall students can solve the problems related to spectroscopy

UNIT- I: **[12 Hours]**

Electron Spin Resonance Spectroscopy: Basic principles, hyperfine couplings, the 'g' values, factors affecting 'g' values, isotropic and anisotropic hyperfine coupling constants, Zero Field splitting and Kramer's degeneracy. Measurement techniques and Applications to simple inorganic and organic free radicals and to inorganic complexes.

NQR Spectroscopy: Quadrupolar nuclei, electric field gradient, nuclear quadrupole coupling constants, energies of quadrupolar transitions, effect of magnetic field. Applications.

Mössbauer Spectroscopy: The Mössbauer effect, chemical isomer shifts, quadrupole interactions, measurement techniques and spectrum display, application to the study of Fe^{2+} and Fe^{3+} compounds, Sn^{2+} and Sn^{4+} compounds(nature of M-L bond, coordination number and structure), detection of oxidation states and inequivalent Mössbauer atoms.

Photoelectron spectroscopy: Basic principles, valence &core binding energies, shifts in energies due to chemical forces, Photoelectron spectra of simple molecules, Auger transitions, measurement techniques. Applications.

UNIT-II [12 Hours]

Ion Exchange Chromatography: Definitions, requirements for ion-exchange resin, synthesis and types of ion-exchange resins, Principles, basic features of ion-exchange reactions, resin properties, ion-exchange capacity, resin selectivity and factors affecting the selectivity, applications of IEC in preparative, purification and recovery process. Separation of lanthanides.

Exclusion Chromatography: Theory and principle of size exclusion chromatography, experimental techniques for gel-filtration chromatography (GFC) and gel-permeation chromatography (GPC), materials for packing-factors governing column efficiency, methodology and applications.

Thermal methods: Thermogravimetric analysis, Instrumentation, factors affecting the results and applications. Differential thermal analysis, simultaneous DTA-TGA curves. Differential scanning calorimetry, applications.

UNIT – III: **[12 Hours]**

Atomic Absorption Spectrometry: Principle, Theory, working of AAS instruments, analytical applications, interferences.

Emission Spectroscopy: Flame Emission Spectroscopy, plasma emission spectrometry, basic principles of flame photometry, evaluation methods in flame photometry, interferences.

Molecular Luminescence Spectroscopy: Theory of fluorescence and phosphorescence, fluorimetry in quantitative analysis, instruments, fluorescence and structure, fluorescence quenching, phosphorescence method, applications in quantitative analysis.

Light-Scattering methods : Nephelometry and turbidimetry- theory, effects of concentration, particle size and wavelength on scattering, instrumentation and applications. Activation analysis.

REFERENCES:

1.A. Salahuddin Kunju and G. Krishnan: Group Theory and its Applications in Chemistry, PHI Learning, N. Delhi, 2010

2.Gurudeep Raj, Ajay Bhagi and Vinod Jain: Group Theory and Symmetry in Chemistry, 4th edn , Krishna Meetut, 2012.

3. U.C. Agarwala, H.L.Nigam, Sudha Agarwal and S.S. Kalra: Molecular Symmetry in Chemistry via Group Theory, Anne Books, N. Delhi, 2013.

4.G.D. Christian : Analytical Chemistry, (4th Ed.), (John Wiley),1986.

5. R.A.Day and A.L. Underwood : Quantitative Analysis, 5th Ed. (Prentice Hall, India), 1998.

6.H.H.Wlliard, L.L.Merrit and J.J.Dean, Instrumental methods of analysis,(7th Ed.) 1988

7. B.K.Sharma, Instrumental Methods of Chemical Analysis (Goel publishing), 2000.

8.Skoog, Holler and Nieman: Principles of Instrumental Analysis, (Harcourt Afca), 2001

OC S 405: ENVIRONMENTAL CHEMISTRY

COURSE OUTCOME:

- This course enlighten the students about environmental pollutions like Air pollution, toxic chemicals in the environment,
- Hydrologic cycle, BOD, COD, radioactive waste management, sewage and industrial effluent treatment, water purification,
- Biochemical effects of Pesticides and heavy metals.
- Students learn effect of toxic chemicals in environment.

UNIT-I **[12 Hrs]**

Environmental segments, evolution of earth's atmosphere. Air pollution : Air pollutants, prevention and control, Green house gases and acid rain. Carbon monoxide, industrial sources and tranportation sources. SO_x- sources, ambient concentration, test methods, control techniques

- scrubbing, , limestone injection process. Ozone hole and CFC's. Photochemical smog and PAN. NO_x - Sources, ambient concentration, test methods, thermodynamics and NO_x, control techniques. Particulates : Size distribution, , particulate collection - settling chambers, centrifugal separators, wet scrubbers, electrostatic precipitators & fabric filters. Catalytic converters for mobile sources. Bhopal gas tragedy.

UNIT-II **[12 Hrs]**

Hydrologic cycle, sources, chemistry of sea water, criteria and standards of water quality- safe drinking water, maximum contamination levels of inorganic and organic chemicals, radiological contaminants, turbidity, microbial contaminants. Public health significance and measurement of colour, turbidity, total solids, acidity, alkalinity, hardness, chloride, residual chlorine, sulphate, fluoride, phosphate and different forms of nitrogen in natural and polluted water. Chemical sources of taste and odour, treatment for their removal, sampling and monitoring techniques. Determination and significance of DO, BOD ,COD and TOC. Water purification for drinking and industrial purposes, disinfection techniques, demineralization, desalination processes and reverse osmosis.

UNIT – III **[12hrs]**

Toxic chemicals in the environment, impact of toxic chemicals on enzymes. Detergents-pollution aspects, eutrophication. Pesticides- pollution of surface water. Sewage and industrial effluent treatment, heavy metal pollution. Chemical speciation- biochemical effects of pesticides, insecticides, particulates, heavy metals (Hg, As, Pb, Se), carbon monoxide, nitrogen oxides, sulphur oxides, hydrocarbon, particulates, ozone, cyanide and PAN. Solid pollutants and its treatment and disposal. Radioactive waste management.

REFERENCES:

1. A.K. De : Environmental Chemistry, (Wiley Eastern).
2. S.K.Banerji : Environmental Chemistry, (Prentice Hall India), 1993.
3 S.D. Faust and O.M. Aly: Chemistry of Water Treatment, (Butterworths),1983.
4. Sawyer and McCarty, Chemistry for Environmental Engineering(McGraw Hill) 1978
5. I.Williams, Environmental Chemistry, John Wiley, 2001
6. S.M.Khopkar, Environmental Pollution Analysis, (Wiley Eastern).

OC S 406-Molecular Spectroscopy & Diffraction Techniques

COURSE OUTCOME:

- Deals with the understanding of the spectroscopic techniques which are based on the interaction of the electromagnetic radiation in the microwave, infrared and X-ray region with the molecules.
- The techniques introduced here are major characterization techniques employed to understand the chemical composition of compounds and the physical characteristics.
- The paper has multidisciplinary relevance as these techniques are used in various fields namely, chemistry, physics biology and materials science.
- Student will be able to learn instrument like x-ray, TEM, SEM and their applications

UNIT-I **[12 hours]**

Introduction to spectroscopy, intensity of spectral lines, Natural line width and broadening, Rotational, vibrational and electronic energy levels, selection rules.

Microwave Spectroscopy- The rotation and classification of molecules, rotation spectra of diatomic and polyatomic molecules. Rigid and non-rigid rotator models. Determination of bond length, isotope effect on rotation spectra. Stark effect, nuclear and electron spin interaction. Microwave Spectrometer.

Vibration Spectroscopy: Vibration spectra of diatomic molecules - linear harmonic oscillator, vibrational energies, zero point energy, force constants & bond strengths; anharmonicity of molecular vibrations- Morse PE diagram, selection rules, fundamental, overtones and hot bands. Vibrations of polyatomic molecules- normal modes of vibrations & nature of molecular vibrations (Ex-CO_2& H_2O).

UNIT–II: **[12 hours]**

Vibration-rotation spectra of diatomic and polyatomic molecules, selection rules, PQR branches. IR Spectrophotometer-Instrumentation

Raman Spectroscopy: Classical and quantum theories of Raman effect, concept of polarizability and polarizability ellipsoid. Rotational and vibrational Raman spectra, selection rules, Raman activity of vibrations, vibrational - rotational Raman spectra, selection rules, mutual exclusion principle, polarization of Raman lines. An introduction to Laser Raman Spectroscopy. Raman Spectrometer – instrumentation. Applications of IR and Raman spectroscopy in elucidation of molecular structure (Ex - H_2O, N_2O & CO_2 molecules).

UNIT III **[12Hours]**

Diffraction Techniques: Introduction, production of X-ray, Bragg`s law, Laue equations, Ewald's diagram, X-Ray diffraction experiments – diffraction of X-rays by a crystalline powder (Debye-Scherrer and flat plate camera), powder diffractometer. Interpretation of power patterns (analytical technique). Single crystal technique - :Laue and Rotation photographic methods. Moving Film method (Weissenberg method). Systematic absences. Crystalline X-ray diffractometer (4 angle), Intensities of diffracted X-rays and structural analysis, X-ray scattering atoms and molecules, Factors affecting X-ray intensities, introduction to Crystal structure analysis. 9hrs.

Electron Diffraction: Introduction, Theory of electron diffraction, Wierl equation and its significance (qualitatively), Elucidation of structure of simple gas molecules. Structure of surfaces - (Low and high Energy Electron Diffraction, Transmission electron microscopy (TEM), SEM. Theory and applications of Neutron diffraction. Comparison between X-ray, electron and Neutron diffractions. 3hrs .

REFERENCES:

1.Fundamentals of Molecular Spectroscopy, Banwell & McCash (Tata McGraw Hill, New Delhi) 2007.
2. Spectroscopy, H. Kaur (Pragathi Prakashana,Meerut), 2012.
3.Spectroscopy, Donald L.Pavia (Cengage learning India Pvt.Ltd., Delhi), 2007.
4.Spectroscopy, B.K.Sharma (Goel prakashan, Meerut), 2013.
5. A Basic Course in Crystallography, JAK Tareen and TRN Kutty, University Press, Hyderabad (2001).
6. Essentials of Crystallography, M.A. Waheb, Narosa Publishing House, New Delhi (2009),
7. X-ray methods, Clive Whiston, (John Wiley & Sons, New York) 1987.

OC P 407: INORGANIC CHEMISTRY PRACTICALS – I

COURSE OUTCOME:

- Students will have hands on experience on the analysis of Hematite Dolomite, Pyrolusite, Solder,
- Analysis of Halide Mixture, Colorimetric Determination, Gravimetric determinations and Statistical Analysis of Data.
- To understand Complexometric determination and hardness of water
- It enables the students to learn Statistical Analysis of Data.

1. Analysis of Hematite-insoluble residue by gravimetry and Iron by volumetry using Ce^{4+}.
2. Analysis of Dolomite - insoluble residue by gravimetry and Ca, Mg by complexometry.
3. Pyrolusite - Insoluble residue by gravimetry and Manganese content by oxalate method.
4. Analysis of solder - Pb and Sn by EDTA method.
5. Complexometric determination of Mn, Cu, Ni and Fe-Cr mixture
6. Hardness of water
7. Analysis of Halide Mixture - Iodide by KIO_3 and total halide by gravimetrically.
8. Colorimetric Determination of Iron by thiocyanate and Cu by aqueous ammonia.
9. Gravimetric Determinations of Mn, Ni, Mo, Pb/Cr, sulphide, thiocyanate.
10. Statistical Analysis of Data.

Reference :

1. Vogel's Text Book of Quantitative Chemical Analysis (5^{th} Ed), G.H. Jeffrey, J. Bassette, J. Mendham and R.C. Denny, Longman, 1999.

OC P 408: ORGANIC CHEMISTRY PRACTICALS – I

COURSE OUTCOME:

- Enlighten the students to understand the method of organic preparation by utilizing various kinds of organic reactions,
- To understand isolation and purification of products.
- To understand oxidation reactions
- To learn substitution reaction.

