University of Pune

Revised Syllabus 2014

M.Sc. II: Organic Chemistry

Semester III

CHO-350	**Organic Reaction Mechanism**	**48 Lectures, 4 Credits**
CHO-351	**Spectroscopic Methods in Structure Determination**	**48 Lectures, 4 Credits**
CHO-352	**Organic Stereochemistry**	**48 Lectures, 4 Credits**
CHO-353	**Pericyclic Reactions, Photochemistry and Heterocyclic Chemistry**	**48 Lectures, 4 Credits**

Semester IV

CHO-450	**Natural Products**	**48 Lectures, 4 Credits**
CHO-451	**Advanced Synthetic Organic Chemistry**	**48 Lectures, 4 Credits**
CHO-452	**Carbohydrate and Chiron approach/ Chiral Drugs and Medicinal Chemistry**	**48 Lectures, 4 Credits**
CHO-453	**Designing Organic Synthesis and Asymmetric Synthesis**	**48 Lectures, 4 Credits**

M.Sc. II: Organic Chemistry Practical

CHO-347	**Single Stage Preparations**	**6 Credits**
CHO-447	**Two Stage Preparations**	**6 Credits**
CHO-448	**Project/Industrial training/ Green Chemistry and Chemical Biology Experiments**	**6 Credits**

Equivalence of previous Syllabus

	New Syllabus 2014 Pattern		Old Syllabus 2008 Pattern
CHO-350	**Organic Reaction Mechanism**	**CH-350**	**Organic Reaction Mechanism**
CHO-351	**Spectroscopic Methods in Structure Determination**	**CH-351**	**Spectroscopic Methods in Structure Determination**
CHO-352	**Organic Stereochemistry**	**CH-352**	**Organic Stereochemistry**
CHO-353	**Pericyclic Reactions, Photochemistry and Heterocyclic Chemistry**	**CH-353**	**Free Radicals, Photochemistry, Pericyclic Reactions and their Applications**
CHO-450	**Chemistry of Natural Products**	**CH-450**	**Chemistry of Natural Products**
CHO-451	**Advanced Synthetic Organic Chemistry**	**CH-451**	**Synthetic Methods in Organic Chemistry**
CHO-452	**Carbohydrate and Chiron Approach/ Chiral Drugs and Medicinal Chemistry**	**CH-452**	**Heterocyclic Chemistry, Chiron Approach and Medicinal Chemistry**
CHO-453	**Designing Organic Synthesis and Asymmetric Synthesis**		
CHO-347	**Single Stage Preparations**	**CH-347**	**Ternary Mixture Separation**
CHO-447	**Double Stage Preparation**	**CH-447**	**Single Stage and Two Stage Preparation**
CHO-448	**Project/Industrial Training/ Green Chemistry and Chemical Biology Experiments**	**CH-448**	**Project and Practicals**

M.Sc. Organic Chemistry PART-II

REVISED SYLLABUS-2014

CHO-350: Organic Reaction Mechanism [4 credits, 48 Lectures]

1. Carbanions-Formation, stability and related name reactions [14L]
   Ref. 1, 2, 3 Vol.A and 7
2. Enamines –formation and applications, Ref. 3 [4L]
3. NGP :Neighbouring group participation , Ref. 1 [6L]
4. Reactions of carbenes and nitrenes Ref.3 Vol B [4L]
5. Free radicals: [14L]
   Generation of radiacls, Stable free radicals, Nucleophilic and electrophilic radicals, Characteristics reactions, -Free radical substitution, addition to multiple bonds, Radicals in synthesis: Inter and intra molecular C-C bond formation via mercuric hydride, tin hydride, thiol dionors, cleavage of C-X, C-Sn, C-Co, C-S, O-O bonds. Oxidative coupling. C-C bond formation in aromatics, SNAr reactions
   Ref. 1, 3 Vol A, 6
6. Mechanisms in Biological Chemistry (Ref. 5) [6L]

References:

