BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE (INDIA)

MASTER OF SCIENCE (ORGANIC CHEMISTRY)

M.Sc.-II (ORGANIC CHEMISTRY)

SEMESTER-III & IV

[CBCS- 2018 Course]

STRUCTURE OF M. Sc. II (ORGANIC CHEMISTRY)

COURSE CODE	COURSE NAME	CREDITS
SEMESTER- III		
PGOC-301	Advanced Organic Reaction Mechanism	4 Credits
PGOC-302	Spectroscopic Methods In Structure Determination	4 Credits
PGOC-303	Advanced Stereochemistry	4 Credits
PGOC-304	Medicinal Chemistry	4 Credits
PGSEC 305	Assessment of Water Quality	2 Credits
SEMESTER-IV		
PGOC-401	Synthetic Organic Chemistry	4 Credits
PGOC-402	Chemistry Of Natural Products	4 Credits
# **Elective Paper (Any One from PGOC-403 to PGOC-405)**		
PGOC-403	Green Chemistry	3 +! Credits
PGOC-404	Applied Organic Chemistry	3 +! Credits
PGOC-405	Bio-Organic Chemistry	3 +! Credits
Lab Course / Practicals*		
PGOC-407	Mixture Separation	2 Credits
PGOC-408	Advanced Preparations	2 Credits
PGOC-409	Research Project / Laboratory Course	2 Credits

***University examination for the practical courses PGOC-407, PGOC-408, PGOC-409 will be conducted at the end of the year.

Core Elective Course includes Core: Elective subjects and Industrial project.
Industrial Project includes one day visit, Internet survey, project writing, presentation or oral and be evaluated as the internal marks for Core: Elective Course (PGAC-403, PGAC-404, PGAC-405).

M. Sc. II (ORGANIC CHEMISTRY)
SEMESTER III
(CBCS-2018 COURSE)
PGOC-301: ADVANCED ORGANIC REACTION MECHANISM

Total Credits: 04 **Total Lectures: 60Hrs**

Course Content:

Carbanions in Organic Chemistry

Ionization of carbon hydrogen bond and prototopy, base and acid catalysed halogenation of ketones, keto-enol equilibria, Structure and rate in enolisation, Concerted and carbanion mechanism for tautomerism, Carbanion character in phenoxide and pyrrolyl anions, Geometry of carbanions, Hydrolysis of haloforms, Aldol, Mannich, Cannizzaro, Darzens, Dieckmann, Claisen Baylis-Hillman reactions, Knoevenagel, Benzoin Condensation, Alkylation of enolates. Reactions of carbenes and nitrenes.

Heterocyclic Chemistry

Synthesis and reactions of : Furon, Pyrrole, Thiophene, Benzofuran, Indole, Benzothiphene, Pyridine, Quinoline, Isoquinoline, Imidazole, Oxazole, Thiazole.

Synthesis of Chloroquine, Papavarine, Amlodipine, Bromouidine, Ranitidine, Vitamin-B6, Tryptophan, Thiamine, Histidine.

Books/References:

1. Mechanism and structure in Organic Chemistry – E.S. Gould (Holt, Rinehart and Winston).
2. Advanced Organic Chemistry Part-A. F. A. Carey and R. J. Sundberg, 5th Ed. Springer (2007).
3. Advanced Organic Chemistry by J. March, 6th Ed.
4. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers. Oxford University Press (2001).
5. Modern Heterocyclic Chemistry – L. A. Paquette (Benjamin).
6. Heterocyclic Chemistry – J. A. Joule and K. Mills 4th Edition Blackwell Publishing (2007).

M. Sc. II (ORGANIC CHEMISTRY)
SEMESTER III
(CBCS-2018 COURSE)
PGOC-302: SPECTROSCOPIC METHODS IN STRUCTURE DETERMINATION

Total Credits: 04 **Total Lectures: 60Hrs**

Course Content:

1. Recapitulation of UV, IR and ^{1}H NMR**.**

2. ^{1}H NMR

(Advanced ideas) FT – techniques, Spin Coupling, Ramsay mechanism of spin coupling, Different spin systems (AB, AX, AMX systems, Calculation of line intensities), Factors affecting coupling constants, Rate processes. Different types of coupling. Methods used for simplification of PMR spectra. NOE, Spin decoupling. Two dimensional (2D) NMR Techniques, COSY, HETCOR. Applications of PMR**.**