Single and two stage organic preparations

1. Electrophilic substitution reactions–Preparations of p-bromoaniline, p-nitroaniline, 2,4,6-tribromophenol and picric acid.
2. Alkylations–Preparation of nerolin and N-methyl anthranilic acid.
3. Acetylations–Preparations of □-D-glucose penta-acetate and 2-naphthyl acetate.
4. Reactions with ring formation–Preparations of 1,2,3,4–tetrahydrocarbazole, 1-phenyl-3-methyl-5-pyrazolone and 7– hydroxy-4-methyl-coumarin.
5. Diazotisation reactions–Preparations of iodo, chloro and azo compounds.
6. Dehydration reactions–Preparations of cyclohexene and succinic anhydride
7. Condensation reactions–Condensations involving diethylmalonate and ethyl aetoacetate. Claisen-Schmidt, Aldol and Perkin condensation reactions.
8. Halogenation reactions-Preparation of n-butylbromide &□, □-dibromocinnamic acid.
9. Reduction reactions–Reductions of nitro compounds and carbonyl compounds.
10. Oxidation reactions-Preparation of p-nitrobenzoic acid, p-benzoquinone and adipic acid.

REFERENCES:

1. Laboratory Manual in Organic Chemistry–R. K. Bansal (New Age, New Delhi)1990.

2. Experimental Organic Chemistry–Vol. I & II–P. R. Singh et al (TMH New Delhi)1981

3. Laboratory Manual in Organic Chemistry–Dey &Sitaraman(Allied , New Delhi)1992.

4. Vogel's Text Book of Practical Organic Chemistry including Qualitative

   Organic Analysis - B. S. Furniss et al., (Longman - ELBS, London), 1989.

5. Manual of Organic Chemistry - Dey and Seetharaman.

6. A Text Book of Practical Organic Chemistry – A.I. Vogel, Vol.III.

8. Practical Organic Chemistry - Mann & Saunders.

OC P 409: PHYSICAL CHEMISTRY PRACTICALS - I

(Any 12 experiments are to be carried out)

COURSE OUTCOME:

- Experiments have been designed which make use of the concepts of electrochemistry, thermodynamics, solution chemistry and surface chemistry.
- Students get hands on experience in use of various instruments.
- It will be able to understand the theoretical concepts.
- To learn Specific and molar refractivity, viscocity, parachor etc.

1. (a) Determination of transport number of Cd^{2+} and SO_4^{2-} ions by EMF method.
   (b) Determination of thermodynamic parameters of a cell reaction by EMF method.
2. Determination of pK values phosphoric acid by potentiometric/pH metric method
3. Potentiometric titration of halides in mixtures (Cl^-, Br^- and I^-) with silver nitrate
4. Verification of Nernst equation for Ag^+, $Cu^{2+}$and Zn^{2+} species.
5. Determination of Solubility product and the Instability constant by potentiometric method.
6. Potentiometric determination of solubility of insoluble silver halide and the standard electrode potential using quinhydrone electrode.
7. Conductometric titrations of displacement and precipitation reactions.
8. Determination of equivalent conductance and dissociation constants of weak acid and base.
9. Determination of solubility of lead iodide at different T & hence molar heat of solution
11. Determination of hydrolysis constant of aniline hydrochloride.
11. Determination of degree of hydrolysis of CH_3CO_2Na and NH_4Cl by conductivity method.
12. Determination of Critical Micelle concentration by conductometric method.
13. Determination of pH of buffer solutions with a pH meter & evaluation of pK_a of acids
14. Verification of Walden`s rule (relation between viscosity of a solution and the electrical conductivity.
15. Study of variation of viscosity of a liquid with temperature
16. Determination of parachor value for CH_2 group and some elements by Surface Tension method,
17. Determination of the composition of a solution by S.T measurement .
18. Determination of the Critical Micelle Concentration by surface tension/spectrophotometric measurements.
19. Determination of the composition of Zinc Ferrocyanide complex by Potentiometric titrations.
20. Determination of Specific and molar refractivity of liquids and paracor value of a species by refractometric method.

Any other relevant experiments of interest.

REFERENCES:

1. Findlay's Practical Physical Chemistry- B. P. Levitt (Longman, London).
2. Experiments in Physical Chemistry– James and Prichard.
3. Experimental Physical Chemistry - Daniels et al.
4. Experimental Physical Chemistry-Das & Behera (Tata McGraw Hill, New Delhi)1983.
5. Advanced Practical Physical Chemistry–Yadav (1989).
6. Experiments in Physical Chemistry–J. C. Ghosh (Bharathi Bhavan)1974.
7.Practical Physical Chemistry-B Viswanathan & P.S Raghavan,(ViVa Books, New Delhi) 2005.

2nd Semester

OC H 451: ADVANCED INORGANIC CHEMISTRY

COURSE OUTCOME:

- Students will study Symmetry and Group Theory,
- Chemistry of higher Boranes, Phosphazene polymers,
- Advances aspects of MOT theory, Trends of transition metals in periodic tables,

Methods of reduction of oxide ores in this course

UNIT - I: **[15 Hours]**

Symmetry and Group Theory

Definitions of group, subgroup, relation between orders of a finite group and its subgroup. Conjugacy relation and classes, symmetry elements and symmetry operations, Schonflies symbols, Matrix representations of symmetry operations, products of symmetry operations, some properties of matrices and vectors, classification of molecules into point groups.

Reducible and irreducible representations. The Great Orthogonality theorem (without proof), character tables. The direct product. Applications of group theory - Molecular vibrations, group theoretical selection rules for electronic transitions, for infra red and Raman spectra. Hybrid orbitals and Molecular orbitals, transformation properties of atomic orbitals.

UNIT – II: **[15 Hours]**

Chemistry of higher boranes, classification, structure and M.O. description of bonding, framework electron counting, Wade's rules, chemistry of B_5H_9, $B_{10}H_{14}$ and $B_nH_n^{2-}$ carboranes and metallocarboranes. Cyclophosphazenes, phosphazene polymers, S-N compounds. Coordination numbers 2-10 and their geometry, crystal field theory of coordination compounds, d-orbital splittings in octahedral, square planar and tetrahedral fields, spectrochemical series, and

Jahn-Teller effect. Structural evidences for ligand field splittings – hydration, ligation and lattice energies, site preference energies. MO theory of coordination compounds- MO energy level diagrams for octahedral and tetrahedral complexes.

UNIT - III: **[15 Hours]**

Trends in oxidations states, stereochemistry and ionic sizes of metals, comparison of 3d, 4d and 5d series by taking Ti and Ni subgroups as examples. Lanthanides and actinides: electronic structure, oxidation states, extraction and separation of lanthanides, stereochemistry, spectral and magnetic properties of lanthanide and actinide complexes, lanthanide complexes as NMR shift reagents. Comparison with d-block ions.

Methods of reduction of oxide ores, Ellingham diagram, chemical and electrolytic reductions, reduction potentials, Latimer and Frost diagrams, effect of complexation on potential.

REFERENCES:

1. J.E Huheey, E.A..Keiter, R.L.Keiter & O K Medhi: Inorganic Chemistry (4th edn.), Pearson, 2006.
2. Shriver, Atkins and Langford : Inorganic Chemistry (3rd edn.) OUP, 1999.
3. J.D.Lee: Concise Inorganic Chemistry, (5th edn.) Blackwell Science, 2000.
4. B.E.Douglas, D.McDaniel &A Alexander: Concepts & Models of Inorganic Chemistry, Wiley 2001

5. W.W.Porterfield: Inorganic chemistry – A Unified Approach, Elsevier, 2005.
6.N.N.Greenwood and A. Earnshaw, Chemistry of the Elements, First Edn(Pergamon Press)
7. Basallo & Johnson, Coordination Chemistry

OC H 452: ADVANCED ORGANIC CHEMISTRY

COURSE OUTCOME:

- Students will gain an understanding of all details of aliphatic/ aromatic electrophilic substitution reactions and aromatic nucleophilic substitution reactions.
- Students will learn about various free radical reactions and elimination reactions including pyrolytic eliminations.
- Students will gain an understanding of formation and hydrolysis of esters,

Addition of carbon-carbon multiple bonds and addition to carbon-heteroatom multiple bonds.

UNIT - I: **[15 Hours]**

Aliphatic Electrophilic Substitution Reactions: Bimolecular mechanisms-S_E1, S_E2 and S_Ei mechanism. Electrophilic substitution reactions accompanied by double bond shifts. 3 hrs

Aromatic Electrophilic and Nucleophilic Substitution Reactions: Mechanism of aromatic electrophilic substitution reactions-nitration, halogenation, sulphonation, Friedel-Crafts alkylation and acylation, orientation and reactivity, energy profile diagram. The ortho/para ratio, ipso attack, orientation in other ring systems. Mechanism of Vilsmeir-Haack reaction, Mannich reaction, Diazonium coupling, Pechmann reaction and Fries rearrangement. Mechanisms of aromatic nucleophilic substitution reactions- S_NAr, S_N1 & aryne mechanism. Von-Richter rearrangement, Sommelet-Houser rearrangement, Smiles rearrangement.12 hrs

UNIT- II: **[15 Hours]**

Free Radical Reactions: Types, mechanisms of free radical substitution reactions &neighbouring group assistance. Reactivity for the aliphatic and aromatic substances at a bridgehead. Reactivity of attacking radical. Effect of solvent on reactivity. Auto-oxidation, coupling of alkynes. Arylation of aromatic compounds by diazonium salts. Sandmeyer, Ullmann & Hunsidiecker reactions. 5 hrs

Elimination Reactions: Discussions of E1, E2 and E1cB mechanisms. Orientation during elimination reactions. Saytzeff and Hofmann rules. Reactivity-effects of substrate structures, attacking base, leaving group and solvent medium. 5 hrs

Pyrolytic Eliminations: Mechanisms of pyrolysis of esters of carboxylic acids. Chugaev reactions, Hofmann degradation, Cope elimination and xanthate pyrolysis. 5 hrs

UNIT- III: **[15 Hours]**

Formation and Hydrolysis of Esters: Plurality of mechanism. Mechanism of esterification reactions. Ester hydrolysis-$A_{AC}2$, $B_{AC}2$, $A_{AC}1$ & $A_{AL}1$ mechanism. Transesterification.4 hrs

Addition to Carbon-Carbon Multiple Bonds: Addition reactions involving electrophiles, nucleophiles and free radicals. Cyclic mechanisms. Orientation and stereochemistry. Addition of halogens, hydrogen halides, carboxylic acids and amines. Addition to cyclopropanes, hydroboration, Michael addition. Addition of oxygen across double bonds. 5 hrs

Addition to Carbon-Hetero Multiple Bonds: Electrophilic, nucleophilic and free radical additions to C=O and C=N systems. Addition of Grignard reagents. Reformasky reaction, aldol condensation, Knoevenagel condensation, Perkin reaction and Wittig reactions. 6 hrs

REFERENCES:

1.Organic Reactions and Their Mechanisms- P.S. Kalsi (New Age, New Delhi),1996.

2.Advanced Organic Chemistry 4th Edn- J. March (Wiley, NY) 2000.

3.Organic Reaction Mechanisms- Bansal (Tata McGraw Hill, New Delhi) 1978.

4.Organic Chemistry-Vol.–I & II-Mukherji, Singh and Kapoor(Wiley Eastern, New Delhi) 1985.

5.Mechanism and Theory in Organic Chemistry-Lowry and Richardson Harper and Row, 1987.

6. Reaction Mechanisms in Organic Chemistry-Mukherji, Singh and Kapoor (McMillan) 1978.

7. Organic Chemistry-P.Y. Bruice (Pearson Education, New Delhi) 2002.

8. Organic Reaction Mechanism-R.K. Bansal (Wiley Eastern Limited, New Delhi) 1993.

9. A Guide Book to Mechanism in Organic Chemistry-Petersykes.

10. Advanced Organic Chemistry –Carey and Sundberg, Part A& B, 3rd edition (Plenum Press, New York) 1990.

11. Organic Chemistry-I.L. Finar (ELBS Longmann, Vol. I) 1984.

12. Advanced General Organic Chemistry-S.K. Ghosh (Book and Alleied (P) Ltd) 1998.

OC H 453 : ADVANCED PHYSICAL CHEMISTRY

COURSE OUTCOME:

- It is an advanced level course which helps to understand the concepts of physics and their subsequent applications in the field of chemistry.
- The concepts of chemical thermodynamics helps in the design of processes in chemical industries.
- The concepts of statistical thermodynamics find relevance in understanding the nature of solids and metals in specific.
- It enables to understand chemical bonding, photochemistry and spectroscopy

UNIT I: **[15hours]**

Chemical Thermodynamics:

Entropy: Physical significance, entropy change in an ideal gas. Variation of entropy with Temperature, Pressure and Volume. Entropy change in reversible and irreversible processes. Thermodynamic equations of state.

Free energy, Maxwell's relations and significance. Helmholtz's and Gibbs free energies, Gibbs – Helmholtz equation and its applications.

Nernst heat theorem: Its consequences and applications. Third law of thermodynamics – statements, applications and Comparison with Nernst Heat theorem.

