School of Chemistry
Faculty of Sciences
University of the Punjab, Lahore
Course Outline

Semester-VII

Programme	**BS Chemistry**	**Course Code**	**Chem-431**	**Credit Hours**	**2**
Course Title	**Molecular Rearrangements**		**Course Type**	**Major (Elective)**	

Course Introduction

This course is designed to develop knowledge about basic concepts in Organic Chemistry including reaction mechanism and molecular rearrangements.
Molecular Rearrangements:Rearrangements, General mechanisms of nucleophilic, Free radical and electrophilic rearrangements,Classification of molecular rearrangements: mechanism of intramolecular 1,2-shifts involving migration of a group from carbon to carbon, carbon to nitrogen, and carbon to oxygen, Aromatic rearrangements, Inter and intra-molecular carbon migration from oxygen to carbon their mechanisms and synthetic applications including Wagner-Meerwein, Pinacol- pinacolone, benzylic acid, Favorski, wittig, Wolff, Beckmann, Hoffmann, Curtius, Lossen and Schmidt; Baeyer-Villiger, Dakin and Fries rearrangements.

Learning Outcomes

On the completion of the course, the students will:

1. To develop basic understanding about the mechanism of molecular rearrangement.
2. Basic principle of rearrangement.
3. To emphasize on the basic principle behind different types of the molecular rearrangement-based reaction of organic compound.
4. Importance of molecular rearrangements in synthetic organic chemistry.

Course Content		**Assignments/Readings**
Week 1	Molecular arrangement Brief introduction about molecular rearrangement	Solve rearrangement challenge
	Modes of rearrangement	Solve problem set
Week 2	Free radical arrangement	Practice problems
	Electrophilic arrangement	
Week 3	Classification of molecular rearrangement and explanation.	
	Mechanism of intramolecular1,2 shifts involving migration of group from carbon to carbon	Solve assigned examples
Week 4	Mechanism of intramolecular1,2 shifts involving migration of group from carbon to oxygen	
	Mechanism of intramolecular1,2 shifts involving migration of group from carbon to nitrogen	Practice problems
Week 5	Aromatic rearrangement	
	Intermolecular and intramolecular carbon migration from oxygen to carbon	
Week 6	Mechanism of Wagner-Meerwein rearrangement	Practice problems
	Synthetic applications of Wagner –Meerwien rearrangement	

Week 7	Practicing the problem question of molecular rearrangement	
	Quiz	
Week 8	**Mid-term Exams**	
Week 9	Pinacol-pinacolone molecular rearrangement	Practice problems
	Molecular rearrangement of benzylic acid	
Week 10	Favorski molecular rearrangement	
	General mechanism of Witting molecular rearrangement	
Week 11	Practicing the problem question of Favorski and Wittig molecular rearrangement	
	Wolff molecular rearrangement	Practice problems
Week 12	General mechanism of Beckmann molecular rearrangement	
	Practicing examples of Beckmann molecular rearrangement	
Week 13	Curtius molecular rearrangement	
	Lossen and Schmidt molecular rearrangement	Practice problems
Week 14	Baeyer-villiger molecular rearrangement	
	Quiz	molecular rearrangements practice
Week 15	Dakin and Fries molecular rearrangement	
	Examples of Dakin and Fries molecular rearrangement	
Week 16	**Final-term Exams**	

Textbooks and Reading Material

1.A Text-Book of Organic Chemistry by M. Younas, ILMI, Pakistan.
2.Organic Chemistry, (5th Ed.) by S.H. Pine, McGraw Hill, New York, USA,1987.
3.A Text-Book of Organic Chemistry by M. Younas, ILMI, Pakistan.
4.Organic Chemistry, (5^{th} Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
5.Organic Chemistry, (6^{th} Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
6.Organic Chemistry, (6^{th} Ed.) by R.T. Morrison, R.N. Boyd and r.K. Boyd, Benjamin Cummings, 1992.
7.Modern Synthetic Reactions, (2^{nd} Ed.) by H.O. House, W.A. Banjamin Inc., Menlo Park, CA.
8.Principals in Organic Synthesis, by R.O.C. Norman and M.J. Coxon, Chapman and Hall, 1993.
9.Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.

Teaching Learning Strategies

1. Modeled Lectures
2. Group discussion
3. Presentations
4. Seminar and workshops
5. Inquiry based learning

Assignments: Types and Number with Calendar
1. Practice questions from the exercises of the recommended books. **2.** Literature review based assignment relevant to the course will also be given during the course.

