**Name of Institute: Indus Institute of Science, Humanities and Liberal Studies**
**Name of Faculty: Dr. Nikunj Valand**

**Course code: MCH0102**
**Course name: Organic Chemistry-I**
Pre-requisites: B. Sc. Chemistry

Credit points:

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

Offered Semester: I

**Course Coordinator (week's XX - XX)**
Full Name: Dr. Nikunj Valand
Department with sitting location: Chemistry
4th Floor, Faculty Room, Bhanvar Building
Telephone: EXT: 3425
Email: nikunjvaland.gd@indusuni.ac.in
Consultation times: Friday 3.20 pm to 4.15 pm

**Course Lecturer (week's xx - XX)**
Full name: Dr. Nikunj Valand
Department with sitting location: Chemistry
4th Floor, Faculty Room, Bhanvar Building.

Telephone: EXT: 3425
Email: nikunjvaland.gd@indusuni.ac.in
Consultation times: Friday 3.20 pm to 4.15 pm

Students will be contacted throughout the session via mail with important information relating to this Course.

## Course Objectives

By participating in and understanding all facets of this course a student will:

1. To understand the concept of mechanism of elimination, nucleophilic and electrophilic substitution reactions.
2. To understand the concept of aromaticity and chemistry of organic compounds.
3. To learn about the reaction intermediates such as carbocation, carbanion, free radicals, carbenes and nitrenes.
4. To study the various rearrangement reactions and their applications
5. To understand the basics of stereo-chemistry.
6. To study the stereo-chemistry of various organic compounds.

## Course Outcomes (CO)

CO1. Define $E^1$, $E^2$ and $E^{1Cb}$ reactions with their detail mechanism. [BT1]
CO2. Differentiate between geometrical and optical isomerism. [BT2]
CO3. Determine the aromaticity of the various organic compounds. [BT3]
CO4. Classify various reaction intermediate species and understand the difference between carbocation and carbanion. [BT4]
CO5. Estimate the stereo-chemical structures of various chiral compounds and enantiomeric relationship between R and S configuration. [BT5]
CO6. Explain the mechanism of different types of rearrangement reactions occurring in organic chemistry. [BT2]

## Course Outline

(Key in topics to be dealt)

- **Elimination, nucleophilic and electrophilic substitution reaction**
- **Neighboring group Participation in Nucleophilic substitution**
- **Huckel's rule and concept of aromaticity**
- **Chemistry of Reactive intermediates**
- **Rearrangements reactions**
- **Identifying stereo chemical terms & relationships**
- **Stereospecific and stereo selective reactions**

## Method of delivery

(Face to Face lectures, Active Learning Techniques, PowerPoint Presentations)

## Study time

(How many hours per week including class attendance)
4 Hours/Week

## CO-PO Mapping (PO: Program Outcomes)

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | - | - | - | 3 | 1 | 1 | - | - |
| **CO2** | 3 | 3 | - | 1 | - | 3 | 2 | 1 | - | - |
| **CO3** | 2 | 3 | - | 1 | 1 | 2 | 2 | 1 | - | - |
| **CO4** | 2 | 2 | - | 1 | 2 | 3 | 2 | 2 | - | - |
| **CO5** | 3 | 3 | - | 2 | - | 1 | 2 | 1 | - | - |
| **CO6** | 3 | 3 | - | 2 | 1 | 3 | 2 | 3 | - | - |
| **MCH0102** | **2.5** | **2.8** | **-** | **1.4** | **1.3** | **2.5** | **1.8** | **1.5** | - | - |

## Bloom's Taxonomy and Knowledge retention (For reference)

(Bloom's taxonomy has been given for reference)