Chemical affinity and thermodynamic functions. Effect of temperature and pressure on chemical equilibrium- van't Hoff reaction isochore and isotherms.

Partial molar properties: Physical significance, determination of partial molar volume and enthalpy. Chemical potential: variation of chemical potential with temperature. Gibbs – Duhem equation.

Thermodynamic functions of mixing, Gibbs – Duhem – Margules equation.

Fugacity: Relationship between fugacity and pressure. Determination of fugacity- graphical method and Lewis Randall rule.
Activity and activity coefficient: Variation of activity and fugacity with temperature and pressure. Determination of activity by vapour pressure method.

UNIT - II: Statistical and Irreversible thermodynamics [15 hours]

Statistical Thermodynamics: Thermodynamic Probability, phase space, micro and macrostates, statistical weight factor, assembly, ensemble-significance, classification and comparison. Distribution laws – Boltzmann law, Maxwell-Boltzmann distribution law. Bose-Einstein and Fermi-Dirac statistics, Limit of applicability of various laws. Relationship between partition function and thermodynamic functions -Average energy, heat capacity, free energy, chemical potential. Introduction to Statistical mechanism of independent, independent and indistinguishable (non-localized) molecules or particles.

Partition function for molecular particles.

Thermodynamic quantities in terms of partition function of particles- Evaluation of Translational, vibrational, rotational, electronic and nuclear derivations of translational, rotational, vibrational and electronic partition functions. Law of equipartition principle. Partition function and equilibrium constant.

Statistical thermodynamic properties of solids (Heat capacity)-Introduction, thermal characteristics of crystalline solid, Einstein model, Debye modification. Nuclear statistics - Introduction, symmetric and nuclear spin, ortho and para nuclear states. Applications of partition function to mono atomic gases, diatomic molecules, equilibrium constant. 9hrs.

Irreversible Thermodynamics – Introduction, Thermodynamics of irreversible processes, Entropy production-rate of entropy production. Phenomenological relations. The principle of microscopic reversibility, Onsager reciprocal relations – validity and applications (Electro kinetic, Thermoelectric phenomena). Irreversible thermodynamics of Non linear regime and biological systems. 6hrs

UNIT III

Postulates of quantum Mechanics. Particle waves, its character and significance. Normalization and orthogonality of wave functions. Operators and their algebra, types and applications, operators for the dynamic variables of a system (position, linear momentum, angular momentum, Kinetic energy, potential energy and total energy) Eigen values and Eigen functions. Quantum numbers and their characteristics. Schrodinger wave equation – significance and derivation. Statistical interpretation of ψ 7 hrs

Solution of SWE for simple systems-particle in a box (1D & 3D), particle in a ring, simple harmonic oscillator, rigid rotor, the H atom (solution of r,θ,Φ equations). Chemical Bonding in diatomics: Covalent bond-Valence bond and molecular orbital approaches with comparison.

Molecular orbital theory applied to homonuclear and heteronuclear diatomic molecules. Introduction to Huckel molecular orbital theory of conjugated systems and its applications.
8hrs

REFERENCES:
1.Thermodynamics for Chemists- S Glasstone(East West press)
2.Physical Chemistry-P W Atkins.
3.Chemical Themodynamics, Rajaram and Kuriokose (East-West)Pearson, Chennai, 2013.
4. Thermodynamics, 3rd Ed., R.C. Srivastava and Subit K Saha (Prentice-Hall of India, Delhi), 2007.
5. Statistical Thermodynamics, M. C. Gupta (New ge International, Delhi)2007.
6.Principles of Physical chemistry; B.R.Puri, L.R.Sharma and M.S.Pathania, Vishal Publishers(2014)
7.Atomic Structure and Chemical Bond , Manasa Chanda, Tata McGraw Hill Publishers(1991).
8.Quantum Chemistry, R.K.Prasad, New Age International (1991)
9.Advanced Physical Chemistry- Gurdeep R Chatwal (Goel Publishes, Meerut), 1992.
10.Introductory Quantum Chemistry – A.K.Chandra (Tata McGraw Hill) 1994.
11.Quantum Chemistry, A.B.Sannigrahi (Book and Allied Pvt.Ltd., Kolkatt), 2013.
12.Quantum Chemistry, Donald A.P (Viva Books, Delhi), 2013.

OC S 454: ORGANIC SPECTROSCOPIC TECHNIQUES

COURSE OUTCOME:

- Enable the students to understand the principle, theory, instrumentation and applications of UV-Visible, Electronic, NMR (^{1}H, ^{13}C, ^{19}F, ^{31}P) and Mass spectroscopy.
- To solve the composite problems involving the applications of UV-Visible, IR, NMR (^{1}H &^{13}C) and Mass spectroscopic techniques.
- To develop the ability to analyse the spectrum and arrive at the correct structure of compound.
- Overall students can get confidence in solving spectroscopic problems.

UNIT–I: **[12 hours]**

UV/Electronic Spectroscopy: Basic principles, Chromophores, auxochromes, Instrumentation and application. Factors affecting the positions of UV bands. Electronic transitions and empirical correlations of predicting λ_{max} of organic compounds. Woodward–Fieser rules. UV absorption of
aromatic compounds - effect of substituents and solvent effects. Emperical rules to calculate $\lambda_{max.}$ Application of UV spectroscopy in the structural study of organic molecules.5 hrs

IR Spectroscopy: Basic principles, Application of infrared spectroscopy in the structural study-identity by finger printing and identification of functional groups. Characteristic vibrational frequencies of common functional groups (alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines). Study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, anhydrides and acids). Factors affecting band positions and intensities such as effect of hydrogen bonding, phase and solvent on vibrational frequencies, overtones, combination bands and Fermi resonance. 7 hr

UNIT-II: Nuclear Magnetic Resonance Spectroscopy **[12 hours]**

Theory and principle, NMR spectrometer, FT NMR and its advantages. Solvents used, chemical shift and its measurements, factors affecting chemical shift. Integration of NMR signals, spin-spin coupling, coupling constant. Shielding and deshielding. Chemical shift assignment of major functional groups, Classification (ABX, AMX, ABC, A_2B_2), spin decoupling, effects of chemical exchange, fluxional molecules, Hindered rotation through

NMR spectrum, Karplus relationships (Karplus curve–variation of coupling constant with dihedral angle), double resonance techniques, NMR shift reagents, solvent effects and Nulear Overhauser Effect. High resolution ^{1}H NMR. Applications of NMR spectroscopy in structure elucidation of simple organic and inorganic molecules. Pulse techniques in NMR, two dimensional and solid state NMR. Use of NMR in Medical diagnostics. 10 hrs

NMR of nuclei other than proton: ^{13}C chemical shift & factors affecting it. Decoupling-Noise decoupling & broad band decoupling. Off-resonance proton decoupling-some representative examples. Introduction to 19F &31P NMR. 2 hrs

UNIT-III: Mass Spectrometry [12 hours]

Basic principles, Instrumentation, interpretation of mass spectra, resolution, exact masses of nucleides, molecular ions, meta-stable ions and isotope ions. Fragmentation processes-representation of fragmentation, basic fragmentation types and rules. Factors influencing fragmentations and reaction pathways. McLafferty rearrangement. Fragmentations associated with functional groups- alkanes, alkenes, cycloalkanes, aromatic hydrocarbons, halides, alcohols, phenols, ethers, acetals, ketals, aldehydes, ketones, quinines, carboxylic acids, esters, amides, acid chlorides, nitro compounds and amines. Ion analysis, ion abundance, retro Diels-Alder fragmentation. Nitrogen rule. High resolution mass spectroscopy. 9 hrs

Composite problems involving the applications of UV, IR, ^{1}H and ^{13}C NMR and mass spectroscopic techniques. Structural elucidation of organic molecules. 3 hrs

REFERENCES:

1. Spectrometric Identification of Organic Compounds - Silverstein, Bassler & Monnill (Wiley)1981.

2. Applications of Absorption Spectroscopy of Organic Compounds-Dyer(Prentice Hall,NY) 1965.

3. Spectroscopy of Organic Compounds-3rd Ed.-P.S.Kalsi (New Age, New Delhi) 2000.

4. Analytical Chemistry-Open Learning : Mass spectrometry.

5. Spectroscopic Methods in Organic Chemistry - Williams and Fleming, TMH.

6. Spectroscopy, Donald L.Pavia (Cengage learning India Pvt.Ltd., Delhi), 2007.

7. Organic Spectroscopy-3rd ed.-W.Kemp (Pagrave Publishers, New York), 1991.

OC S 455: ANALYTICAL AND GREEN CHEMISTRY

COURSE OUTCOME:

- Enable the students to learn about cell structure and functions, lipids, lipoproteins.
- To understand the importance and functions of enzymes and coenzymes in biological systems.
- It helps in understanding metabolic pathways of cholesterol, bile acids, prostaglandins.
- Mechanism of reactions catalyzed by the above coenzymes.

UNIT I: **12 Hours**

Cell Structure and Functions: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of animal and plant cells. Overview of metabolic processes – catabolism and anabolism. ATP- the biological energy currency. Origin of life – unique properties of carbon, chemical evolution and rise of living systems.

Lipids: Fatty acids, essential fatty acids, structure and function of triacylglycerides, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins.

Lipoproteins: composition and function, role in atherosclerosis, properties of lipid aggregates, micelles, bilayers, liposomes and their biological functions. Biological membranes- Fluid mosaic model of membrane structure. Lipid metabolism (-oxidation of fatty acids).

UNIT II: **12 Hours**

Enzymes: Introduction**,** Classification, Enzyme substrate complex formation models: Lock and Key model, Host-Guest and Induced- Fit model. Factors affecting enzyme activity (pH, temperature), enzyme inhibition (reversible and irreversible) and immobilised enzymes. Examples of some typical enzyme mechanisms for Triose phosphate isomerase, α- Carboxy peptidase-A and Ribonuclease. Enzymatic synthesis of α-amino acids and peptides. Transformations of lipases and esterases. Kinetic resolutions of catboxylic acids, esters and alcohols-Transesterification. Enzymatic synthesis of α-amino acids and peptides. Transformations of lipases and esterases.

Coenzymes **12 Hours**

Introduction. Co factors - cosubstrates - prosthetic groups. Classification-Vitamin derived coenzymes and metabolite coenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate (TPP), pyridoxal phosphate (PLP), oxidized and reduced forms of nicotinamide adenosine dinucleotide / their phosphates (NAD, NADH, $NADP^+$, NADPH), Flavin adenine nucleotide (FAD, FADH2), Flavin mononucleotide (FMN, FMNH2) and tetrahydrofolate. Adenosine triphosphate (ATP) and adenosine diphosphate (ADP). Mechanism of reactions catalyzed by the above coenzymes.

REFERENCES:

1. Principles of Biochemistry – A L Lehninger, Worth Publishers.
2. Biochemistry – L Stryer, W H Freeman.
3. Biochemistry – J David Rawn and Neil Patters.
4. Biochemistry – Voet and Voet, John Wiley.
5. Outlines of Biochemistry – E E Conn and P K Stumpf. John Wiley.
6. Enzyme structure and mechanism - Fersht and Freeman
7. Outlines of Biochemistry - Conn and Stumpf
8. Principles of Biochemistry - Horton & others.
9. Bioorganic chemistry - A chemical approach to enzyme action - Herman Dugas and Christopher Penney.

OC E 456 : ENVIRONMENTAL, ELECTRO AND POLYMER CHEMISTRY

COURSE OUTCOME:

- It is an elective course offered to students from disciplines other than chemistry.

- It aims at enhancing their general understanding of chemistry. Few important topics such as sources and detection of air pollution, batteries as power sources, devices of solar energy conversion,
- polymers used in day to day life and for medical and technical applications will be taught.
- Awareness of plastic pollution and technique of plastic waste management

UNIT-I: **[12 Hours]**

Environmental segments, evolution of earth's atmosphere. Air pollution: Air pollutants, prevention and control, Green house gases and acid rain. Carbon monoxide, industrial sources and transportation sources. SO_x- sources, ambient concentration, test methods, control techniques - scrubbing, limestone injection process. Ozone hole and CFC's. Photochemical smog and PAN. NO_x - Sources, ambient concentration, test methods, thermodynamics and NO_x, control techniques. Particulates: Size distribution, particulate collection - settling chambers, centrifugal separators, wet scrubbers, electrostatic precipitators & fabric filters. Catalytic converters for mobile sources. Bhopal gas tragedy.