Assessment

Sr. No.	Elements	Weightage	Details
1	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester-VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-432**	**Credit Hours**	**1**
Course Title	**Organic Chemistry Lab-1**		**Course Type**	**Major (Elective)**	

Course Introduction

This course is designed to make the students to gain experimental skills for different organic transformations and purification.
Multi-step preparation involving1,2 migration and spectroscopic characterization: benzil-benzilic acid rearrangement, pinacol-pinacolone rearrangement, Hoffman rearrangement, favorski rearrangement,Beckmann rearrangement.

Learning Outcomes

On the completion of the course, the students will:

1. Understand the key concepts of organic synthesis
2. Familiarize with organic preparations and quantitative analysis

	Course Content	**Assignments/Readings**
Week 1	Organic Preparations: Synthesis and characterization of pinacolone (ketone) from pinacole (diol) (pinacol-pinacolone rearrangement)	Literature survey
Week 2	Synthesis of benzil from benzoin	
Week 3	Prepare benzilic acid from benzil (benzil-benzilic acid rearrangement)	
Week 4	Synthesis of 3-nitroaniline from 3-nitrobenzamide (Hoffman rearrangement)	Search different methods of synthesis
Week 5	Exp. 5 Synthesis of cyclopentanecarboxylate from 2-chlorocyclohexanone (Favorski rearrangement)	
Week 6	Preparation of benanilide from benzophenone (Beckmann rearrangement)	
Week 7	Synthesis of picric acid from phenol (nitration of phenol)	Literature survey
Week 8	**Mid Term Examinations**	
Week 9	Preparation of benzophenone	
Week 10	Preparation of meta - dinitro benzene from nitrobenzene	
Week 11	Synthesis of chlorbutol (chloritone)	Search different methods of synthesis
Week 12	Synthesis of azo dye	
	Synthesis of azo dye	
Week 13	Synthesis of methyl orange dye	Search out uses of methyl orange in daily life
Week 14	Synthesis of phenyl urea	
Week 15	Synthesis of paracetamol	Search out uses of paracetamol

Week 16	Final Term Examinations	

Textbooks and Reading Material

1. The Systematic Identification of Organic Compounds (8th Ed.) by R.L. Shriner et al., Wiley, 2003.
2. Practical Organic Chemistry by F.G. Mann and B.C. Saunders, Longman, UK. 1978.
3. Vogel's Textbook of Practical Organic Chemistry (5th Ed.) by A.I. Vogel et al. Longman, UK, 1989
4. Advanced Practical Organic Chemistry, by J. Leonard, B. Lygo, G. Procter, CRC. 1994.
5. -Advanced Practical Organic Chemistry (2nd Ed.) by N.K. Vishnoi, Vikas Publishing House Pvt. Ltd. India, 1996.
6. K.N. Williamson and K.M. Masters, *Macroscale and Microscale Organic Experiments*, published by Cengage learning, 2011.
7. J.J. Li, C. Limberakis and D.A. Pflum, *Modern Organic Synthesis in Laboratory*, Oxford University Press, 2007.
8. J. Leonard, B. Lygo and G. Procter Nelson, *Advanced Practical Organic Chemistry*, Thomes Ltd. UK, 2001.

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

Assignments: Types and Number with Calendar

1. Lab activities and practical performance from week 1 to week 16.
2. Literature review based assignment relevant to the course will also be given during the course.
3. Maintain record of all Practicals in note book under the following headings:
   Theory, Procedure, Chemicals, Observations and Results, Precautions

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester-VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-433**	**Credit Hours**	**2**
Course Title	**Oxidation & Reduction**		**Course Type**	**Major (Elective)**	

Course Introduction

To achieve knowledge about the mechanisms and principles operative in different types of methods for oxidation and reduction of organic compounds.

Oxidation Reactions

Introduction, oxidation of saturated hydrocarbons, olefinic double bonds, aromatic rings, systems containing oxygen such as phenols, alcohols, aldehydes, ketones, and dicarbonyl compounds, oxidative decarboxylation, of acids, oxidation of systems containing nitrogen such as amines, hydrazines and hydrazones.

Reduction Reactions

Introduction, reduction of cycloalkanes, alkenes, alkynes, and aromatic rings, hydrogenolysis, reduction of benzylic and allylic systems, aldehydes and ketones, alcohols, pinacols, epoxides, acids and their derivatives, Reduction of system containing nitrogen such as imines, oximes and nitro compounds.