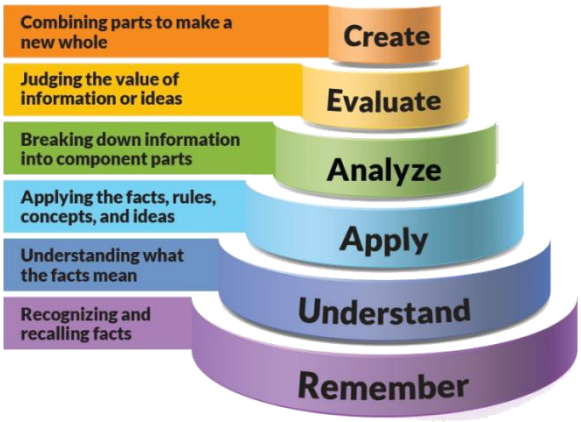


Figure 1: Blooms Taxonomy

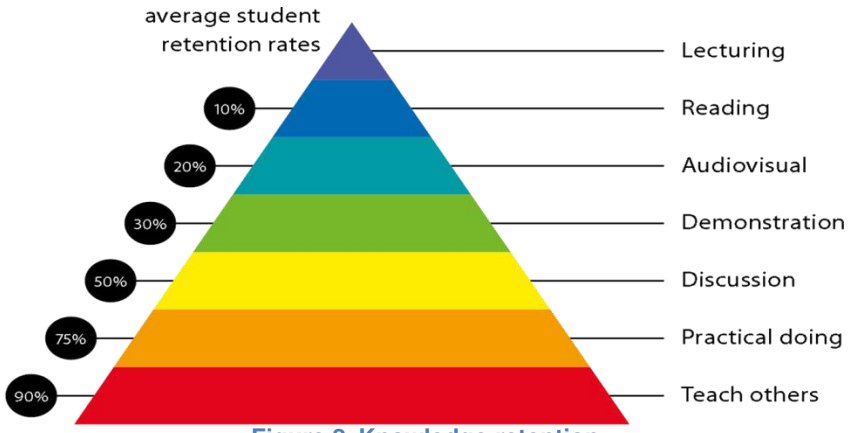


Figure 2: Knowledge retention

## Graduate Qualities and Capabilities covered

(Qualities post graduates harness crediting this Course)

| General Graduate Qualities | Department of Chemistry Post Graduate Capabilities |
|---|---|
| **Informed**<br>Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas. | **1 Professional knowledge, grounding & awareness:-**<br>Students will gain knowledge about chemistry subjects in both areas i.e. theory as well as practical's. Professionally students will know how chemistry is important in our daily life as well as to build up any industry. Students will be having knowledge/ awareness about chemicals' such as how to use them and how hazardous they are for the environment. |
| **Independent learners**<br>Engage with new ideas and ways of thinking and critically analyse issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others. | **2 Information literacy, gathering & processing:-**<br>Student's will be able identify the problems happening in the society as well as in the industry such as Photochemistry, uses of Aromatic heterocyclic compounds and their reactions, Organic waste coming from the industries etc. with this basic information |

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| | they will be having the ability to gather the possible solutions. |
| **Problem solvers**<br>Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards. | **4 Problem solving skills:-**<br>Organic Chemistry education provides students with the tools to solve many problems based on Chemistry. This means that students should be able to apply the scientific method: define a problem clearly, develop testable hypotheses, design and execute experiments, analyse data using appropriate statistical methods, and draw appropriate conclusions.<br>Students should be able to integrate knowledge across chemical sub disciplines and apply this knowledge to solve problems. In the laboratory, in addition to the characteristics described above, students should understand the fundamental uncertainties in experimental measurements. |
| **Effective communicators**<br>Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication. | **5 Written communication:-**<br>Students should be able to retrieve specific information from the chemical literature, critically evaluate technical articles, and manage many types of chemical information. Students should be able to develop proficiency with electronic searching of appropriate technical databases, including structure-based searching. |
| | **6 Oral communication:-**<br>Students should orally able to use communication technology such as computerized presentations as well as software for word processing, chemical-structure drawing, writing review articles on any related topic, poster preparation and research paper presentation to any conferences. |
| | **7 Teamwork:-**<br>Students should be able to Solve scientific problems often involving working in disciplinary and multidisciplinary teams. This is especially true in industry and increasingly in academic settings. Students should learn to work productively with a diverse group of peers in classroom and laboratory activities. Students should be able to lead portions of an activity or be effective followers, as dictated by the situation. Peer- and self-assessment is often an effective way to evaluate student contributions to group activities. |

| | |
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| **Responsible**<br>Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities. | **10 Sustainability, societal & environmental impact:**<br>With this course students will know/ aware/ learn about the sustainable use of the organic reagents while performing the laboratory experiments. Students will be able to understand various photochemical reactions happening in the environment and their participation in global warming. So they will be having capabilities/ knowledge how to tackle/ deal with different types of organic pollutants coming from the organic laboratory and industry. |