UNIT-II **[12 hrs]**

Corrosion: Introduction, consequence, type, prevention, & measurement. Conventional sources of energy, limitations, Importance of storage, Battery-Electrodes, Cell, battery Brief account of primary, secondary, lithium battery and fuel cells. Semiconductor electrodes and Solar energy system. 7 hrs

Introduction to bioelectrochemistry, electrochemical communication in biological organisms.

Theory and applications of Electroplating and electroless plating. 7hrs .

Reaction Kinetics-Theory and applications of different types of reactions- Oscillatory, chain reaction, branched chain reaction. . Energy of activation and thermodynamic parameters, Collision theory of reaction rates limitations and basics of transition state theory. 5 hrs

UNIT- III **[12 hrs]**

Polymers: Introduction-Basic concepts and classification of polymers, Molecular weight and its distribution, Chemistry of polymerization- Step, chain, Coordination, Copolymerization. Polymerization techniques- bulk, solution, suspension, emulsion, poly-condensation, solid and gas phase polymerization. Chemical and geometrical structure of polymer molecules, Structure property relationship- Physical, Thermal and mechanical properties 6hrs

Synthesis, properties, structural features and applications of some important commercial polymers (PE, PP,PS, PVC, PMMA, PET, Nylon-6,Nylon-6,6) , Engineering polymers (Kevlar, Nomex, ABS, PC, Teflon). Applications of polymers in separations: reverse osmosis, ultra and nano-filtration. Applications in electronics- conducting polymers and electronic shielding, Applications of polymers in medicine.

Management of plastics in environment- recycling, incineration and biodegradation.
6hrs

REFERENCES:

1. A.K. De : Environmental Chemistry, (Wiley Eastern).
2. S.K.Banerji : Environmental Chemistry, (Prentice Hall India), 1993.
3. Sawyer and McCarty, Chemistry for Environmental Engineering(McGraw Hill) 1978.
4. An Introduction to metallic corrosion and its prevention-Raj Narayan (Oxford-IBH, New Delhi), 1983.
5.Chemical& Electrochemical Energy Systems, R. Narayan & B. Viswanathan (University Press), 1998.
6. Industrial Electrochemistry, D. Peltcher & F. C. Walsh (Chapman & Hall)1990.

7. F.W. Billmeyer, Text book of Polymer science, 3rd Ednn, A Wiley- Interscience Publication, New York, 2005
8.. V.R. Gowariker, Polymer Science, New Age International (P) Ltd., New Delhi, 2012
9. R.W. Dyson, Specialty Polymers, Chapman and Hall, New York, 1987
10. J.R. Fried, Polymer Science and Technology, Prentice Hall of India Pvt. Ltd., New Delhi, 1999
11. P. Ghosh, Polymer Science and Technology, Tata - McGraw Hill, New Delhi, 1995

OC P 457: INORGANIC CHEMISTRY PRACTICALS-II

COURSE OUTCOME:

- The students will have hands on experience in the qualitative analysis of mixtures of Inorganic Salts containing 3 cations in which 1 less common metal ion and 2 anions.
- Students will learn the systematic methods of separation techniques.
- Apart from inorganic radicals they also learn the separation organic radicals.

Qualitative Analysis of mixtures of Inorganic Salts containing 3 cations and 2 anions (1 less common metal ions like Tl, W, Mo, V, Zr, Th, U, Ce, Ti and Li to be included among anions organic acid radicals, phosphate, borate and fluoride separation included).

REFERENCES:

1. Vogel's Text Book of Quantitative Chemical Analysis (5^{th} Ed), G. H. Jeffrey, J. Bassette, J.Mendham and R. C. Denny, Longman, 1999

2. Vogel's Qualitative Inorganic Analysis (7^{th} Ed), G. Svehla, Longman (2001).

OC P 458: ORGANIC CHEMISTRY PRACTICALS-II

COURSE OUTCOME:

- Student will gain the in-depth knowledge and skill in organic separations,
- purifications, qualitative analyses.
- Separation of binary mixtures of organic compounds containing both mono and bifunctional groups
- Students will learn preparation of suitable derivatives.

Separation and systematic qualitative analysis of binary mixtures of organic compounds containing both mono and bifunctional groups and preparation of suitable derivatives.

REFERENCES:

1.Practical Organic Chemistry-F .G. Mann and B. C. Saunders (ELBS, England), 2001.

2. Practical Organic Chemistry - A. I. Vogel (Longman-ELBS, England), 1971.

3. Experimental Organic Chemistry–Vol.I&II Singh et al(TMH, New Delhi)1981.

4. Semimicro Qualitative Organic Analysis–Cheronis etal Wiley-Eastern, New Delhi) 1964.

5. Vogel's Text Book of Practical Organic Chemistry Including Qualitative Organic Analysis- B. S. Furniss *et al* (Longman-ELBS, England), 1978.

6. Manual of Organic Chemistry - Dey and Seetharaman.

7. Modern Experimental Organic Chemistry-John H. Miller and E.F. Neugil.

OC P 459: PHYSICAL CHEMISTRY PRACTICALS- II
(At least 12 experiments are to be carried out)

COURSE OUTCOME:

- In continuation with the practical course introduced in the first semester, this course provides opportunity to students to test the concepts learnt in the basic physical chemistry course CH H 403.
- Experiments have been designed on thermodynamics, kinetics, surface and interface chemistry. With the training gained.
- Students will be able to handle issues related to metallurgical processes, waste water treatment, energy efficient processes, action of soaps and detergents etc.

1. Determination of cryoscopic constants of solvents and molecular weight of non volatile substances by thermal method.

2. Determination of degree of dissociation, Vant Hoff factor and molecular weight of an electrolyte by cryoscopy method using copper calorimeter/Dewar flask..

3. Heat of solution of a sparingly soluble compound in water by solubility method.

4. Phase diagram of two component systems by thermal analysis.

5. Phase diagram of three component system (a) 3 liquids with single binodal curve, and b) two liquids and one solid

6.Kinetics of acid catalyzed hydrolysis of methyl acetate and determination of (a) order and rate constant and (b) Energy of activation.

7. Determination of a) Energy of activation & b) rate constant for the First and second order kinetics of reaction between potassium persulphate and potassium iodide.

8. Kinetics of sodium formate – iodine reaction.

9. Determination of the latent heat of evaporation of carbon tetrachloride.

10. Preparation of colloidal solutions.

11. Verification of F & L adsorption isotherms for acetic acid on activated charcoal.

12. To study the adsorption of iodine on charcoal from alcoholic solution.

13. To study the effects of gelatin solution on the precipitation values.

14. Comparison of detergent action of detergents and determination of interfacial tension.

15. Thermodynamic prediction and measurement of the solubility of naphthalene in benzene.

Study of association of benzoic acid in benzene/toluene. Any other relevant experiments of interest.

REFERENCES:-

1. Practical Physical Chemistry- B Viswanathan & P.S Raghavan,(ViVa Books, Delhi) 2005.
2. Findlay's Practical Physical Chemistry- B. P. Levitt (Longman, London).
3. Experiments in Physical Chemistry– James and Prichard.
4. Experimental Physical Chemistry - Daniels et al.
4. Experimental Physical Chemistry-Das & Behera (Tata McGraw Hill, New Delhi)1983.
5. Advanced Practical Physical Chemistry–Yadav (1989).
6. Experiments in Physical Chemistry–J. C. Ghosh (Bharathi Bhavan)1974.

3rd SEMESTER

OC H 501: Organic Reaction Mechanism

COURSE OUTCOME:

- Students will gain the in-depth knowledge about twenty organic name reactions, their mechanisms and synthetic uses with multiple examples.
- Students will learn about the mechanism and synthetic utility of various kinds of nineteen molecular rearrangement reactions with diverse examples.
- Students will understand the synthetic design with diverse chemical reactions planning of organic synthesis and functionality

UNIT I: **[15 Hours]**

Organic Name Reactions: Reactions, Mechanisms and synthetic uses of the following:Stobbe condensation, Darzen condensation, Gattermann-Koch reaction, Cannizzaro reaction,Duff reaction Chichibabin reaction, Benzoin condensation, Claisen-Schmidt condensation, Claisen reaction, Simon-Smith reaction, Stork Enamine reactions, Sharpless asymmetric epoxidation, Hofmann-Loffler-Freytag reaction, Suzuki coupling, Heck reaction, Woodward and Prevost Hydroxylation, Bucherer reaction, Ullmann reaction. Wittig reaction-Mitsunobu reaction, Stephen reaction.

UNIT- II: **[15 Hours]**

Molecular Rearrangements: Classification and general mechanistic treatment ofnucleophilic, electrophilic and free radical rearrangements. Intermolecular and Intramolecular migration, nature of migration and migratory aptitudes. Mechanism of Wagner-Meerwein, Dienone-Phenol, Pinacol-Pinacolone, Demyanov, Benzil-Benzilic acid, Fries, Wolff, Favorskii, Neber, Benzidine, Baeyer-Villiger, Beckmann, Lossen, Curtius, Schmidt, Stevens, Shapiro, Baker-Venkatraman and Amadori rearrangement.

UNIT- III: **[15 Hours]**

Synthetic Design: Carbon skeleton frame work, Classification of carbon-carbon single bondand double bond forming reaction and their use in carbon skeleton ring formation. Ring forming and ring cleaving reactions, use of Thorpe condensation, Carbene insertion reaction,

Friedel-Crafts reaction, 1,3-dipolar addition and Ene reaction in ring formation, Oxidative cleavage of rings and Retro Diel's-Alder reactions.

Planning of Organic Synthesis: Selection of starting materials and key intermediates duringthe synthesis. Synthesis of Cubane and Iswarane. Use of Robinson annulation, Dieckmann cyclisation, Arndt-Eistert synthesis, Diel's- Alder reaction in organic synthesis.

Functionality: Synthesis of 6- and 7- methoxy tetralones, biotin and penicillin-V withspecial reference to the introduction of functional groups. Stereo chemical consideration and stereo selectivity during organic synthesis.

References:

1. Advanced Organic Chemistry- Part A & B-Francis A Carey and R. J. Sundberg (Plenum)
3. Organic Chemistry, Vol 1-3 Mukherji Singh and Kapoor (Wiley Eastern, New Delhi)
4. Synthetic Organic Chemistry- G.R.Chatwal (Himalaya, Bombay), 1994.
5. Organic Reaction Mechanisms-V.K.Ahluw alia & R.K.Parashar (Narovasa publishing house), 2006
6. Organic Chemistry, Vol I-II, I.L.Finar (Longmann ELBS, London), 1973.
7. Advanced Organic Chemistry:Reaction Mechanisms- Reinhard Bruckner (Academic), 2005.
8. Organic Reactions and their mechanisms-P.S.Kalsi (New Age, New Delhi), 1996.
9. Organic Synthesis- R. E. Ireland (Prentice Hall India), 1969.
10. Art in Organic Synthesis- Anand, Bindra & Ranganath-(Wiley New Delhi), 1970.
11. Modern Methods of Organic Synthesis-N.Carruthers (Cambridge University), 1996.

OC H 502: Synthetic Reagents and Spectroscopic Techniques

COURSE OUTCOME:

- Students will learn the preparation, properties, reactions and uses of organometallic reagents in organic synthesis.
- Students will know the uses of Gillman's reagent, LDA, DCC, 1,3-dithiane, TMSI, DDQ, SeO_2, Wikinson's catalyst, PTCs, Baker's yeast, PPA, TMS-CN, hydrosilane, chloramines-T, Woodward-Prevost hydroxylation, Zeigler-Natta catalyst, and crown ethers in organic synthesis and functional group transformation.
- Students will acquire the knowledge of utilization of principles of green chemistry by the use of crown ethers and ionic liquids in organic synthesis and microwave induced reactions.
- Students will demonstrate an understanding advanced aspects of IR, ^{1}H and ^{13}C NMR and Mass spectroscopy.
- Students will develop the ability to solve the composite problems involving the application of UV-Visible, IR, NMR (^{1}H &^{13}C) and Mass spectroscopic data, interpret the spectra to elucidate the structure of organic molecules.

UNIT- I: Reagents in Organic Synthesis-I **[15 Hours]**

Organometallic Reagents: Preparation and properties of Organolithium andorganomagnesium compounds. Their uses in organic synthesis and in the preparation of Organometallic compounds.

Methods of preparation, properties, reactivity and reactions of Organozinc, Organocadmium, Organomercury Organoindium, Organoaluminium and Organotellurium reagents.

Silicon containing Reagents: Introduction, preparation reactions & stereochemistry, Petersonreaction.

Boron containing Reagents: Introduction, preparations, Hydroborations, reactions ofOrganoboranes- Isomerization, oxidation, protonolysis, carbonylation, cyanidation. Synthesis of esters, E and Z alkenes, conjugated dienes and alkynes.