Learning Outcomes

On the completion of the course, the students will:

1. Able to develop basic understanding about oxidation and reduction.
2. Able to understand mechanisms and principles operative in different types of methods for oxidation and reduction of organic compounds.

	Course Content	**Assignments/Readings**
Week 1	Oxidation Introduction, oxidation of saturate hydrocarbons Oxidation of olefinic double bonds and aromatic rings.	Literature survey
	Oxidation of systems containing oxygen such as phenols.	
Week 2	Oxidation of systems containing oxygen such as alcohols	
	Quiz	
Week 3	Oxidation of ketones	Practice problems
	Oxidation of aldehydes,	
Week 4	Oxidation of dicarbonyl compounds,	
Week 5	Practice problems from literature	
	Oxidative decarboxylation of acids,	
Week 6	Quiz	
	Oxidation of systems containing nitrogen such as amines	
Week 7	Oxidation of hydrazones and hydrazines.	Practice problems
Week 8	Mid Term Examinations	

Week 9	Reduction Introduction to reduction and reduction of cycloalkanes,	Literature survey
	Reduction of alkenes	
Week 10	Reduction of alkynes	Practice problems
	Reduction of aromatic rings	
Week 11	Hydrogenolysis	
	Reduction of benzylic systems	
Week 12	Reduction of allylic systems	Practice problems
	Reduction of Aldehydes	
Week 13	Reduction of ketones	
	Quiz	Prepare reductions in all functional groups
Week 14	Alcohols, pinacols, epoxides, acids and their derivatives	Practice problems
	Reduction of system containing nitrogen such as imines, oximes and nitro compoundst	
Week 15		
	Practice problems from different books	
Week 16	Final Term Examinations	

Textbooks and Reading Material

1. Organic Chemistry, (6th Ed.) by R.T. Morrison, R.N. Boyd and R.K. Boyd, Benjamin Cummings, 1992.
2. Modern Synthetic Reactions, (2nd Ed.) by H.O. House, W.A. Banjamin Inc., Menlo Park, CA.
3. Principals in Organic Synthesis, by R.O.C. Norman and M.J. Coxon, Chapman and Hall, 1993.
4. Organic Chemistry, Vol. I (6th Ed.) and II (5th Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
5. March's Advance Organic Chemistry: Reactions, Mechanisms and Structures. (6th Ed.) by M.B. Smith and J. March, Wiley, 2007.
6. Organic Chemistry, (5th Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
7. Organic Chemistry, (6th Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
8. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work/Numerical problem sets
4. Seminar/ Workshop

Assignments: Types and Number with Calendar
Problem sets relevant to topic will be given as assignments. Literature review based assignment relevant to the course will also be given during the course.

Assessment			
Sr. No.	**Elements**	**Weightage**	**Details**
1	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester-VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-434**	**Credit Hour**	**1**
Course Title	**Organic Chemistry Lab II**		**Course Type**	**Major (Elective)**	

Course Introduction

This course is designed to gain experimental skills for different organic transformations, separation and identification of three components in a mixture of unknown compounds via systematic physical and chemical tests.
Qualitative analysis
Three component organic mixture analysis (separation and identification of three unknown components). Recrystallization and Derivatizations

Learning Outcomes

On the completion of the course, the students will:

1. Understand the key concepts of organic synthesis
2. Familiarize with organic separation and qualitative analysis

Course Content		Assignments/Readings
Week 1	Three Component Mixture Analysis Preparations of solutions and reagents	Literature survey on preparation of solutions
Week 2	Separation of three component mixtures (basic intro)	
Week 3	Separation of given mixture of urea, anthracene and salicylic acid	
Week 4	Separation of given mixture of urea, benzoic acid and beta-naphthol	Enlist different separation techniques.
Week 5	Separation of given mixture of naphthalene, cinnamic acid and Di-phenylamine	
Week 6	Separation of given mixture of benzil, tartaric acid and alpha-naphthol	
Week 7	Separation of given mixture of biphenyl, salicylic acid and sucrose	
Week 8	**Mid Term Examinations**	
Week 9	**Mixture Analysis** Separation of given mixture of benzoic acid resorcinol and naphthalene	Write chemistry of all reactions performed
Week 10	Separation of given mixture of oxalic acid, beta-naphthol and anthracene	Write chemistry of all reactions performed
Week 11	Separation of given mixture of benzamide, glucose and cinnamic acid	
Week 12	Separation of given mixture of urea, tartaric acid and alph-naohthol	Write chemistry of all reactions performed
	Separation of given mixture of diphenylamine, salicylic acid and benzophenone	Write chemistry of all reactions performed
Week 13	Separation of given mixture of glucose, naphthalene and beta-naphthol	
Week 14	Separation of given mixture of thiourea, anthracene and salicylic acid	Enlist harmful chemical and their handling.
Week 15	Separation of given mixture of naphthalene, benzoic acid and glycine	

Week 16	Final Term Examinations	

Textbooks and Reading Material

1. Vogel's Textbook of Practical Organic Chemistry (5th Ed.) by A.I. Vogel et al. Longman, UK, 1989.
2. Advanced Practical Organic Chemistry, by J. Leonard, B. Lygo, G. Procter, CRC. 1994.
3. Advanced Practical Organic Chemistry (2nd Ed.) by N.K. Vishnoi, Vikas Publishing House Pvt. Ltd. India, 1996.
4. K.N. Williamson and K.M. Masters, *Macroscale and Microscale Organic Experiments*, published by Cengage learning, 2011.
5. J.J. Li, C. Limberakis and D.A. Pflum, *Modern Organic Synthesis in Laboratory*, Oxford University Press, 2007.
6. J. Leonard, B. Lygo and G. Procter Nelson, *Advanced Practical Organic Chemistry*, Thomes Ltd. UK, 2001.

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

Assignments: Types and Number with Calendar

1. Lab activities and practical performance from week 1 to week 16.
2. Literature review based assignment relevant to the course will also be given during the course.
3. Maintain record of all Practicals in note book under the following headings:
   Theory, Procedure, Chemicals, Observations and Results, Precautions

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester-VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-435**	**Credit Hours**	**2**
Course Title	**NMR Spectroscopy**		**Course Type**	**Major (Elective)**	

Course Introduction

This course is organized to develop knowledge about basic concepts determining structure of an organic compound by using NMR Spectrometry and its significance in Organic chemistry. Nuclear Magnetic Resonance (NMR) Spectroscopy

NMR: Basic principles, theory, spin flipping, nuclear precession and absorption of electromagnetic radiation, spin relaxation, basic introduction of 1-D (^{1}H and ^{13}C) NMR spectroscopy, chemical shifts and integration curve, instrumentation, spin-spin splitting and coupling constants. Structure elucidation of small and substituted aromatic compounds.

Learning Outcomes

On the completion of the course, the students will:

1.Fully aware of instrumentation, working and applications of NMR spectroscopy

2. Able to elucidate the structure from NMR spectra

3. able to differentiate organic compounds.

	Course Content	Assignments/Readings
Week 1	**NMR spectroscopy** : introduction and basic principles.	Literature survey
	Theory of NMR spectroscopy: spin flipping and conditions	
Week 2	Nuclear precession and absorption of electromagnetic radiation	
Week 3	Spin relaxation	
	Quiz	Revision of theory
Week 4	Basic Instrumentation	
	Instrumentation; function of different parts	
Week 5	Basic introduction of 1-D NMR	
	(^{1}H and ^{13}C) NMR spectroscopy,	Literature survey
Week 6	Surprise Test	
	(^{1}H and ^{13}C) NMR spectroscopy,	
Week 7	Chemical shifts	Memorize values of chemical shifts
Week 8	**Mid Term Examinations**	
Week 9	Integration curve	
Week 10	Spin-spin splitting	Literature survey
Week 11	Coupling constants	Memorize values
Week 12	Quiz	

	Structure elucidation of small and substituted aliphatic compounds.	Practice problems
Week 13		
	Structure elucidation of simple aromatic compounds.	Practice problems
Week 14	Structure elucidation of small and substituted aromatic compounds.	Practice problems
	.	
Week 15	Interpretation of different NMR spectra	
Week 16	**Final Term Examinations**	

Textbooks and Reading Material

1. Kemp, W. Organic Spectroscopy. W.H. Freeman & Company: New York, 1991; 3rd Ed.
2. Pavia, D.L; Lampman, G.M; Kriz, G.S; Vyvyan, J.R. Introduction to Spectroscopy. Brooks/Cole Cengage Learning, 2009; 4th Ed.
3. Organic Chemistry, by Jonathan Clayden, Nick Greeves and Stuart Warren, Oxford University Press, 2000.
4. Basic One and Two-Dimensional NMR Spectroscopy by Jack K. Becconsall (4^{th} Ed). Wiley-VCH verlag GmbH & Co. KGA, 2005.
5. Williams, D. and I. Fleming, Spectroscopic Methods in Organic Chemistry, McGrawHill, New York
6. Silverstein, R. M., G. C. Bassler and T. C. Morrill, Spectrometric identification of organic compounds. Wiley, Chichester, 1991.