3. ^{13}C NMR

Elementary ideas, Instrumental problems, Chemical shift features of hydrocarbons, Effect of substituents on chemical shifts, Different type of carbons (alkene, alkyne, allene and carbonyl).
DEPT(with 3 different angles), Application of ^{13}CNMR**.**

4. Mass Spectrometry

Theory, Instrumentation, Various methods of ionization (field ionisation, EIMS, SIMS, FAB, MALDI), Different detectors (magnetic analyzer, ion cyclotron analyzer, Quadrupole mass filter, Time of flight (TOF). Rules of fragmentation of different functional groups, Factors controlling fragmentation. Application of Mass spectroscopy**.**

5. Problems based on joint application of UV, IR, PMR, CMR, and Mass. (Including reaction sequences)

Books/References:

1. Introduction to Spectroscopy – D. L. Pavia, G.M. Lampman, G. S. Kriz, 3rd Ed. (Harcourt college publishers).
2. Spectrometric Identification of Organic Compounds - R. M. Silverstein, F. X. Webster, 6th Ed. John Wiley and Sons.
3. Spectroscopic Methods in Organic Chemistry - D. H. Williams and I. Flemming Mc Graw Hill
4. Absorption Spectroscopy of Organic Molecules – V. M. Parikh
5. Nuclear Magnetic Resonance – Basic Principles- Atta-Ur-Rehman, Springer-Verlag (1986).
6. One and Two dimensional NMR Spectroscopy – Atta-Ur-Rehman, Elsevier (1989).

7.Organic Structure Analysis- Phillip Crews, Rodriguez, Jaspars, Oxford University Press(1998).
8. Organic Structural Spectroscopy- Joseph B.Lambert, Shurvell, Lightner, Cooks, Prentice-Hall
9. Organic structures from spectra –Field L.D., Kalman J.R. and Sternhell S. 4th Ed. John Wiley and Sons Ltd.

M. Sc. II (ORGANIC CHEMISTRY)
SEMESTER III
(CBCS-2018 COURSE)
PGOC-303: ADVANCED STEREOCHEMISTRY

Total Credits: 04 **Total Lectures: 60Hrs**
Course Content:

1. Stereochemistry of rings other than six membered .
Ref. 1, 6, 7

2. Fused Bridged and Caged rings .

Ref.1, 2, 6, 7

3. Recapitulation of prochirality, Homotopic and Heterotopic ligands, Stereoselectivity in cyclic compounds, Enantioselectivity, Diastereoselectivity, Stereoselective aldol reactions. Cram's rule, Felkin Anh rule, Cram's chelate model. Asymmetric synthesis use of chiral auxiliaries, Chiral reagents and catalysts, Asymmetric hydrogenation, Asymmetric epoxidation and asymmetric dihydroxylation.
Ref. 3 chapters 33, 34, 35

4. Stereochemistry of Morphine, Quinine and Strychnine.

Ref. 4, 5, 6

Books/References:
1. Stereochemistry of Carbon Compounds - E. L. Eliel.
2. Stereochemistry of Carbon Compounds - E. L. Eliel and S. H. Wilen.
3. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press).
4. Chemistry of Natural Products – N. R. Krishnaswamy (University Press).
5. Organic Chemistry vol. II - I. L. Finar, 5th edition (Longman).
6. Stereochemistry of Organic Compounds –Nasipuri.
7. Stereochemistry of Organic Compounds – P. Kalasi.
8. Organic Stereochemistry – Jagadamba Singh.

M. Sc. II (ORGANIC CHEMISTRY)
SEMESTER III
(CBCS-2018 COURSE)
PGOC-304: MEDICINAL CHEMISTRY

Total Credits: 04 **Total Lectures: 60Hrs**

Course Content:

1: Concepts of Medicinal Chemistry.

Important terminology in medicinal chemistry: Drugs, Pharmacy, Pharmaceutics, Toxicology; Pharmacodynamic agents, Pharmacophore, Pharmacodynamics, metabolite and antimetabolites, chemotherapy. Mechanism of chemotherapeutic actions: 1) Biological defences 2) Chemical defences. a) Surface active agent, b) Metabolic antagonism. Assay of Drugs: Chemical assay, Biological assay, Immunological assay, LD-50 and ED-50.

2: Drug metabolism.