Organotin Compounds: Synthesis of Organostannanes and their utility in C-C bond formingreactions. Tributyltin hydride, Barton decarboxylation reaction, Barton deoxygenation, Stelly-Kelly coupling reaction.

UNIT- II: Reagents in Organic Synthesis-II **[15 Hours]**

Use of the following reagents in Organic synthesis and functional group transformation: Gillman's reagent, Lithium diisopropylamide (LDA), Dicyclohexyl carbodiimide (DCC), 1,3-dithiane (reactivity-umpolong), Trimethyl silyliodide, DDQ, Selenium dioxide, Wilkinsons catalyst, Phase transfer catalysts, Baker's yeast, Polyphosphoric acid. Trimethyl silyl cyanide, Hydrosilanes, Chloramine-T, Aluminium*iso*-propoxide. Woodward and Prevost hydroxylation, Zeigler-Natta catalyst, Phase transfer catalysts, Crown ethers.

UNIT –III: **[15 Hours]**

IR, ^{1}H NMR and ^{13}C-NMR: Characteristic vibrational frequencies of alkanes, alkenes,alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (Ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of H-bonding & solvent effect on vibrational frequencies.

Chemical shift of different class of organic compounds. Spin-spin coupling – illustrate with different examples. AB, AX-Spin system. Chemical exchange, effct of deuteration, complex spin-spin interaction between two, three, four and five nuclei. Stereochemistry, hindered rotation;Karplus-Curve. Variation of coupling constant with dihedral angle.Pulse techniques,Techniques for simplication of spectra, Heteronuclear coupling,INDOR,2D-NMR,FT-NMR.Applications of NMR

Composite problems involving the application of UV, IR, ^{1}H NMR and ^{13}C-NMR and Mass spectroscopy technique in the structural elucidation of organic molecules.

Green Techniques:

Crown Ethers: Introduction, Nomenclature, Synthesis of Dibenzo[18]crown-6, Aza-crown,Cryptates, Synthetic applications like esterification, saponification, elimation reactions, superoxide anion, generation of carbenes.

Microwave induced reactions: Introduction, advantages, limitations, precautions,application like Deprotection, Hydrolysis, Condensation, ortho ester claisen rearrangement. **Ionic Liquids:** Introduction, properties, types, preparation, applications like Epoxidation,Alkene Metathesis, Oxidation, Reduction and Enzyme catalysed synthesis.

References :

1. Advanced Organic chemistry 5th edition -J. March (John Wiley and sons).
2. Organic Chemistry- J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford University Press).
3. E. Eliel and S.H. Wilen, Stereochemistry of Organic compounds, John Wiley.
4. Organic Spectroscopy- William Kemp(Palgrave)2005.
5. Advanced Organic Chemistry – Part A& B, 3rd edition- F.A. Carey and Sundberg, (Plenum Press) 1990.
6. Advanced General Organic Chemistry-S.K. Ghosh (Book and Alleied (P) Ltd) 1998.
7. Organic Synthesis, special Techniques -V.K. Ahluwalia and Renu Agrawal (Narosa Publications).
8. Spectrometric Identification of Organic Compounds - Silverstein, Bassler & Monnill (Wiley)1981.
9. Spectroscopy of Organic Compounds-3rd Ed.-P.S.Kalsi (New Age, New Delhi) 2000.
10. Spectroscopic Methods in Organic Chemistry - Williams and Fleming, TMH.
11. Spectroscopy, Donald L.Pavia (Cengage learning India Pvt.Ltd., Delhi), 2007.
12. Organic Spectroscopy-3rd ed.-W.Kemp (Pagrave Publishers, New York), 1991.

OC H 503: Advanced Heterocyclic Chemistry

COURSE OUTCOME:

- Students will understand the various types of systematic nomenclature of simple, fused and bridged heterocyclic compounds with one or more diverse heteroatoms.
- Students will get the sound knowledge on the structure, synthesis and reactions of various three, four, five, six and seven membered simple and fused heterocyclic compounds with one or more heteroatom
- Study the use of heterocycles in functional group and ring transformations.
- Students will acquire knowledge about the synthesis and reactions of mesionic compounds, structure and synthesis of anthocyanins, anthocyanidins, flavones, flavonols and isoflavones.

UNIT -II: Heterocyclic Chemistry-I **[15 Hours]**

Introduction, Biologically important heterocycles, Nomenclature of Heterocycles, Replacement and systematic nomenclature, Hantzsch-Widman system for monocyclic, fused and bridged heterocycles. Synthesis and reactions of three membered heterocycles-aziridines, oxiranes, episulfides, diaziridines, oxazirines and diazirines. Synthesis and reactions of four membered heterocycles-oxetanes, azetidines and thietanes. Synthesis & reactions of five membered eterocycles-furan, pyrrole, thiophene, oxazoles, imidazoles and thiazoles.

UNIT -II: Heterocyclic Chemistry-II **[15 Hours]**

Structure, synthesis and reactions of six membered heterocycles- pyridine, α- and γ-Pyrones, oxazines. Pyrazines, Pyridazines, Pyrimidines. Synthesis and reactions of seven heterocycles- Azepines, Oxepines and Thiepines. Synthesis and reactions of fused heterocycles- benzofuran, benzothiophene & indole.selenophenes, tellurophenes, Quinolines, Isoquinolines, Coumarins, Naphthyridines and Purines.

UNIT -III: Heterocyclic Chemistry-III **[15 Hours]**

Mesoionic compounds: Introduction, Synthesis and reactions of sydnones.

Anthocyanins and Anthocyanidins: Introduction and general methods of synthesis.

Flavones, Flavonols and Isoflavones: Introduction and synthesis of flavone, flavonal andquercetin. Structural elucidation and synthesis of Uric acid, Caffeine.

Heterocycles in functional group and ring transformations: Alkanes from thiophenes,dienes from pyrroles, alcohols from isooxazolines, conversion of coumarin to benzofuran, sydnone to pyrazole, chromones to pyrazoles, furans to pyridines, pyrrole to pyridines, pyrimidine to pyrazole, isatins to quinolines, indoles to quinoline. Dimroth and Cornforth rearrangements.

References:

1 An Introduction To the Chemistry of Heterocyclic Compounds-Acheson (Wiley Eastern),1997.
2. Heterocyclic Chemistry- J.Joule & G.Smith (Van Nostrand ELBS), 1978.
3. Polymer Science- V.R.Gowariker, N.V.Vishwanathan & T.Shridhar (Wiley Eastern)
4. Comprehensive Heterocyclic Chemistry Vol-I-VI Ed. Katritzky & Rees (Pergamon), 1984.
5. Organic Chemistry, Vol I & II, I.L.Finar (Longmann ELBS, London), 1973.
6. Natural Products Chemistry, Vol-I & II- G.R.Chatwal(Himalaya), 1990

OC S 504: Organic Photochemistry & Pericyclic Reactions

COURSE OUTCOME:

- Students will gain knowledge on principles of photochemistry and diverse types of photochemical reactions of various classes of organic molecules with multiple examples, photochemistry of vision, photodegradation of polymers, photochemical cell, energy conversion and storage, photocatalysis, photocleavage of waste,
- They learn photo-oxidation and reduction reactions.
- Students will understand the photochemical reactions of various three, four, five, six and seven membered simple and fused heterocyclic compounds with one or more heteroatoms, various fiveand six membered simple and fused heterocyclic compounds.
- Students will learn the concepts of pericyclic reactions, diverse types of electrocyclic, cycloaddition and sigmatropic reactions with multiple examples.

UNIT-I: Organic Photochemistry [12 Hours]

Bonding and antibonding orbital, σ and π orbitals, σ* and π* orbitals, singlet and triplet states, relative energies and excited states, Chemistry of excited states of organic molecules, Jablonski diagram and quantum yield, Photodissociation, Photoreduction, Photochemical isomerisation, Photocyclisation and related reactions. Norrish Type-I and Type-II reactions, Di-pi methane rearrangement, Optical pumping, Barton reaction and Photo Fries rearrangement, Paterno-Buchi reaction, Photochemistry of alkenes, benzenes, Yang cyclisation. Photochemistry of vision. photodegradation of polymers. Introduction to

Photochemical cells, energy conversion and storage. Photocatalysis: Photocleavage of wastewhich are environmentally hazardous by using TiO_2, Photooxidation and photoreduction reactions.

UNIT-II: [12 Hours]

Photochemistry of Heterocycles: Photo-oxidation of pyrroles, photochemical reactions ofpyrazoles, 1,2,3 and 1,2,4-triazoles, 1,2,3-triazines, 1,3,4-oxadiazoles, mono and disubstituted tetrazoles. Photochemistry of pyridazines and pyrimidines. Photochemistry of five membered heterocycles-with one heteroatom-Pyrrole, Furan and Thiophene; with two hetero atoms-Thiazole, Oxazole, isoxazole and Pyrazole. Photochemistry of six and seven membered heterocycles-Pyridine, Pyrones, Pyridazine and Pyrazine. Fused heterocycles-Benzothiophene. Synthesis of Pyrazine from azirine derivatives. Photochemical reactions of Pyrazine.

UNIT-III: [12 Hours]

Pericyclic Reactions: Introduction, Characteristics and classification of pericyclic reactions-Electrocyclic, cycloaddition & cycloreversions and sigmatropic reactions. Aromatic Transition States (ATS)/Perturbation Molecular Orbitals (PMO) approach for the interpretation of mechanism of pericyclic reactions. Molecular orbital symmetry, Frontier orbitals of ethylene,1,3-butadiene, 1,3,5-hexatriene and allyl systems. Woodward-Hoffmann correlation diagram and FMO approach.

Electrocyclic Reactions: Introduction, Con-rotatory and dis-rotatory Process, 4n and 4n+2systems. Reactions of cations and anions, formation and cyclisation of dipolar molecules. **Cycloaddition reaction:** Suprafacial and Antrafacial addition, notation of cycloadditions,2+2 and 4+2 systems, 2+2 additions of ketones, secondary effects of substitutes on the rates of cycioadditions and chelotropic reactions. 1,3-dipolar cycloaddition reactions and their applications in the synthesis of five membered heterocycles, nitrile oxid and sydnones. **Sigmatropic reactions:** FMO approach and perturbation of molecular (PMO) approach forthe explanation of sigmatropic rearrgements under thermal and photochemical

conditions. Suprafacial and Antrafacial shift of H, [1,3] [1,5] [1,7] and [3,3]-sigmatropic shifts. Walk, Claisen, Cope, Oxy-Cope and Aza-Cope rearrangements.

References:

1. Organic Photochemistry- Vol I & II- O.L. Chapman (Marcel Decker).
2. Organic Chemistry- Vol 1-3 - Mukherji Singh and Kapoor (Wiley Eastern).
3. Organic Reaction Mechanisms-V.K.Ahluwalia & R.K.Parashar (Narosa) 2006.
4. Advanced Organic Chemistry-Reaction Mechanisms, Reinhard Bruckner (Academic), 2005.
5. Pericyclic reactions, S.M Mukherji (McMillan) 1979.
6. J. A. Joule and G. F. Smith: Heterocyclic Chemistry, Cambidge University press (1972).
7. A. R. Katritzky and C. J. Rees: Comprehensive Heterocyclic Chemistry, Pergamon (1984)
8. D. H.R. Barton and W. D. Ollis: Comprehensive Organic Chemistry, Vol 14, Heterocyclic Compounds, Pergamon (1979).
9. A. R. Katritzky: Advances in Heterocyclic Chemistry, Vol 15-25, Academic (1971-81).

OC S 505 : Bioorganic Chemistry

COURSE OUTCOME:

Students will be able to:

- Understand the configuration and conformation of monosaccharides, chemistry of important derivatives of monosaccharides, structure and synthesis of disaccharides, general methods of determination of polysaccharide structures, structure and industrial applications of polysaccharides.
- Explain the peptide bond formation, synthetic protocol for peptides, solution and solid phase peptide synthesis, Methods of peptide structure determination, different types protein structures, non-steroidal hormones, nucleosides, nucleotides, synthesis of nucleosides, nucleotides and polynucleotides, structure and functions of nucleic acids.
- Learn the classification, nomenclature, sources, deficiency diseases, biological functions and chemistry of Vitamin A_1, B_3, B_5, C and K_1.
- Know the classification and chemistry of antibiotics like Penicillin V, Streptomycin, chloramphenicol and tetracyclins.