1. Mechanism and structure in Organic Chemistry – E. S. Gould (Holt, Rinehart and Winston)
2. Advanced organic chemistry by J. March, 6th Ed.
3. Advanced organic chemistry. F. A. Carey and R. J. Sundberg, 5th Ed. Springer (2007)
4. A guidebook to mechanism in organic chemistry – Peter Sykes 6th Ed. Orient Longman
5. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers. Oxford University Press (2001)
6. Radicals in Organic Synthesis B. Giese, Pergamon press (1986)

CHO-351: Spectroscopic Methods in Structure Determination

[4 credits, 48 Lectures]

^{1}H NMR Spectroscopy (14 L)

Chemical shift, factors influencing chemical shift, deshielding, chemical shift values and correlation for protons bonded to carbons (aliphatic, olefinic, aldehydic, aromatic) and other nuclei (alcohols, phenols, enols, acids, amides and mercaptans), chemical exchange, effect of deuteration, spin-spin coupling, (n+1) rule, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), factors effecting coupling constant "J", classification of spin system like AB, AX, AX_2, ABX, AMX, ABC, A_2B_2. Spin decoupling, Factors affecting coupling constant, simplification of complex spectra, nuclear magnetic

double resonance, spin decoupling, contact shift reagents, solvent effects, nuclear over-hauser effect (NOE), resonance of other nuclei like ^{31}P, ^{19}F

^{13}C NMR spectroscopy (8 L)

FT NMR, Types of ^{13}C NMR Spectra: un-decoupled, Proton decoupled, Off resonance, APT, INEPT, DEPT, chemical shift, calculations of chemical shifts of aliphatic, olefinic, alkyne, aromatic, hetero aromatic and carbonyl carbons, factors affecting chemical shifts, Homo nuclear (^{13}C-^{13}C) and Hetero nuclear (^{13}C-^{1}H)coupling constants.

2D NMR Techniques (6 L)

General idea about two dimensional NMR spectroscopy, Correlation spectroscopy (COSY)- Homo COSY (^{1}H-^{1}H), TOCSY, Hetero COSY (HMQC, HMBC), Homo and Hetero nuclear 2D resolved spectroscopy, NOESY and 2D-INADEQUATE experiments and their applications.

Mass Spectrometry (10 L)

Instrumentation, various methods of ionization (field ionization, field desorption, SIMS, FAB, MALDI, Californium plasma), different detectors (magnetic analyzer, ion cyclotron analyzer, Quadrupoule mass filter, time of flight (TOF). Rules of fragmentation of different functional groups, factors controlling fragmentation

Problems based on joint application of UV, IR, PMR, CMR, and Mass. **(10 L)**

(Including reaction sequences)

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 (1998).
9. Organic structures from spectra –Field L.D., Kalman J.R. and Sternhell S. 4th Ed. John Wiley and sons Ltd.

10. Spectroscopic identification of organic compound- R M Silverstein, G C Bassler and T C Morril, John Wiley
11. Introduction to NMR spectroscopy-R J Abrahm, J Fisher and P loftus Wiley
12. Organic spectroscopy-William kemp, E L B with McMillan
13. Spectroscopy of organic molecule-PS Kalsi,Wiley, Esterna, New Delhi
14. Organic spectroscopy-RT Morrison and RN Boyd
15. Practical NMR spectroscopy-ML Martin, J J Delpench, and D J Martyin
16. Spectroscopic methods in organic chemistry-D H Willson, I Fleming
17. Spectroscopy in organic chemistry- C N R Rao and J R Ferraro
18. NMR –Basic principle and application-H Guntur
19. Interpretation of NMR spectra-Roy H Bible
20. Mass spectrometry organic chemical applications, J H Banyon

CHO-352: Organic Stereochemistry

[4 credits, 48 Lectures]

1. Stereochemistry of six membered rings. Ref. 1, 4, 5, 6 (12L)
2. Stereochemistry of rings other than six membered Ref. 1, 4, 5, 6 (8L)
3. Fused Bridged and caged rings Ref. 1, 2, 4, 5 (6L)
4. Resolution of racemic modification Ref. 1, 4 (6L)
5. Geometrical Isomerism and Stereochemistry of olefins Ref.1, 2 (10L)
6. CD and ORD Ref. 1,2,4 (2L)
7. Determination of stereochemistry organic compounds using NMR. (4L)