Introduction, Oxidation, Reduction, Hydrolysis, Conjugation.

3: Antimicobacterial drugs.

Introduction, First-line agents (Primary tubercular drugs): Structure and activity of streptomycin and dihydro-streptomycin, Synthesis and SAR of 4-amino salicylic acid and isoniazid.

4: Antibiotics. 1.

Introduction, classification of antibiotics,

2. Cell wall synthesis,

3. Mechanism of action of antibiotics, a) Inhibition of cell-wall synthesis, b) Inhibition of bacterial protein synthesis, c) Disorganization of the cytoplasmic membrane, d) Interference in the bacterial nucleic acid synthesis, e) Inhibition of the tetrahydro-folate biosynthesis.

4. Cell wall synthesis inhibitors (β-Lactam antibiotics): Synthesis of Penicillin-G, Amoxicillin, Aampicilin from 6-APA, Cephalexin, Structure and activity of benzyl penicillin, Semi-synthetic penicillin, Cephalosporin, Mode of action of penicillin and cephalosporin.

Books/References:

1. Medicinal Chemistry-William O. Foye
2. T. B. of Organic Medicinal and Pharmaceutical Chemistry-Wilson and Gisvold's (Ed. Robert F. Dorge).
3. An Introduction to Medicinal Chemistry-Graham L. Patrick
4. Principles of Medicinal Chemistry (Vol. I and II)-S. S. Kadam, K. R. Mahadik and K. G. Bothara (Nirali Prakashan).
5. Medicinal Chemistry (Vol. I and II)-Burger.
6. An introduction to drug design-S. S. Pandeya and J. R. Dimmock (New age international).
7. The organic chemistry of drug design and drug action-R. B. Silverman (Academic Press).
8. Strategies for organic drug synthesis and design-D. Lednicer Wiley.
9. Pharmacological Basis of Therapeutics-Goodman and Gilman's (McGraw Hill).

M. SC. II (ORGANIC CHEMISTRY)
SEMESTER III
(CBCS-2018 COURSE)
PGSEC 305: ASSESSMENT OF WATER QUALITY

Total Credits: 02 **Total Lectures: 30Hrs**

Course Content:

The main objective of course is to improve the awareness and skills of the students in modern techniques of analysis of water for research and extension activities. Use of instruments and their general upkeep/maintenance, interpretation of analytical data and formulation of reports/recommendations.

The course is designed to cover water characteristics, testing techniques and methods of interpretation of data, so as to make it more useful in the context of global competition in quality and precision of analysis.. About the Course: The course will cover some theory lectures on topics most relevant to the subject along with appropriate number of practical exercises with greater emphasis on analytical techniques adopting a demonstration and learning-by-doing type of approach. Interpretation of test results and formulation of recommendations and/or reports will be a vital component.

The course context: Collect samples in scientific way from residential plumbing and municipal distribution systems for analysis Take physical tests like (Colour, pH, Temp etc) at the spot and use preservatives for further analysis Conduct chemical tests of samples in lab (e.g. Alkalinity, Hardness, TDS. DO, COD etc with biological tests) as possible as. To conduct chlorine residual or turbidity tests.Compare the obtained values with WHO, CPCB or BSI Standards

References:

1. Hand Book of Methods in Env. Studies by S.K. MAITI ABD Publishers, Jaipur, India.
2. Instrumental methods of chem. Analysis G. R. Chatwal and Anand Himalaya publishing house, New Delhi.
3. Environmental Science Principle & Pract. R. C. Das & Behera Prentice Hall of India pvt. Ltd. New Delhi.

M. Sc. II (ORGANIC CHEMISTRY)
SEMESTER IV
(CBCS-2018 COURSE)
PGOC-401: SYNTHETIC ORGANIC CHEMISTRY

Total Credits: 04 **Total Lectures: 60Hrs**
Course Content:

1. Transition metal complexes in organic synthesis; only Pd, Ni, Co, Pt, Fe, Rh, Ru; Grubb's catalyst, Ziegler Natta catalyst.
2. Use of Boron, Silicon and Tin in organic synthesis.

Ref.2, chapter 47

3. Designing of organic synthesis.
4. Umpolung in organic synthesis.
5. Protection and deprotection of hydroxyl, amino, carboxyl, ketone and aldehyde functions as illustrated in the synthesis of polypeptide and polynucleotide.

Books/References:

1. Modern Synthetic Reactions – H. O. House (Benjamin).
2. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press).
3. Designing of Organic Synthesis – S. Warren (Wiley).
4. Some Modern Methods of Organic Synthesis – W. Carruthers (Cambridge).
5. Organic Synthesis – M. B. Smith.
6. Organometallics in Organic Synthesis – J. M. Swan and D. C. Black (Chapman and Hall).
7. Advanced Organic Chemistry, Part B – F. A Carey and R. J. Sundberg 5^{th} edition (2007).

M. Sc. II (ORGANIC CHEMISTRY)
SEMESTER IV
(CBCS-2018 COURSE)
PGOC-402: CHEMISTRY OF NATURAL PRODUCTS

Total Credits: 04 **Total Lectures: 60Hrs**

Course Content:

1) Terpenoids

Structure and synthesis of Abietic acid, Zingiberene, Santonin, Cuparenonne and Caryophyllene.

2) Alkaloids

Structure, Stereochemistry, Synthesis and biosynthesis of morphine, reserpine, ephedrine, (+) conin.

3) a) Steroids

Occurrence, Nomenclature, Basic skeleton, Diels hydrocarbon and study of the following Hormones: Androsterone, Testosterone, Estrone, Progesterone, Aldosterone and Cartisone. Biosynthesis of steroids.

b) Prostaglandins

Occurrence, nomenclature, classification, biogenesis and physiological effects, synthesis of PGE2 and PGF2

4) Biogenesis

Alkaloids (pyridine, morphine and indole type) Terpenoids, Cholesterol, Flavones, Coumarins, Carbohydrates and Proteins.

5) Vitamins

Synthesis of biotin and vitamin B2, Synthesis of vitamin B1, Biological functions of B_6, B_{12}, folic acid and thiamine.

Books/ References:

1. The total synthesis of natural products- Apsimon.
2. Alkaloids - Manskey and Holmes.
3. Chemistry of Terpenes - A.A. Newmen.
4. The chemistry of natural products- P. D B.Mayo.
5. Terpenes- Simonson.
6. Aspects of terpenoid chemistry and biochemistry- T.W. Goddwin.
7. Vitamins and Co-enzymes- Woguer.
8. Chemistry of Natural products- P. W. Bently.
9. Steriods - Fieser and Fieser.

10. Organic Chemistry Vol. II and I- I. Finar.
11. The molecules of nature - J.B. Hendrickson.
12. The biogenesis of natural products Peter Bernfield.
13. Total synthesis of steroids- R.T. Slickenstaff A.C. Ghosh and G.C. Wole .
14. The chemistry of natural products- vol. Nakanishi.

M. Sc. II (ORGANIC CHEMISTRY)
SEMESTER IV
(CBCS-2018 COURSE)
PGOC-403: GREEN CHEMISTRY

Total Credits: 03 **Total Lectures: 45Hrs**

Course Content:

1. Introduction to Green Chemistry.

Introduction, Principles, atom economy and scope, Inception to green chemistry, Introduction to alternative approaches, Solvent free reactions-principle, scope, utility of solvent free conditions, controlling solvent free reactions. Phase changes, optimum reaction temperatures, miscibility of reactants and catalysts.

Solvent free microwave assisted organic synthesis: Introduction, solvents free techniques-Reactions on solid mineral support, solid-solid phase transfer catalysts reactions without solvent, support or catalyst. Microwave activation-benefits, limitations, equipments, microwave effects-according to reaction medium and according to reaction mechanism.

2. Approaches to Green Chemistry.

Basic principles of green synthesis:

a) Use of green reagents in green synthesis-dimethyl carbonate, polymer supported reagents-per acids, chromic acids.

b) Green catalysts: Acid catalysts, oxidation catalysts, and basic catalysts.

c) Phase transfer catalyst in green synthesis: Aliquat 336, benzyltrimethyl ammonium chloride (TMBA), Tetra-n-butyl ammonium chloride.

d) Advantages of PTC reactions to green synthesis. Applications of PTC's in C-alkylation, N-alkylation, S-alkylation, darzens reaction, Williamsons synthesis and Wittig reaction.