UNIT I **[12 Hours]**

Carbohydrates Configuration and conformation of monosaccharides, Hudsons rule,Mutarotation. Chemistry of important derivatives of monosaccharides-ethers, esters, acetals, ketals, deoxysugars, aminosugars, Structure of disaccharides-maltose, cellobiose and sucrose. General methods of structural degradation of polysaccharides- methylation & partial hydrolysis, Smith degradation and alkaline degradation techniques. Structures of cellulose, chitin, starch and glycogen.

UNIT II **[12 Hours]**

Peptides & Proteins: Peptide bond formation and synthesis of polypeptides, Amino andcarboxy protecting groups in peptide synthesis, Solid phase peptide synthesis-Merrifield method, Peptide structure determination-Sequence and End group anaysis (N-Terminus and C-Terminus), Secondary, Tertiary and Quaternary structure of proteins.

Nucleic acids: Nucleosides and Nucleotides, Chemical synthesis of nucleosides andnucleotides. Poly nucleotides- Structure and functions of DNA and RNA.

Non steroidal hormones: Study of the Oxytocin, Vasopressin and synthetic analogs, Generalstudy of ACTH, Growth hormones, Somotropin and Insulin.

UNIT III **[12 Hours]**

Vitamins: Classification and Nomenclature. Source, deficiency diseases and biologicalfunctions of Vitamins. Study of Vitamin A_1, Vitamin B_3, Vitamin B_5, Vitamin C and Vitamin K_1.

Antibiotics: Introduction, Classification, Chemistry of Pencillin V, Streptomycin,Chloramphenicol and Tetracyclin.

References:

1.Organic Chemistry-P.Y.Bruice (Pearson Education Pvt. Ltd.,New Delhi),2002.
2.Organic Chemistry 4^{th} Edn.–S.H. Pine et al (McGraw-Hill, London) 1987.
3.Advanced Organic Chemistry- R.A. Carey and R.J. Sundberg (Plenum, New York)1990.
4. Organic Chemistry, Vol I & II, I.L.Finar (Longmann ELBS, London), 1973.
5. Natural Products Chemistry, Vol-I & II- G.R.Chatwal(Himalaya), 1990.

OC E 506 : ANALYTICAL AND GREEN CHEMISTYRY

COURSE OUTCOME:

Enable the students:

- To understand the basic principles and theory of UV-Visible, Electronic, Infra Red, Nuclear Magnetic Resonance and Mass Spectroscopy.
- To study the utility of these techniques in structure elucidation of simple organic molecules.
- To know about water cycle, water sources, water quality, significant measurements of water parameters and treatment of water for drinking and industrial purposes.
- To learn about principles and use of green chemistry in laboratory synthesis.
- To understand the basic principles and utility of sonochemistry and Microwave induced organic synthesis.

UNIT- I: **[12 Hours]**

UV/Electronic Spectroscopy: Basic principles, Beer-Lambert law, types of absorptionbands, Factors affecting the positions of UV bands. Theoretical prediction of λmax for polyenes, α,β-unsaturated aldehydes, ketones (Woodward-Fieser rules) and substituted benzenes.

IR Spectroscopy: Basic principles, Application of infrared spectroscopy in the structuralstudy-identity by finger printing and identification of functional groups. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines). Study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides and acids). Factors affecting band positions and intensities

Nuclear Magnetic Resonance Spectroscopy: Basic principles, Solvents used, chemical shiftand its measurements, factors affecting chemical shift. Integration of NMR signals, spin-spin coupling, coupling constant. Shielding and deshielding. High resolution ^{1}H NMR. Applications of NMR spectroscopy in structure elucidation of simple organic molecules.

Mass Spectrometry: Basic principles, molecular ions, meta-stable ions and isotope ions. Fragmentation processes, McLafferty rearrangement. retro Diels-Alder fragmentations. Nitrogen rule.

UNIT- II: **[12 Hours]**

Hydrologic cycle, sources, chemistry of sea water, criteria and standards of water quality-safe drinking water, maximum contamination levels of inorganic and organic chemicals, radiological contaminants, turbidity, microbial contaminants. Public health significance and measurement of colour, turbidity, total solids, acidity, alkalinity, hardness, chloride, residual chlorine, sulphate, fluoride, phosphate and different forms of nitrogen in natural and polluted water. Chemical sources of taste and odour, treatment for their removal, sampling and monitoring techniques. Determination and significance of DO, BOD ,COD and TOC. Water purification for drinking and industrial purposes, disinfection techniques, demineralization, desalination processes and reverse osmosis . Treatment of liquid radioactive wastes

UNIT- III: **[12 Hours]**

Green Chemistry: Definition and principles, planning a green synthesis in a chemicallaboratory, Green preparation-Aqueous phase reactions, solid state (solventless) reactions, photochemical reactions, Phase transfer catalyst catalysed reactions (Quaternary ammonium salts & Crown ethers), enzymatic transformations & reactions in ionic liquids.

Sonochemistry: Introduction, instrumentation, the phenomenon of cavitation, Sonochemicalesterification, substitution, addition, oxidation, reduction and coupling reactions.

Microwave induced organic synthesis: Introduction, reaction vessel and reaction medium,concept, specific effect, atom efficiency, % atom utilisation, advantages and limitations, alkylation of active methylene compounds, N-alkylation, condensation of active methylene compounds with aldehydes, Diels-Alder reaction, Leuckardt reductive amination of ketones, ortho ester Claisen rearrangement.

References:

1. Organic Spectroscopy-3rd Ed.-W.Kemp (Pagrave Publishers, New York), 1991.
2. Spectrometric Identification of Organic Compounds - Silverstein, Bassler & Monnill (Wiley)1981.
3. Applications of Absorption Spectroscopy of Organic Compounds-Dyer(Prentice Hall,NY) 1965.
4. Spectroscopy of Organic Compounds-3rd Ed.-P.S.Kalsi (New Age, New Delhi) 2000.
5. Spectroscopic Methods in Organic Chemistry - Williams and Fleming, TMH.
6. A.K. De : Environmental Chemistry, (Wiley Eastern).
7. S.K.Banerji : Environmental Chemistry, (Prentice Hall India), 1993.
8 S.D. Faust and O.M. Aly : Chemistry of Water Treatment, (Butterworths),1983.
9. Sawyer and McCarty, Chemistry for Environmental Engineering(McGraw Hill) 1978
10. I.Williams, Environmental Chemistry, John Wiley, 2001.
11. S.M.Khopkar, Environmental Pollution Analysis, (Wiley Eastern).
12. Organic Synthesis-Special Techniques, V.K.Ahluwalia & R. Aggarwal, Narosa, 2001.
Green Chemistry-Environment friendly alternatives- R.Sanghi & M.M.Srivatsava Narosa, 2003.
13. Green Chemistry-Environment benign reactions- V.K.Ahluwalia, Ane Books India, 2006.

OC P 507: Organic Chemistry Practicals – III

COURSE OUTCOME:

Enable the students:

- To understand and learn the principle of quantitative estimation of different types of organic molecules, methods o such as sugars, amino acids, phenols, carboxylic acids, amides, esters, aldehydes, ketones, urea, acid-ester mixture, amide-ester mixture.
- To know the estimation of functional groups like hydroxyl, vic-hydroxy, enol, amino, amide, unsaturation, nitro group
- Semi-micro analysis of nitrogen, halogen, alkoxy, C-methyl and active hydrogens. nd semi-micro analysis of nitrogen, halogen, alkoxy, C-methyl and active hydrogens. nd semi-micro analysis of nitrogen, halogen, alkoxy, C-methyl and active hydrogens.

Quantitative determination of sugars, amino acids, phenols, carboxylic acids, amides, esters, aldehydes, ketones, urea by various methods. Determinations of acid & ester and acid & amide in the mixtures.
Determination of functional groups like hydroxyl, vic-hydroxyl, enol, amino, amide, unsaturation and nitro groups by various methods. Semi-micro analysis of Nitrogen, Halogen, Alkoxy, C-methyl and active hydrogens.

OC P 508: Organic Chemistry Practicals – IV

COURSE OUTCOME:

Enable the students:

- To gain the knowledge about the isolationand characterization of caffeine, recinolic acid, azelic acid, piperine, hesperidine, cysteine, casein, lycopene, carotenes, lipase and sucrose.
- To understand the extraction of groundnut oil and cocnut oil, determination of saponification and iodine values. value of the oils and fats.
- To know the identification and purification of organic compounds by paper, TLC and column chromatographic techniques.
- To learn the characterization of natural products by oxidation and derivatisation.

Isolation and Charecterization of natural products like Caffeine, Recinoleic acid, Azelic acid, Piperine, Hespiridine, Cysteine, Casein, Lycopene and enzymes like Lipase and Sucrase. Extraction of Groundnut oil and Coconut oil. Determination of Saponification oils and fats, Determination of Iodine values of oils and fats using ICl & chloramine-T. Isolation of Carotenes-Purification by paper, TLC and Column. Charecterization of natural products by oxidation studies, Derivatization of natural products.

OC P 509: Organic Chemistry Practicals – V

COURSE OUTCOME:

Enable the students:

- To acquire in-depth knowledge and skill on separation and purification of ternary mixture of organic compounds,
- Identification and qualitative analysis of the individual compounds of the mixture,
- Characterization by derivatization,
- Recording physical constant, TLC and spectral techniques.

Separation, purification, analysis and derivatization of ternary mixture of organic compounds, Identification, separation and qualitative analysis of the individual compounds and preparation of suitable derivative for each component, identification of derivative by m.p., TLC and spectral techniques.

References:-

1. Elementary Practical Organic Chemistry-Vol. III: quantitative Organic Analysis- A.I Vogel
2. Vogel's Text Book of Practical Organic Chemistry- Furniss et al. (ELBS, London)1978.
3. Experimental Organic Chemistry- Vol. I &II- P.R.Singh (Tata McGraw-Hill) 1981.
4. Practical Organic Chemistry- IV Ed- Dey &.Sitaraman (Allied)
5. Laboratory Experiments in Organic Chemistry-Adam, Johnson & Wicon (McMillan, London) 1979.
6. Experimental Organic Chemistry- H. D. Durst & G. E. Goke (McGraw-Hill)1980

4th SEMESTER

OC H 551: Organic Synthetic Methods

COURSE OUTCOME:

Enable the students:

- To acquire knowledge on the various reagents employed for oxidation and reduction of various kinds of organic molecules.
- To understand the various methods of halogenations of carbonyl compounds, benzylic and allylic halogenations.
- To learn the principles and technologies used in disconnection approach,
- To study the utility of protecting group strategy in organic synthesis and retrosynthetic analysis.

UNIT-I: **[15 Hours]**

Reduction Reactions: Catalytic hydrogenation-Introduction, catalysts and solventsemployed, reduction of functional groups, mechanisms and stereochemistry of catalytic hydrogenations, Hydrogenolysis, homogeneous catalytic hydrogenation.

Metal hydride reduction: Reduction with $LiAlH_4$, $NaBH_4$,BH_3, $AlH_3$and DIBAL.Stereochemistry of reduction, Functional group transformation during reduction, Reduction with diborane and related reactions. Reduction with Trimethylsilane. Reduction in Biological systems-NADH, FAD.

Dissolving Metal Reductions: Mechanisms of reduction of conjugated system and carbonylcompounds((including Birch, Benkeser, Clemmensen reductions), Bimolecular reductions of esters, Birch reduction, Reduction with hydrazine and its derivatives, Wolf-Kishner reduction, McMurry reaction, Pummer, Willgerdot, Corey-Bakshi-Shibata and Tishchenkoreactions. Reduction with arene sulphonyl derivative of hydrazine, Reaction with diimide andrelated compounds.

UNIT-II: **[15 Hours]**

Oxidation Reactions: Introduction and different oxidative processes, Mechanism ofoxidation reaction with chromium (Jones, Sarett, Collins & PCC), Lead tetra acetate, Oxone, Osmium tetroxide, MnO_2 and manganese salts, peracids and peresters, periodic acid, Ozone, Dess-Martin periodinane, TEMPO, CAN, Swern oxidation and their synthetic importance in functional group transformation.

Halogenation Reactions: Halogenation of olefins and carbonyl compounds, Benzylic andAllylic halogenation, Dehalogenation reactions. Dehydrogenation with S, Se, Pt, Pd, Ni.

UNIT-III **[15 Hours]**

Basic principles and technologies used in disconnection approach. Synthons and synthetic equivalents. Interconversion of functional groups. One group C-X and two group C-X disconnections.

Protecting groups: Principle of protection of hydroxyl, amino, carboxylic and carbonylgroups and their synthetic applications.

Retrosynthetic analysis: Analysis of alcohols, carbonyl compounds, cyclic and acyclicalkanes, benzocaine, p-methoxyacetophenone, acetonecyanohydrin, 2-methyl-6-methoxy-indole-3-acetic acid, 6-methylquinoline & 1-phenyl-4-p-methoxyphenyl-1,3-butadiene, Limonene, Danishefsky's pentalenolactone, Benziodarone, nitrofurazone, Warfarin and Juvabione.

References :

1. Modern Organic Reactions- H.O.House
2. Organic Synthesis- R.E.Ireland (Prentice Hall India) 1969.
3. Art in Organic Synthesis- Anand, Bindra & Ranganath (Wiley) 1970.
4. Organic Synthesis a Disconnection Approach- Stuart
5. Advanced Organic Chemistry, IV ed., Part A & B- Carrey & Sundberg (Kluwer-Academic) 2001.
6. Modern Methods of Organic Synthesis-N. Carruthers (Cambridge University), 1996.
7. Selected Organic Synthesis-Ian Fleming (John Wiley & Sons) 1973.

OC H 552: Medicinal Chemistry

COURSE OUTCOME:

- Students will gain an understanding on the classification and nomenclature of drugs, modern theories of drug action and drug design.
- Students will able to know classification, synthesis and mode of action of antipyretic analgesis drugs, general anesthetics, local anesthetics, cardiovascular drugs, antineoplastic agents and antiviral drugs with suitable examples.
- Students will understand the classification, nomenclature, source and deficiency diseases and biological functions of various vitamins, chemistry of penicillins,cephalosporin C, streptomycin, chlorampthe knowledge of nomenclaturehenicol and tetracyclins.
- Students will acquire knowledge about nomenclature, classification and biological role of prostaglandins, Structural elucidation, stereochemistry and total synthesis of prostaglandins.

UNIT-I: **[15 Hours]**

Drugs: Introduction, Classification and nomenclature of drugs. Theories of drug action-Occupancy theory, Rate theory, Induced fit theory and Perturbation theory. Analogues and Prodrugs, Factors governing drug design. Rational approach to drug design, Variation method of drug designing, tailoring of drugs, Physico-Chemical factors and biological activities. Factors governing the ability of drugs, Isosterism and Bio-isosterism.

Antipyretic Analgesics: Classification, synthesis of Phenacetin, Aspirin, Cinchophen,Phenazone and Mefenamic acid, mode of action.

General Anesthetics: Introduction and classification, synthesis of methoxyfluorane,Thiopental sodium and Fentanyl citrate, Mode of action.

Local anesthetic: Introduction and classification, synthesis of benzocaine, α-Eucaine,Lignocaine hydrochloride and Dibucaine hydrochloride, Mode of action.

UNIT-II: **[15 Hours]**

Cardiovascular drugs: Introduction, classification, Synthesis of Hydralazine, Methyldopa,Diazoxide, Procainamide, Propranolol, Bretylium tosylate, Isoxsupurine, Prenylamine & their mode of action.

Antimalarials: Introduction and classification, Synthesis of Chloroquine phosphate, Pamaquine, Meparine hydrochloride, Proguanil hydrochloride, pyrimethanine and dapsone, Mode of action.

Antineoplastic agents: Introduction and classification, Synthesis of Mechlorethaminehydrochloride, Busalfan triethylenemelamine, Methotrexate, Mercaptopurinum and Flurouracil, Mode of action.

Antiviral drugs: Introduction, classification, mechanism of action study of somerepresentative drugs like Methisazone, Idoxuridine, Amantidine hydrochloride.

UNIT-III: **[15 Hours]**

Vitamins: Introduction, Classification and Nomenclature-Source and Deficiency diseases,Biological, functions of Vitamins, Study of Vitamin A_1, Vitamin B_1, B_2 and B_6, Vitamin H, Vitamin C, Vitamin E, Vitamin K_1.

Antibiotics: Introduction, Classification, Chemistry of Pencillin V, Cephalosporine C,Streptomycin, Chloramphenicol and Tetracyclin.

Prostaglandins: Introduction, Nomenclature, Classification and Biological role ofProstaglandins, Structural elucidation and stereochemistry of PGE_1, PGE_2 and PGE_3. Total synthesis of PGE_1 (Corey's method & Up John's synthesis).

References:

1. Medicinal Chemistry- Ashutosh Kar (New Age.) 2005,
2. Medicinal Chemistry- G. R.Chatwal (Himalaya) 2002.
3. Natural Products Chemistry, Vol-I & II- G. R. Chatwal (Himalaya) 1990.
4. Principles of Drug Action, II ed.- A.G oldstein Lewis Arnold & Suner M. Kalman (Wiley Int. Ed.)
5. Organic Chemistry, Vol I & II, I.L.Finar (Longmann ELBS, London) 1973.
6. Chemistry of Natural Products, Vol-I & II – O. P. Agarwal (Goel Gorakhpur) 1985.

Chemistry of Natural Products: A Unified Approach-N R Krishnaswamy (University Press) 1999

A) Chemistry of Natural Products-Sujata V. Bhat, B.A. Nagasampagi, Meenakshi Sivakumar (Springer-Narosa) 2005.

OC H 553: Natural Products Chemistry

COURSE OUTCOME:

- Students will get a good understanding of isolation, classification natural products,
- To learn methods of structure elucidation and synthesis of various types of alkaloids, terpenoids, carotenoids,
- Steroids and steroidal hormones with representative examples, transformations in steroids and hormones and
- To study steroidal oral contraceptives.

UNIT-I: **[15 Hours]**

Alkaloids: Definition, Classification and isolation of alkaloids, general methods of structuraldetermination of alkaloids, detailed study of structure elucidation, stereochemistry, rearrangement, Synthesis and biogenesis of Papaverine, Adrenaline, Ephedrine, Piperine, Cinchonine, Quinine, Morphine, Yohimbine, Reserpine and Lysergic acid.

UNIT- II: **[15 Hours]**

Terpenoids: Introduction, classification, isoprene rules, methods of structure determination.Structural elucidation & synthesis of Geraniol, Menthol, α-Pinene, Camphor, Farnesol, Zingiberene and α-Santonin, Vetivones, Caryophylene. **Diterpenoids:** Abietic and Gibberillic acid.

Triterpenoids: Squalene and Phytol.

Carotenoides: Introduction and geometrical isomerization of Carotenes. Structure andSynthesis of β-Carotene and Lycopene.

UNIT- III: **[15 Hours]**

Steroids: Introduction and Nomenclature of steroids, Blanc's rule, Barbier-Wielanddegradation, Oppenauer oxidation, Diel's hydrocarbon, Chemistry of Cholestrol, Ergosterol, Vitamin-D, Stigmasterol & bile acids.

Steroidal hormones: Chemistry of Oestrone, esterdiol, estriol and their chemicalrelationship. Progesterone, androsterone and testosterone - Structure and Synthesis of Cortisone, Cortisol and Aldosterone. Transformations in steroids and hormones. Steroidal oral contraceptives.

References:

1. Natural Products Chemistry Vol-I & II. G. R. Chatwal (Himalaya) 1990.
2. Chemistry of Natural Products – Vol-I & II – O. P. Agarwal (Goel) 1985.
3. Organic Chemistry, Vol-I & II- I. L. Finar (Longmann ELBS London), 2000.
4. Chemistry of Natural Products: A Unified Approach-N R Krishnaswamy (University Press) 1999.
5. Chemistry of Natural Products-Sujata V. Bhat, B.A. Nagasampagi, Meenakshi Sivakumar (Springer-Narosa) 2005.

OC S 554: Synthetic Polymers, Dyes and Pesticides

COURSE OUTCOME:

Enable the students:

- To acquire detailed knowledge in classification and nomenclature of polymers, methods of polymerization, mechanism and stereochemistry, properties, structure,

synthesis and applications of synthetic polymers, polyesters, polyamides, phenol-formaldehyde, urea-formaldehyde and epoxy resins, polyurethanes, polycarbonates, synthetic rubber, manufacture and structural features of natural rubber and regenerated cellulose.

- To understand the modern theories of colour and constitution, classification of dyes, methods of applying dyes to the fabrics, Synthesis and applications of various types of azo dyes, triphenyl methane dyes, cyanin dyes, reactive dyes, optical brighteners and pigments.
- To gain knowledge about classification, mode of action and synthesis of several organophosphorous and organochlorine insecticides, natural pyrethroid insecticides, isolation and structure of natural pyrethrins, synthetic pyrethroids,
- To study the Synthesis and uses of insect pheromones in pest control, fungicides and herbicides, fumigants and repellants, mechanism of action and toxicities of insecticides, fungides and herbicides.

UNIT–I: **[12 Hours]**

Synthetic polymers: Classification and Nomenclature. Methods of polymerization,Mechanism and Stereochemistry, Addition polymerization (Anionic, Cationic and Free radical process), Condensation and Stepwise polymerization, Coordination polymerization, Ring opening polymerization. Mechanism of co polymerization. Properties, Structure and applications of Polythene, Polypropylene, PVC, Polystyrene & Acrylic polymers, Teflon, polyesters, polyamides, Phenol-Formaldehyde resins, Urea-Formaldehyde resins, Epoxy resins, Polyurethanes, Polycarbonates, Synthetic rubber. Structural features and manufacture of natural rubber and Regenerated cellulose. Ziegler-Natta catalyst.

UNIT -II : **[12 Hours]**

Dyes: Introduction, modern theories of colour and chemical constitution. Classification ofdyes, methods of applying dyes to the fabrics. A general study of Azo dyes- Orange –II, rosanthrene O, Naphthol blue black 6B, Mordant brown, Congo red, Methyl orange, Chrysoidin G, Bismark brown.

Triphenylmethane dyes- Malachite green, Rosaniline, Crystal violet and Phenolphthalein;

Cyanin dyes- Ethyl Red, Cyanin blue and Quinaldine, Reactive dyes and Optical brighteners-Tinapal and Blankophor.

Pigments: Fast violet, Lake red and Orange R.

UNIT - III : **[12 Hours]**

Insecticides: Introduction, classification, mode of action and synthesis of Methoxychlor,chlordane, heptachlor, Hexachlorocyclohexane, Parathion, Diazenon, Sevin and Beygon. Naturally occurring insecticides-pyrethroids-natural pyrethrins-isolation and structures, synthetic pyrethroids.

Insect Pheromones: Introduction, Classification and use in insect pest control. Synthesis ofdisparlure, grandisol, Periplanone-A & B and bomykol. **Fungicides**: Introduction, Systemic fungicides-types & examples.

Herbicides: Introduction, study of sulfonyl ureas and heterocyclic sulphonamides.Fumigants and repellants. Mechanism of action and toxicities of insecticides, fungicides and herbicides.

References:

1. Polymer Science- V.R.Gowariker, N.V.Vishwanathan & T.Shridhar (Wiley Eastern) 2008.
2. Textbook of Polymer Science, 3rd Edition, Fred W. Billmeyer(Wiley) 1984.
3. A Textbook of Synthetic Dyes- O.D. Tyagi&M. Yadav(Anmol Publications) 2002.

4. Textbook of Dyes - A. Arora(SonaliPublications) 2009.
5. Synthetic Dyes – Vol-I – Venkataraman, 1999.
6. Synthesis and Chemistry of Agrochemicals, Vol I & II, ACS, Wahington.
7. Chemicals for Crop Protection and Pest Managements, M B Green, G.S. Hartley West, Pergamon.
8. Chemistry of Insecticides and Fungicides, Sree Ramulu, Oxford & IBH, 1985.

OC S 555: Separation Techniques and Organometallic Chemistry

COURSE OUTCOME:

- The students will learn the theory, principle, analytical and industrial applications of column chromatography, paper chromatography, thin layer chromatography, gas chromatography and High performance liquid chromatography.
- The student will gain the knowledge about types, routes of synthesis and reactions of transition metal alkyls, carbenes, carbines and hydrides.
- The student will understand the preparative methods, bonding, structure of transition metal-carbon pi-complexes, catalysis by organometallic compounds,
- To study homogeneous catalysis by organometallics in hydrogenation, hydrosilation, hydrocyanation, isomerisation of olefins, hydrocarbonylation of olefins, polymerization of olefins and acetylenes, synthetic applications of organocuprates, hydrozirconation, transmetallation by organonickels and carbonylation by metal carbonylates.

UNIT- I: **[12 Hours]**

Column Chromatography (CC): Construction and operation of column, choice ofadsorbents and eluents, techniques of elution, methods of detection, analytical and industrial applications.

Paper Chromatography (PC): Definitions, theory and principle, techniques; one, two-dimensional and circular PC, mechanism of separation, structure of cellulose and types of paper, methodology, preparation of sample, choice of solvents, location of spots and measurements of RF value, factors affecting RF values, advantages and applications.

Thin Layer Chromatography (TLC): Definition, mechanism, efficiency of TL plates,methodology selection of stationary and mobile phases, preparation of plates. Spotting, development, identification and detection, reproducibility of RF values, comparison of TLC with high performance thin-layer chromatography, paper chromatography and column chromatography. Qualitative and quantitative analysis.

UNIT- II: **[12 Hours]**

Gas chromatography (GC): Principle, comparison of GSC and GLC, instrumentationcolumns pack and tubular, study of detectors-thermal conductivity. Flame ionization, electron capture and mass spectrometry. Factors affecting the separation, applications.

High Pressure Liquid Chromatography (HPLC): Apparatus, pumps, column packing,charecteristics of liquid chromatographic detectors-UV, IR, refractometer and fluorescences detectors, advantages and applications.

Organometallic Compounds: Transition metal alkyls and aryls- types, routes of synthesis,Nucleophilic and electrophilic cleavage of metal-carbon sigma bonded compounds. Alkane activation. Transition metal to carbon multiple-bonded compounds- carbenes, carbynes, synthesis, structural characteristics and reactivity. Transition metal hydrides – synthetic

routes, properties, structure and reactivity, synthetic applications.

UNIT - III: **[12 Hours]**

Transition metal-carbon pi complexes: Preparative methods, nature of bonding, structuralfeatures of olefinic, acetylenic, allylic and η^5- cyclopentadienyl and η^6- benzene complexes. Important reactions relating to nucleophilic and electrophilic attack on ligands.

Catalysis by organometallic compounds:16- and 18-electron rules, oxidative addition,insertion, deinsertion and reductive elimination reactions.

Homogeneous catalysis by organometallics: Hydrogenation, hydrosilation, hydrocyanationand isomerization of olefins, immobilisation of homogeneous hydrogenation catalysts, hydrocarbonylation of olefins (oxo reaction-cobalt and rhodium oxo catalysts), carbonylation of alcohols-Monsanto acetic acid process. Polymerization of olefins and acetylenes: Ziegler-Natta catalyst systems. Fischer-Tropsch reaction, Water Gas Shift reactions.

Synthetic applications of organocuprates. Hydrozirconation, transmetallation reactions by organonickels, carbonylation by metal carbonylates.

References:

1. Chromatography-E. Heftman (Ed), Part A and Part B, 5th ed. Elsevier, 1992.
2. Chromatography Today- D. F. Poole and S.K. Poole, Elsevier , 1991.
3. Principles of Instrumental Analysis-Skoog, Holler and Nieman, 5th ed. Saunders, 1998
4. Quantitative Analysis-R. A. Day and A. L. Underwood, 5th ed. Prentice-Hall, 1998.
5. Instrumental Methods of Chemical Analysis -B. K. Sharma, 19th ed, Goel, 2000.
6. Principles and Applications of Organotransition Metal Chemistry - J.P.Collman, L.S.hegedus, J.R.Norton and R.G.Finke (University Science Books) 1987.
7. Organometallic Chemistry - R.C.Mehrotra and A.Singh (New Age International) 1999.
8. Organometallic Chemistry of Transition Metals-R.H.Crabtree (Wiley) 1999.

OC S 556: Organic Synthetic Strategies and Petrochemicals

COURSE OUTCOME:

Enable the students:

- To understand the preparation, properties and uses of polymer supported reagents in organic synthesis such as oligosaccharides, Dieckmann cyclisation, Aldol, Wittig, etherfication, acetal formation and diazatransfer reactions.
- To gain the knowledge of mechanistic aspects of nine multicmponent reactions, asymmetric synthesis by employing chiral pool, chiral auxiliaries, chiral reagent and chiral catalysts.
- To learn the origin, formation and composition of petroleum, petroleum refining, reforming, fractionation, cracking, petroleum products and their applications,
- To learn manufacture of synthetic petrol, origin of coal, coal carbonization, coal gasification and coal tar based chemicals, coal conversions and manufacture of petrochemicals.

UNIT- I: **[12 Hours]**

Polymer supported reagents in organic synthesis: Introduction, properties of polymersupport, advantages of polymer supported reagents and choice of polymers. Applications: Substrate covalently bound to the support: Synthesis of oligosachcharides, Dieckmann cyclisation. Preparation of polymer bound aldehyde and application in aldol and Wittig reactions. Synthesis of polystyryl boronic acid and use in diol protection reaction. Reagent

linked to a polymeric material: Preparation of sulfonazide polymer and application in diazotransfer reaction. Synthesis of polymer bound per acid and its applications. Polymer supported catalytic reactions: Preparation of polymer supported AlCl3 and application in etherification and acetal formation reactions.

Multicomponent Reactions: Studies on the mechanistic aspects and use of theUgi, Passerini,Biginelli, Hantzsch, Doebner-Miller, Jacobson, Barbier, Baylis-Hilmann and Mannich reactions.

UNIT- II: **[12 Hours]**

Assymmetric Synthesis: The Chiral pool; Alpha amino acids in the synthesis ofBenzodiapines, Carbohydrates(Benzyl D-Mannose to Swainsonine) Preparation of tomolal from D-mannitol, Felion-Ahn model and Cram's chelation control. Enantiomeric excess and its determination.

Chiral Auxiliaries: Oxazolidinones, Chiral sulfoxides in controlling the reduction ofketones, Use of chiral Auxillaries in Diels-Alder and aldol reactions. **Chiral Reagents:** BINOL, DIBAL, Tartarates, Lithium diamides.

Chiral Catalysts: Rhodium and Ruthenium catalysts with Chiral phosphine ligands like (R)-BINAP, (R,R)-DIOP.

Asymmetric amplification and autocatalysis.

UNIT- III: **[12 Hours]**

Petrochemicals: Origin and formation of Petroleum, Composition of crude Petroleum andnatural gas, Petroleum refining, reforming, fractionation, cracking, knocking, octane and cetane numbers. Ion, different types of petroleum products and their applications. Ignition point, flash point and octane number. Manufacture of synthetic petrol - Bergius and Fischer Tropsh processes.

Origin of coal, coal carbonisation, coal gasification and coal tar based chemicals. Chemistry of coal conversions.

Manufacture of petrochemicals: Preparation of methanol, chlorinated methanes and carbondisulphide from methane, Preparation of Ethyl chloride, ethanol, ethylene oxide from ethylene, anufacture of the following from propylene - Isopropanol, cumene, glycerine and acrylonitrile. Manufacture of vinyl chloride, chloroprene, acrylonitrile and acetaldehyde from acetylene.

References*:*

1. Stereochemistry of Organic compounds-Nasipuri (New Age International).
2. Stereochemistry of Organic compounds-P.S. Kalsi (Wiley Eastern).
3. Organic chemistry- J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford University Press)
4. Stereochemistry of Organic compounds - E. Eliel and S.H. Wilen (John Wiley).
5. Art in Organic Synthesis- Anand, Bindra & Ranganath-(Wiley New Delhi), 1970.
6. Organic Synthesis a Disconnection Approach- Stuart Warren
7. Advanced Organic Chemistry-IV-Ed. Part A & B-F.J.Carrey & R.J.Sundberg (Kluwer) 2001.
8. Modern Methods of Organic Synthesis, 2nd edn.-N.Carruthers (Cambridge University), 1998.

9. Introduction to Petrochemicals, 2nd ed. - S. Maiti (Oxford and IBH) 2002.
10.Modern Petroleum Refining Processes, 4th ed.- B.K.B. Rao (Oxford and IBH) 2005.
11.Advanced Petroleum Refining, 1st ed., G.N. Sarkar (Khanna Publishers) 1998
12.The Chemistry and Technology of Petroleum - S.G James (Marcel Dekker) 1991.
Chrotechnology: Industrial Synthesis of Optically active compounds-R. A. Sheldon, Marcel Dekker) 1993
- Organic Chemistry- R. E. Ireland (Prentice-Hall India) 1975.
- Principles and applications of asymmetric synthesis-G D Lin, Y M Li and A S C Chan (Wiley Interscience) 2001.
13. Organic synthesis: Special techniques-V. K. Ahluwalia and R. Aggarwal (Narosa) 2003
14. Polymers as aids in Organic synthesis- N. K. Mathur, C. K. Narang and R. E. Williams (Academic Press) 1980.

OC P 557 : Organic Chemistry Practicals –VI

COURSE OUTCOME:

Enable the students:

- To gain the knowledge of preparation and purification of eighteen organic molecules using multistep organic synthetic protocol.
- To know the synthesis and purification of one derivative each of furan, indole, pyrazole, quinoline, thiazole, acridine, coumarin and triazoles.
- To learn the synthesis of picric acid, para red, methyl red, methyl orange, flourecein, eosin, indigo and dyeing of fabrics.

Preparation of Ethyl resorcinol from Resorcinol, 3-Bromo-4-methyl benzaldehyde from p-Toluedine, ε-Caprolactam from cyclohexanone, p-Aminobenzoic acid from p-Nitrotoluene, s-Tribromobenzene from aniline, o-hydroxyacetophenone from phenol, Benzanilide from Benzophenone, Benzylic acid from Benzoin, Benzopinacolone from Benzophenone, p-Chlorotoluene from p-Toludine, 2,5-Dihydroxyacetophenone from Hydroquinone, 2,4-Dinitrophenylhydrazine from Chlorobenzene, m-Nitrobenzoic acid from Benzoic acid, 2,4-Dinitrophenol from Chlorobenzene, o-Aminobenzoic acid from Phthalic acid, 2-Carbethoxycyclopentanone from Adipic acid, α-Acetylaminocinnamic acid from Glycine, p-Aminoazobenzene from Aniline.
Synthesis of one derivative each of Furan, Indole, Pyrazole, Quinoline, Thiazole, Acridine, Coumarin and Triazole containing heterocycles. Synthesis of Picric acid, Para red, Methyl red, Methyl orange, Flourescein, Eosin, Indigo and dyeing of fabrics.

OC P 558: ORGANIC CHEMISTRY PRACTICALS-VII

COURSE OUTCOME:

- The students will understand the separation of components from mixture of organic compounds by fractional crystallization, fractional distillation, adsorption, paper, TLC and column chromatography, purification and characterization of organic compounds.
- The students learn the determination of pKa values, molar extinction coefficients, keto-enol equilibrium, order of reactions, salt effect and effect of acidity on reaction rates.
- To know the preparation and estimation of aryloxy acetic acids, anilinoacetic acids, estimation of carbohydrates and proteins.

- To understand the elucidation of structure of organic compounds using UV, IR, NMR and mass spectra, locating the organic compounds by reference to literature, use of computers in the study of conformation and geometry of simple organic molecules, utility of chemdraw and chemsketch.

Separation of components from mixture of organic compounds by fractional crystallization, fractional distillation, adsorption, Paper, TLC and column chromatography. The purification and characterization of organic compounds.
Determination of pKa values, molar extinction coefficients, keto-enol equilibrium, order of reactions-S_N1 and S_N2 reactions, salt effect and effect of acidity on reaction rates.
Preparation and Estimation of aryloxyacetic acids, anilinoacetic acids, Carbohydrates, Proteins.
Elucidation of structure of organic compounds using UV, IR, NMR and Mass spectra.
Locating an organic compound by reference to literature (Chemical Abstract).
Applications of computers in the study of conformation and geometry of some simple organic molecules. Utility of Chem draw and Chem sketch.

References:

1. Elementary Practical Organic Chemistry-Vol. III quantitative Organic Analysis- A.I. Vogel
2. Vogel's Text Book of Practical Organic Chemistry- Furniss et al. (ELBS)1978.
3. Experimetal Organic Chemistry- Vol. I &II- P. R. Singh (Tata McGraw-Hill) 1981.
4. Practical Organic Chemistry- IV Ed- Dey & Sitaraman (Allied)
5. Laboratory Experiments in Organic Chemistry-Adam, Johnson & Wicon (McMillan), 1979.
6. Experimental Organic Chemistry- H. D. Durst & G. E. Goke (McGraw-Hill) 1980.
7. More Spectroscopic Problems in Organic Chemistry-A.J. Baker et al.(Heyden) 1975.
8. Spectral Problems in Organic Chemistry- Davis & Wells (Chapman & Hall) 1984

OC P 559: PROJECT WORK AND DISSERTATI

COURSE OUTCOME:

Enable the students:

- To design the project by collecting required background material by referring the literature
- To understand the functioning and safety features in the industry.
- To improve the experimental and soft skills.
- To learn various analytical and instrumental techniques and interpretation of analytical data.