Ref. 3 Chapters 32 (1st Edition)

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 1st. Ed.
4. Stereochemistry of organic compounds –Nasipuri
5. Stereochemistry of organic compounds-Kalsi
6. Organic stereochemistry – Jagdamba Singh

CHO-353: Photochemistry, Pericyclic Reactions and Heterocyclic Chemistry [4 credits, 48 Lectures]

1. **Photochemistry** [12L]

   General basic principles, photochemistry of carbonyl compounds, alkenes, dienes, polyenes and aromatic compounds, photorearrangements, Barton reaction
   Ref. 1,2,3,4

   Application of photochemical reactions in synthesis– Isocomene, Cedrene
   Ref. 8, 9

2. **Pericyclic reactions** [12L]

   Electrocyclic, cycloaddition, sigmatropic and ene reactions. 1,3-dipolar additions, Analysis by correlation diagrams, FMO approach and ATS concept. Application of pericyclic reactions.
   Ref. 1, 3, 5, 6, 7, 13

3. **Heterocyclic Chemistry** (24 L)

   a) Five and six membered heterocycles with one and two hetero atoms:
   Synthesis, reactivity, aromatic character and importance of following heterocyclic rings: Furan, Pyrrole, Thiophene, Pyrazole, Imidazole, Pyridine, Pyrimidine
   b) Condensed five and six membered heterocycles:
   Benzofuran, Indole, Benzothiophene, Quinoline
   c) Condensed five membered heterocycles:
   Benzoxazole, Benzthiazole, Benzimidazole
   d) Five and six membered heterocycles with more than two hetero atoms:
   Synthesis, reactivity, aromatic character and importance of following heterocycles: 1,2,3-triazole, 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,5-oxadiazole, tetrazole,
   Ref. 14-20

References:

1. Advanced Organic Chemistry, Part A – F. A. Carey and R. J. Sundberg, 5th Ed. Springer (2007)
2. Excited states in Organic Chemistry- J.A. Barltrop and J.D.Coyle, John Wiley & sons
3. Photochemistry and Pericyclic reactions-Jagdamba Singh, Jaya Singh 3rd Ed.
4. Organic photochemistry: A visual approach-Jan Kopecky, VCH publishers (1992).
5. Conservation of orbital symmetry – R. B. Woodward and R. Hoffmann; Verlag Chemie, Academic press (1971).
6. Orbital Symmetry : A problem solving approach- R. E. Lehr and A. P. Marchand; Academic (1972)
7. Organic reactions and orbital symmetry, 2nd Ed. T. L. Gilchrist and R. C. Storr; Cambridge, University Press.
8. Classics in total synthesis- K. C. Nicolaou and E. J. Sorensen; VHC (1996)
9. P. A. Wender and J. J. Howbert **J. Am. Chem. Soc**. **103**, 688-690 (1981)
10. Pericyclic reactions: A text book –S. Sankararaman
11. Pericyclic reactions- Gill and Willis

12. Frontier orbitals and organic chemical reactions-Ian Fleming, John Wiley & sons
13. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers
14. Heterocyclic Chemistry -T. Gilchrist
15. An introduction to the chemistry of heterocyclic compounds-R M Acheso
16. Heterocyclic Chemistry- J A Joule and K Mills
17. Principles of modern heterocyclic chemistry- A Paquette
18. Heterocyclic Chemistry- J A Joule and Smith
19. Handbook of Heterocyclic Chemistry- A R Katritzky, A F Pozharskii
20. Heterocyclic Chemistry-II- R R Gupta, M Kumar, V Gupta, Springer (India) pvt

CHO–450 Chemistry of Natural Products [4 credits, 48 Lectures]