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work/Numerical problem sets
4. Seminar/ Workshop

Assignments: Types and Number with Calendar

1. Structural determination from NMR spectra given in work sheet.
2. Literature review based assignment relevant to the course will also be given during the course.

Assessment

Sr. No.	Elements	Weightage	Details
1	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester-VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-436**	**Credit Hours**	**1**
Course Title	**Organic Chemistry Lab-III**		**Course Type**	**Major (Elective)**	

Course Introduction

To gain experimental skills for different organic transformations, workups, separation and identification of products obtained in a multistep synthesis.
Multistep Organic Preparations
Conversion of carboxylic acid to ester, its reduction to alcohol; Conversion of alcohol to alkyl halide and carbonyl compounds; Protection and deprotections; Aniline to 4-nitro- and 4-bromoanilines via acetanilide etc.

Learning Outcomes

On the completion of the course, the students will:

1. Describe the purification and spectroscopic techniques
2. Familiarize with organic preparations and quantitative analysis

	Course Content	Assignments/Readings
Week 1	Organic Preparations: Synthesis of Flourescein from resorcinol and phthalic anhydride	Write chemistry of all reactions
Week 2	Synthesis and separation of o-bromoaniline and p-bromoaniline from aniline	
Week 3	Synthesis and separation of o-bromoaniline and p-bromoaniline from aniline	
Week 4	Synthesis and separation of o-bromoaniline and p-bromoaniline from aniline	
Week 5	Synthesis and separation of o-nitrotoluene and p-nitrotoluene	Write chemistry of all reactions
Week 6	Synthesis of anti-pyrine	
Week 7	Synthesis of anti-pyrine	
Week 8	**Mid Term Examination**	
Week 9	Preparation of alcohol from carboxylic acid	
Week 10	Preparation of alcohol from carboxylic acid	
Week 11	Preparation of alcohol from carboxylic acid	
Week 12	Synthesis and separation of o-bromo toluene and p-bromotoluene	Write chemistry of all reactions
Week 13	Synthesis of benzpinacol (Photochemical reaction)	
Week 14	Synthesis of benzpinacol (Photochemical reaction)	
Week 15	Synthesis of benzpinacol (Photochemical reaction)	
Week 16	**Final Term Examinations**	

Textbooks and Reading Material

1. The Systematic Identification of Organic Compounds (8th Ed.) by R.L. Shriner et al., Wiley, 2003.
2. Practical Organic Chemistry by F.G. Mann and B.C. Saunders, Longman, UK. 1978.
3. Vogel's Textbook of Practical Organic Chemistry (5th Ed.) by A.I. Vogel et al. Longman, UK, 1989
4. Advanced Practical Organic Chemistry, by J. Leonard, B. Lygo, G. Procter, CRC. 1994.
5. Advanced Practical Organic Chemistry (2nd Ed.) by N.K. Vishnoi, Vikas Publishing House Pvt. Ltd. India, 1996.
6. K.N. Williamson and K.M. Masters, *Macroscale and Microscale Organic Experiments*, published by Cengage learning, 2011.
7. J.J. Li, C. Limberakis and D.A. Pflum, *Modern Organic Synthesis in Laboratory*, Oxford University Press, 2007.
8. J. Leonard, B. Lygo and G. Procter Nelson, *Advanced Practical Organic Chemistry*, Thomes Ltd. UK, 2001.

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

Assignments: Types and Number with Calendar

1. Lab activities and practical performance from week 1 to week 16.
2. Literature review based assignment relevant to the course will also be given during the course.
3. Maintain record of all Practicals in note book under the following headings:
   Theory, Procedure, Chemicals, Observations and Results, Precautions

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester-VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-437**	**Credit Hours**	**3**
Course Title	**Reaction Mechanism II**		**Course Type**	**Major (Elective)**	

Course Introduction

This course is organized to develop knowledge about basic concepts of reactions chemistry Modes of reactions occurring in aliphatic and aromatic system.To grasp ideas about the mechanisms, basic rules and principles working behind different types of nucleophilic substitutions and elimination reactions.