3. Microwave induced and ultrasound assisted green synthesis.

Introduction to synthetic organic transformations under microwave.

a) Microwave assisted reactions in water: Hoffmann elimination, hydrolysis, oxidation, saponification reactions.

b) Microwave assisted reactions in organic solvents: Esterification reactions, Fries rearrangement, Ortho ester Claisen rearrangement, Diels-Alder reaction, decarboxylation.

c) Microwave solvent free reactions (solid state reactions): Deacetylation, Deprotection, saponification of ester, alkylation of reactive methylene compounds, synthesis of nitriles from aldehydes, and reductions.

d) Ultrasound assisted reactions: Introduction, substitution, addition, oxidation, reduction reactions.

Books /References:

1. Organic Chemistry, vol-2, I.- L. Finar, ELBS.
2. Stereoselective Synthesis: A practical Approach- M. Nogrudi, VCH.
3. Organic Synthesis in water- Paul A. Grieco Blackie.
4. Green Chemistry, theory and practice- Paul T. Anastas and John C. Warner.
5. New Trends in Green chemistry- V. K. Ahluwalia and M. Kidwai.
6. Organic Synthesis: Special techniques- V. K. Ahluwalia and Renu Aggarwal.

M. Sc. II (ORGANIC CHEMISTRY)
SEMESTER IV
(CBCS-2018 COURSE)
PGOC-404: APPLIED ORGANIC CHEMISTRY

Total Credits: 03 Total Lectures: 45Hrs

Course Content:

1) Agrochemical:

a. Carbamate pesticides: Introduction, carbaryl, Baygon, Aldicarb, Ziram, Zineb
b. Organophosphorus pesticides: Malathion, monocrotophos, dimethoate, phorate, mevinphos
c. Insect repellents: General survey and synthesis
d. Juvenile harmone: introduction structures JHA importance synthesis
e. Pheromones: introduction, examples, and importance in IPM synthesis of juvabione bombycol, grandisol, and disparure

2) Dyes and Intermediates:

Synthesis of important dye intermediates. Commercial processes for Azo dyes, reactive dyes, optical brighteners, thermal sensitive dyes, dispenses dyes.

References/ Books:

1. Colour Chemistry – Allan.
2. Chemistry of Synthetic Dyes Vol- 1 to 7.- K. Venkataraman
3. Dyes & their intermediates- Abrahart.
4. The Chemistry of Pesticides and formulations - N. N. Melikov.
5. Chemistry of Pesticides- K. H. Buchel.
6. Pesticides - R. Cleymlin.
7. Text book of Polymer Science- F. W. Billmeyer.
8. Contemporary Polymer Chemistry- H. R. Alcock and F. W. Lambe.
9. Physics & Chemistry of Polymers- J. M. G. Cowie, Blackie.
10. Unit Processes in Organic Synthesis- P. H. Groggins.
11. Perfumary Technology-. B. Biollot & P. V. Wells
12. A formulary of Cosmetic Preparations- M. Ash & I. Ash.

M. Sc. II (ORGANIC CHEMISTRY)
SEMESTER IV
(CBCS-2018 COURSE)
PGOC-405: BIO-ORGANIC CHEMISTRY

Total Credits: 03 **Total Lectures: 45 Hrs**

Course Content:

1: Enzymes

Definition, Classification and nomenclature of enzymes. Factors affecting the enzyme catalysed reactions. Advantages and limitations of enzymes in organic synthesis-mechanistic aspects of enzyme catalysis -Lock and Key mechanism, Induced-Fit mechanism, Michaelis-Menten Equation, Desolvation and salvation-substitution theory, Three point attachment rule. Factors affecting the enzyme catalysed reactions. Enzyme selectivity-Chemo, regio, diastereo and enantio selectivity-Illustration with suitable examples.

2: Nucleic acids

Introduction, Hydrolysis of nucleic acids, Structure physical and chemical properties of the heterocyclic bases-Adenine, Guanine, Cytosine, Uracil and Thiamine. structure and synthesis of nucleosides and nucleotides. Deoxyribose nucleic acid (DNA): Primary, secondary, tertiary structure of DNA. Structure of RNA. Types of RNA- mRNA, rRNA and tRNA.

Books/ References:

1. Natural products: Chemistry and Biological significance- J.Mann, R.S.Davidson, J.B.Hobbs,
D.V., Banthropde & J. B. Harborne, Longm, an, Essex.

M. Sc. II (ORGANIC CHEMISTRY)
SEMESTER III& IV
(CBCS-2018 COURSE)
PGOC- 407 : MIXTURE SEPARATION

Total Credits: 02

Course Content:

TERNARY MIXTURE SEPARATION:

Separation of at least ten mixtures containing three components. The mixtures should also involve separation of nitro phenols, amino acids, low boiling substances, water soluble substances. Amines, Phenols and acids used should also contain other elements and functional groups. The mixture separation should be carried out on micro-scale using ether.

M. Sc. II (ORGANIC CHEMISTRY)
SEMESTER III & IV
(CBCS-2018 COURSE)
PGOC-408 : ADVANCED PREPARATIONS

Total Credits: 02

Course Content:

SINGLE STAGE AND TWO STAGE PREPARATIONS:

At least eight single stage and eight two stage preparations from the following should be carried
out. The preparations should be carried out on micro scale.

Single Stage Preparations:

1. Acetophenone → Ethyl Benzene
2. Anthranilic acid → ortho Iodobenzoic acid
3. Diels-Alder reaction using Anthracene and Maleic anhydride
4. Benzyl cyanide → p-Nitro benzyl cyanide
5. Bromobenzene → p-Nitro bromobenzene
6. 2-Naphthol → 2,2'-Dihydroxybinaphthyl
7. Glycine → Hippuric acid
8. Salicylic acid → 5-Nitrosalicylic acid
9. Resorcinol Resacetophenone
10. 2-Methoxynephthalene →1-Formyl-2-methoxynaphthalene
11. p-Xylene →Ter-phthalic acid
12. o-Nitrotoluene + Benzaldehyde $\xrightarrow{\text{Base}}$ → condensation

Two Stage Preparations:

1. Benzophenone → Oxime → Benzanilide
2. Benzoin → Benzil → Benzilquinoxaline
3. Benzaldehyde + Acetophenone → Benzalacetophenone → Epoxide
4. 4-Nitrotoluene → 4-Nitrobenzoic acid → 4-Aminobenzoic acid
5. Resorcinol → 4-methyl-7-hydroxycoumarin → 4-methyl-7-acetoxy -coumarin
6. Phenol →Salicyaldehyde →Coumarin
7. Cyclohexanone → Phenylhydrazone →1,2,3,4- tetrahydrocarbazole
8. Acetanilide → p-Nitroacetanilide → p-Nitroaniline
9. Hydroquinone → Quinone → 1,2,4- Triacetoxybenzene
10. Cyclohexanone → Oxime → Caprolactum
11. Hydroquinone → Diacetate → 2,5-Dihydroxy acetophenone
12. 4-Chlorophenol → 4-Chlorophenyl acetate → 5-Chloro-2-hydroxyacetophenone

Interpretation of NMR, IR and Mass Spectra of about 15 compounds. Minimum 2 three stage preparations to demonstrate how to develop a synthetic sequence.

M. Sc. II (ORGANIC CHEMISTRY)
SEMESTER III & IV
(CBCS-2018 COURSE)
PGOC-409: LAB COURSE/ PRACTICALS

Total Credits: 02
Course Content:

PROJECT AND PRACTICALS:
1. Students should carry out a small research project. This should make them familiar with literature survey, research methodologies, Identification of products by analytical and spectral methods and familiarity with chromatographic techniques.

2. Students who are not assigned the project should carry out at least 12 experiments and students who are assigned project work should carry out at least 6 experiments to illustrate the principles of organic reaction mechanism, stereochemistry or selectivity of reagents.

Suggested reagents and reactions –
$LiAlH_4$ (reduction of ethyl benzoate to benzyl alcohol), $NaBH_4$ (reduction of anisaldehyde to p- methoxy benzyl alcohol), SeO_2, NBS(bromination of p-nitrotoluene), Grignard Reaction (preparation of triphenyl carbinol or diphenyl methyl carbinol), Wittig Reaction (preparation of ethyl cinnamate from benzaldehyde), Cannizzaro's reaction (on benzaldehyde) Asymmetric reduction, Phase transfer catalyst isolation of natural products (like Eugenol from cloves, Limonene from orange peels, Trimyristin from nutmeg etc.), photochemical reaction, Peracid and lead tetra acetate oxidation, rearrangement reactions, synthesis of heterocyclic compounds like Hydantoin, thiohydantoin, pyrazolone, Biginelli reaction (synthesis of 4-aryl-3,4-dihydropyrimidinone).