1. Structure and stereochemistry of Hardwickiic acid, Camptothecin and podophyllotoxin (8L)
   Ref. 1 to 4 and 11
2. Synthesis of (16L)
   i) Taxol Ref. 6
   ii) Estrone and Mifepristone Ref. 6, 7
   iii) Juvabione (K.Mori and Matsui, Pawson and Cheung Synthesis) Ref.12
   iv) Fredericamycin A Ref. 5
3. Biogenesis – The building blocks and construction mechanism of (24L)
   1. Terpenoids – Mono, Sesqui, Di and Triterpenoids and cholesterol
   2. Alkaloids derived from ornithine, lysine, nicotinic acid, tyrosine and tryptophan.
   3. The shikimate pathway – cinnamic acids, lignans and lignin, coumarins, flavonoids and stilbens, isoflavanoids and terpenoid quinones.
      Ref. 8, 9, 10

References:

1. **J. Am Chem. Soc**. **88,** 3888 (1966).
2. M. C. Wani and M. E. Wall **J. Org. Chem. 34**, 1364 (1969).
3. (i) **Tetrahedron Letters**, 3751 (1964).,
   (ii) **Tetrahedron Letters**, 2861 and 2865 (1968).
4. Chemistry of Natural products- Kalsi
5. Principles of organic synthesis by R. O. C. Norman and J.M.Coxon; Chapman and Hall
6. Classics in organic synthesis – K. C. Nicolaou & E. J. Sorensen
7. **J.Indian Inst.Sci**. 81,287 (2001)
8. Medicinal Natural Products - A Biosynthetic approach by Paul M. Dewick 2nd Ed.(Wiley)
9. Secondary metabolism - J. Mann, 2nd edition.
10. Chemical aspects of Biosynthesis – J. Mann (1994).
11. i) **J.C.S. Perkin Transactions II**, 288-292, (1973). ii) **J.Am.Chem.Soc**. Vol.77.432-437, (1955).
12. Advanced Organic Chemistry- Carey and Sundberg Part B 5th Ed.

CHO-451: Advanced Synthetic Organic Chemistry [4 credits, 48 Lectures]

1. Transition metal complexes in organic synthesis ; only Pd, Ni, Co, Fe (Metal mediated C-C and C-X bond formation reactions: Suzuki, Heck, Sonogashira, Stille, Fukuyama, Kumada, Hiyama, Negishi, Buchwald-Hartwig, Noyori, Reppe, Oxo process [16L]
2. C=C formation reactions: Wittig, Horner-Wordworth-Emmons, Shapiro, Bamford-Stevens, McMurry, Julia-Lythgoe and Peterson olefination reactions, Titanium-carbene mediated olefination: Tebbe, Petasis and Nysted reagent [8L]
3. Multi-component reactions: Ugi, Passerini, Biginelli and Mannich reactions [4L]
4. Ring formation reactions: Pausan-Khand, Bergman and Nazerov cyclization [3L]
5. Click chemistry: criterion for click reaction, Sharpless azides cycloadditions [2L]
6. Metathesis: Grubbs 1st and 2nd generation catalyst, Olefin cross coupling (OCM), ring closing (RCM) and ring opening (ROM) metathesis, applications [4L]
7. Use of Boron and Silicon in organic synthesis [8L]
8. Other important reactions: Baylis Hilman, Eschenmoser-Tanabe fragmentation, Mitsunobu reaction [3L]

References:

1. Organic synthesis using transition metals-Roderick Bates (Wiley)
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 – Michael 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, 5th edition (2007)
8. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken
9. Organic synthesis- Robert E Ireland
10. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti and Barbara Czako

CHO-452: Carbohydrate and Chiron approach, Chiral Drugs and Medicinal Chemistry [4 credits, 48 Lectures]

1. Carbohydrates [4L]

Introduction of sugars, structures of triose, tetrose, pentose, hexose, stereochemistry and reactions of Glucose, conformation and anomeric effects in hexoses Ref. 1, 2

2. Chiron approach [8L]

a) Introduction

b) The concept of chiral templates and chirons wherein the carbon skeleton is the chiral precursor.

c) Utilisation of the basic concepts for retrosynthetic strategy and synthesis of the following – (S) Propanediol, (R) and (S) – Epichlorohydrin, L (+)-Alanine,