## Practical work: NA

(Mention what practical work this Course involves)

## Lecture/tutorial times

(Give lecture times in the format below)

**Monday-02:15 to 03:10 PM**
**Wednesday-02:15 to 03:10 PM**
**Thursday-11:45 to 12:40 PM**
**Friday-03:10 to 04:05 PM**

## Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

## Details of referencing system to be used in written work

1. Designing Organic Synthesis, S. Warren. Wiley.
2. Organic Synthesis: The Disconnection Approach, S. Warren, Wiley.
3. Organic Synthesis-Concept, Methods and Starting Materials, J. Fuhrhop.
4. Some Modern Methods of Organic Synthesis. W carruthers, Cambridge Univ. Press.
5. Modern Synthetic Reactions H.O. House, W.A Benjamin.
6. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, J. March. Wiley.
7. Principles of Organic Chemistry Part B.F .a. Carey and R.J. Sund berg, Plenum Press.
8. Fundamentals of photochemistry, K.K. Rothagi-Mukheriji, Wiley- Eastern.
9. Essentials of Molecular Photochemistry, Gilbert and J. Baggott, Blackwell Scientific Publication.
10. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
11. An Introduction to the Chemistry of Heterocyclic Compounds by R.M. Aches on (John Wiley & Sons Ltd. New York, 1967).
12. Heterocyclic Chemistry (2/e) by J.A. Joule and G.F. Smith (Van No strand Reinhold (UK) Co.Ltd.1978).

13. The Chemistry of Carbon Compounds by Rodd, E.R.(Ed.),Vol.4A to 4C(Elsevier, Amsterdam,1957 1973).
14. Ring Index by Patterson, Capell and Walker (American Chemical Society, New York, 1960).

## Text books

1. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March, 6thEdition, John Wiley.
2. Carbenes, nitrenes and arynes, T.L. Gilchrist and C.W. Rees.
3. Guidebook to Mechanism in Organic Chemistry by Peter Sykes, 6thEdition, Prentice Hall.
4. Advanced Organic Chemistry Part A: Structure and Mechanism and Part B: Reaction and synthesis, Francis A. Carey, Richard J. Sundberg, 5thEdition, Springer.
5. Organic Chemistry, Jonathan Clayden, Nick Geeves, Stuart Warren, 1stEdition, Oxford University Press.
6. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, 3rdEdition, Blackie Academic and Professional.
7. StereoChemistry, P.S. Kalsi, New Age Publications.
8. Reagents in Organic Synthesis- Fieser and Fieser, John Wiley.
9. Physical Organic Chemistry by Jack Hynes,(plenum publication)
10. Organic Chemistry, T.W. Graham Solomons and Graig B. Frymes, John Wiley and Sons.
11. Organic Chemistry, F. A. Carey, McGraw Hill Edition.
12. General Organic Chemistry Sachin Kumar Ghose, New Central book agency.
13. Organic Chemistry Vol 1-2 I.L.Finar 5thedition,ELBS.

## Additional Materials: NA

## ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

**Theory**

CIE (60 marks)

1. Mid semester Examination = 40 marks
2. Attendance = 5 marks
3. Presentation = 5 marks
4. Assignment = 10 marks

**Total = 60 marks**

ESE (40 marks)

1. Theory Exam = **40 marks**

## SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 50% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e. mid semester or end semester) of semester concerned. Students must make themselves available during

the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 50% marks to clear the concerned components.