Aliphatic Nucleophilic Substitutions: Mechanism of SN1, SN2, SNi, SN1', SN2' and SNi' reactions, kinetics, stereochemical and other evidence; effects of other substrate structure, attacking nucleophile, leaving group and solvent; neighboring group participation (Anchimeric assistance).

Elimination Reactions: Mechanism of E1, E2, and E1cB elimination reactions; kinetics and stereochemical studies; applications of thermodynamically and kinetically controlled reactions (Saytzeff and Hoffmann reactions), Effects of substrates, solvent, base, leaving group and temperature on kinetics, competition between elimination and substitution reactions. Pyrolytic eliminations.

Electrophilic Aromatic Substitutions: General mechanism (kinetic, isotopic and spectroscopic evidences), nitration, sulfonation, halogenation, Friedel- Crafts alkylation and acylation, orientation and reactivity; poly-substitution reactions of aromatic compounds.

Nucleophilic Aromatic Substitutions:Addition and elimination mechanism, Benzyne mechanism, Radical mechanism, Sandmeyer reaction and its examples.

Learning Outcomes

On the completion of the course, the students will be:

1. Develop basic knowledge of mechanisms, basic rules and principles working behind different types of nucleophilic substitutions and elimination reactions.
2. Importance of nucleophilic and electrophilic reaction in different reaction mechanism

Course Content		Assignments/Readings
Week 1	Introduction of substitution reactions. Mechanism of SN1 and SN2 mechanism,	Problem set
	.Mechanism of SNi, SN1', SN2' and SNi' reactions	Solve assigned examples from literature
Week 2	Effects of other substrate structure, effect of solvent, attacking nucleophile, leaving group on substitution reactions.	Literature survey
	Neighboring group participation (Anchimeric assistance) and its explanation	
Week 3	Elimination reactions and mechanism of E1 and E2 reactions	
	Mechanism of E1, E2, and E1cB elimination reactions	Problem set
Week 4	Kinetics and stereochemical studies of elimination reaction	Literature survey
	Applications of thermodynamically and kinetically controlled reactions	

Week 5	Saytzeff and Hoffmann reacti7ons	Solve assigned examples from literature
	Effects of substrates and solvent,	
Week 6	Effects of base, leaving group and temperature on kinetics,	
Week 7	Comparison of substitution and elimination reaction	
	Pyrolytic eliminations.	
Week 8	**Mid Term Examinations**	
Week 9	Introduction and General mechanism of electrophilic substitution reactions.	Literature survey
	Kinetic, isotopic and spectroscopic evidences	
Week 10	Nitration and sulfonation,	
	Halogenation, Friedel- Crafts alkylation and acylation	Problem set
Week 11	Quiz	
	Orientation and reactivity;	
Week 12	Poly-substitution reactions of aromatic compounds.	Problem set
	.Nucleophilic Aromatic Substitutions, Addition and elimination mechanism	Literature survey
Week 13		
	Radical mechanism	
Week 14	Sandmeyer reaction and its examples	
	Benzyne mechanism	Problem set
Week 15	Presentations	
	Presentations	
Week 16	**Final Term Examinations**	

Textbooks and Reading Material

1. Organic Chemistry, (5th Ed.) by S.H. Pine, McGraw Hill, New York, USA, 1987.
2. Organic Chemistry, (6th Ed.) by Francis A. Carey, McGraw Hill, USA, 2005.
3. Organic Chemistry, Vol. I (6th Ed.) and II (5th Ed.) by I.L. Finar, Pearson Education (Singapore) Pvt. Ltd. 2008.
4. March's Advance Organic Chemistry: Reactions, Mechanisms and Structures. (6th Ed.) by M.B. Smith and J. March, Wiley, 2007.
5. Organic Chemistry, (6th Ed.) by R.T. Morrison, R.N. Boyd and r.K. Boyd, Benjamin Cummings, 1992.
6. Modern Synthetic Reactions, (2nd Ed.) by H.O. House, W.A. Banjamin Inc., Menlo Park, CA.
7. Principals in Organic Synthesis, by R.O.C. Norman and M.J. Coxon, Chapman and Hall, 1993.

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work/Numerical problem sets
4. Seminar/ Workshop

Assignments: Types and Number with Calendar

1. Problem sets relevant to topic will be given as assignments from week 1 to week 16.
2. Literature review based assignment relevant to the course will also be given during the course.

Assessment

Sr. No.	Elements	Weightage	Details
1	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.