(-) Multistratin, (-) Pentenomycin, (-) Shikimic acid, Ref. 1,2,3

3. **Chiral Drugs** **[12L]**

a) Introduction of chiral drugs, Eutomer, Distomer and eudesmic ratio,

b) Distomers-a) with no side effects b) with undesirable side effects Synthesis and pharmacological activity of S-Ibuprofen, S-Metaprolol, Ininvir sulfate, Dextropropoxyphen, (+) Ephedrine, Griseofulvin, R-Indacrinnone, hydrochloride, S-S-captopril

Ref. 4, 5

References:

1. Organic Chemistry – R. P. Morrison and R. N. Boyd
2. Organic Chemistry – I. L. Finar, volume II
3. Chiron Approach in organic synthesis – S. Hanessianh
4. Pharmaceutical Chemistry and drug synthesis –Rot and Kleeman
5. Drug Design –E.J. Arienes

4. Medicinal Chemistry

1. Introduction to drugs, their action and discovery Ref. 1,2,3 [4L]
2. Relation of Drug structure and its chemical and biological properties [4L]
   Ref. 1,2,3
3. Structure, activity and quantitative relationship Ref. 1,2,3 [3L]
4. Drug targets Ref. 3 [4L]
5. Antimicrobial drugs: [9L]

Antibactaerials: Discovery and development of Penicillins, Cephalosporins, Sulphones and sulphonamides, Tetracyclins, Macrolides, Polypeptides, Chloromycetin

Antifungals: Fungal Diseases and Anti-fungal agents

Antivirals: Viral diseases and Anti-viral drugs

Anti-protozoals: Anti-malarials, Anti-amoebic

Ref. 4,5,6

References:

1. Medicinal Chemistry an Introduction-Gareth Thomas 2nd Ed. Wiley
2. An introduction to medicinal chemistry-Graham L. Patrick 5th Ed. Oxford
3. Introduction to Medicinal Chemistry-Alex Gringauz (Wiley)
4. Foye's Medicinal Chemistry
5. Medicinal Chemistry-A. Burger
6. Medicinal Chemistry-Ashutosh Karr

CHO-453: Designing Organic Synthesis and Asymmetric Synthesis

[4 credits, 48 Lectures]

1. Designing of organic synthesis: Protection and de-protection of hydroxyl, amino, carboxyl, ketone and aldehyde functions as illustrated in the synthesis of polypeptide and polynucleotide, enamines, Umpolung in organic synthesis, Reterosynthesis. (24L)

2. Principles and applications of asymmetric synthesis: (24L)
   stereoselectivity in cyclic compounds, enantio-selectivity, diastereo-selectivity, enatiomeric and diastereomeric excess, 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

1. Designing of organic synthesis – S. Warren (Wiley)
2. Some modern methods of organic synthesis – W. Carruthers (Cambridge)
3. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press)
4. Organic synthesis – Michael B. Smith
5. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007)
6. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken
7. Organic synthesis- Robert E Ireland
8. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti and Barbara Czako

M.Sc. II: Organic Chemistry Practical

CHO-347: (A) Single stage preparations **[6 Credits]**

At least Fourteen single stage and three Isolation of Natural products should carried out. The preparation should be carried out on micro scale.

1. 2-Phenyl indole (Fischer indole synthesis),
2. 7-Hydroxy -3-methyl flavone (Baker-Venkatraman reaction),
3. Benzyl alcohol and benzoic acid from benzaldehyde (Cannizzaro reaction)
4. 4-Chlorotoluene from p-toluidine (Sandmeyer reaction)
5. Benzilic acid from benzoin (Benzilic acid rearrangement)
6. Benzopinacol (Photochemical reaction),
7. 7-Hydroxy-4-methyl coumarin (Pechmann Reaction)
8. 4-Methyl benzophenone (Friedal Craft reaction)

9. Benzanilide (Beckmann rearrangement)
10. Vanillyl alcohol from vanillin ($NaBH_4$ reduction)
11. 2- and 4-nitrophenols (nitration and separation by steam distillation)
12. Stilbene from benzyl chloride (Wittig reaction)
13. Ethyl cinnamate from benzaldehyde (Wittig reaction)
14. Triphenyl or diphenyl methyl carbinol (Grignard reaction)
15. Benzotriazole
16. 1-Phenyl-3-methyl pyrazol-5-one
17. Glucose pentaacetate
18. 2,4-diethoxycarbonyl-3,4-dimethyl pyrrole from ethyl acetoacetate
19. Quinoline from aniline Skraup synthesis)
20. Benzimidazole from benzyl
21. Cyclohexanol from cyclohexanone (LAH reduction)