### Practical Work Report/ Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

### Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

### Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

### Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

### University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

**Plagiarism** - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

***Do not copy the work of other students.***
***Do not share your work with other students (except where required for a group activity or assessment)***

## Course schedule (subject to change)

**(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)**

| | Week # | Topic & contents | CO Addressed | Teaching Learning Activity (TLA) |
|---|---|---|---|---|
| | Weeks 1 | **Elimination, nucleophilic and electrophilic substitution reaction** Mechanism, Orientation and stereochemistry of E1, E2 and E1CB reaction. Reactivity: effects of substrate | 1 | |

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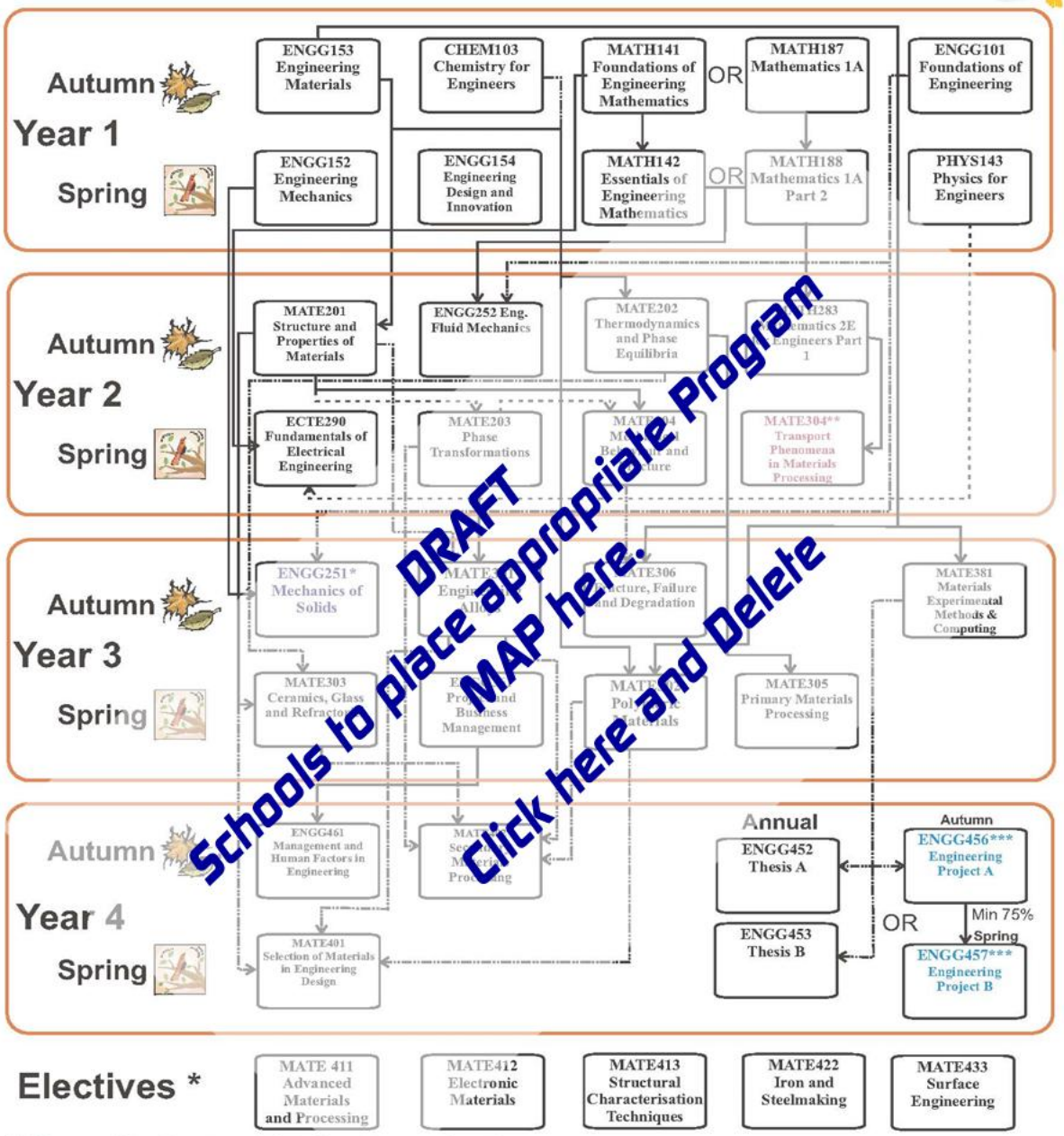
|---|---|---|---|---|
| | | structures, attacking base, solvent and leaving group. | | |
| | Weeks 2 | Mechanism and orientation in pyrolytic*syn*e liminations- Chugaev, Cope elimination, Burgess Dehydration Reaction, Selenoxide Elimination and Grieco Elimination. Hoffman and Saytzef eliminations, Bredt's Rule. | 1 | |
| | Week 3 | Nucleophilic substitution at the carbonyl (C=O), alcohol and nitrogen: Baeyer-Villiger oxidation and the benzoin condensation, Alcohols: The Mitsunobu reaction, Nitrogen: The von Richter and Smiles rearrangements respectively. | 1 | |
| | Week 4 | Neighbouring group Participation in Nucleophilic substitution: O (COO-, -OH), N (NH2, NHR, NR2), ,S (SH, SR), and halogen as Neighbouring group donor.<br>Aromatic electrophilic substitution reactions: The arenium ion mechanism, orientation and reactivity: Vilsmeier-Haack reaction and Gattermann-Koch reaction. | 1 | |
| | Week 5 | **Aromaticity:**<br>Aromaticity and types of aromaticity.<br>Huckel's rule and concept of aromaticity | 3 | |
| | Week 6 | Frost circle diagram for cyclobutadiene, benzene and others.<br>NMR- criteria to checkaromaticity character. | 3 | |
| | Week 7 | Aromaticity in benzenoid and non-benzenoid compounds and charged rings, annulenes, fulvenes, azulenes,<br>Aromaticity of Crown ether, cryptands, cyclodextrins, catenanes and rotaxanes.Inclusion complex, its stability and applications. | 3 | |
| | | | | |
| | Week 8 | **Reactive intermediates and Rearrangements:**<br>Discuss stability, structure, generation and fate for mentioned intermediates.<br>Carbocation, Carbanions | 3 | |
| | Week 9 | Discuss stability, structure, generation and fate for mentioned intermediates. | 3 | |

| | | | | |
|---|---|---|---|---|
| | | Carbenes, Free radicals, Nitrenes | | |
| | Week 10 | **Rearrangements:** Carbon to Carbon migration of R, H and Ar- (Pinacol-Pinacolone rearrangement Favorskii rearrangement, Wagner–Meerwein rearrangement). | 4 & 6 | |
| | Week 11 | Carbon to Nitrogen migrations (Schmidt rearrangement, Lossen rearrangement, Beckmann rearrangement). | 4 & 6 | |
| | Week 12 | **Stereochemistry:** Identifying stereo-chemical terms & relationships (Stereochemistry, Enantiomers, Diastereomers, Conformations, Configurations, Epimers, Anomers, Prochiral, Chiral carbon, Chiral molecules, Meso, Optical activity, Specific rotation, Atrop isomerism, etc.) | 4 & 6 | |
| | Week 13 | 2-D representations (line drawings, Fischer projections, Haworth projections)<br>Nomenclature (R/S, E/Z, D/L, d/l, Cis/Trans, Threo/Erythreo)<br>Physical and chemical properties of stereoisomer | 2 & 5 | |
| | Week 14 | Prochiral environments (enantiotopic, diastereotopic)<br>Stereochemistry in $SN^2$ (inversion)<br>Stereochemistry in elimination reaction mechanisms (E2, Hoffmann). | 2 & 5 | |
| | Week 15 | Stereochemistry in additions to alkenes (syn, anti, Diels-Alder)<br>Stereochemistry in additions to carbonyls (Cram's rule)<br>Chiral drugs<br>Stereospecific and stereo selective reaction. | 2 & 5 | |

# PROGRAM MAP for Bachelor of Engineering (Materials Engineering)

## DEGREE - 2012






* Note: Students will take three electives
Some electives are only offered every 2nd year

ENGG251* Note: Full time students entering Year 3 in 2012 will need to take one elective in Autumn as they have already completed ENGG251

MATE304** Note: Full time students entering Year 3 in 2012 will need to take MATE304 in Spring of their 4th year or take it in 2012 and defer another subject to Spring 2012

ENGG456***Note: If ENGG456 Engineering Project A (6cp) is done instead of a thesis, a student needs to complete 4 electives and is not eligible for honours