B) Isolation of Natural products (Any three)

1. Caffeine from tea leaves (Soxhlet extraction)
2. Piperine from pepper (Soxhlet extraction)
3. Eucalyptus oil from leaves (Steam distillation)
4. Lycopene from tomatoes
5. Trimyristin from nutmeg
6. Cinnamaldehyde from cinnamom
7. Eugenol from clove

References:

1. Practical organic chemistry by Mann & Saunders
2. Text book of practical organic chemistry –by Vogel
3. The synthesis, identification of organic compounds –Ralph L. Shriner, Christine K.F. Hermann, Terence C. Morrill and David Y. Curtin

CHO-447 : Two stage preparations (any Ten) **[6 Credits]**

1. Benzaldehyde → Benzalacetophenone → Epoxide
2. 4-Nitro toluene → 4-Nitro benzoic acid → 4-Amino benzoic acid
3. Resorcinol → 4-methyl-7-hydroxy coumarin → 4-Methyl-7-acetoxy coumarin
4. Cyclohexanone → Phenyl hydrazone → 1,2,3,4-Tetrahydrocarbazole
5. Hydroquinone → Hydroquinone diacetate → 1,2,4-Triacetoxy benzene
6. Acetanilide → p-Acetamidobenzene sulphonyl chloride → P. Acetamidobenzene sulphonamide
7. p-Amino phenol → p-Acetyl amino phenol → p-Ethoxy acetanilide
8. Hippuric acid → Azalactone → 4-Benzylidene 2-phenyl oxazol-5-one
9. p-Cresol → p-Cresyl benzoate → 2-Hydroxy-5-methyl benzophenone
10. Phthalimide → N-Benzylphthalimide → Benzylamine

11. o-Nitroaniline → o-Phenylene diamine → Benzimidazole
12. Phthalic acid → Phthalimide → Anthranilic acid
13. Benzyl cyanide→ p-Nitrobenzyl cyanide→p-Nitro phenyl acetic acid
14. Hydroquinone → Hydroquinone diacetate → 2,5-Dihydroxy acetopheneone
15. Cyclohexanone→ Enamine→2-Acetyl cyclohexanone
16. α-Pinene→ Disiamyl borane→Pinanol

CHO-448: Project/Industrial training/Green Chemistry and Chemical biology experiments (any Twelve) [6 Credits]

1. Preparation of acetanilide from aniline and acetic acid using Zn dust
2. Base catalyzed aldol condensation using $LiOH.H_2O$ as a Catalyst.
3. Bromination of *trans*-stilbene using sodium bromide and sodium bromate
4. [4+2] cycloaddition reaction in aqueous medium at room temperature
5. Benzil Benzilic acid rearrangement under solvent free condition
6. Thiamine hydrochloride catalyzed synthesis of benzoin from benzaldehyde
7. Clay catalyzed solid state synthesis of 7-hydroxy-4-methylcoumarin
8. Ecofriendly nitration of phenols and its derivatives using Calcium nitrate
9. Bromination of acetanilide using ceric ammonium nitrate in aqueous medium
10. Green approach for preparation of benzopinacolone from bezopinacol using iodine catalyst
11. Preparation of 1, 1-bis-2-naphthol under grinding at room temperature.
12. Solvent free aldol condensation between 3,4-dimethoxybenzaldehyde and 1-indanone
13. Solvent free quantitative solid phase synthesis of azomethines from substituted anilines and substituted benzaldehydes.
14. Sucrose to ethyl alcohol (Baker's yeast)
15. Asymmetric reduction of EAA by using Baker's yeast

Note: i) Project/Industrial training students have to perform 6 practical from the above experiments.

ii) 20% students should be given project or industrial training.

Reference:

1. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Aggarwal
2. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST