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##### FIRST SEMESTER 2021-2022

### 

### Course Handout

Date: 20.08.2021

Course No: CHEM F212

Course Title: **ORGANIC CHEMISTRY -I**

Instructor-in-charge: Manab Chakravarty

**1**. **Scope and objective of the course:** To familiarize the students with basic mechanistic aspects of organic reactions including mechanistic types, thermodynamics and kinetics, the important intermediates involved in organic reactions, functional group chemistry.

**2. Text Book:** R. T. Morrison, R. Boyd and S. K. Bhattacharjee, Organic Chemistry, 7th edition. **(T1)**

**Reference Books:** J. Clayden, N. Greeves, S. Warren, P. Wothers, Organic Chemistry, OUP, 1st ed., 2000. **(R1)**

Jerry March, Advanced Organic Chemistry, John Wiley & Sons, 4th ed., 1992. **(R2)**

G Marc Loudon, Organic Chemistry, Oxford, 4th Edition, 2002.

Francis A Carey, Organic Chemistry, Tata McGrawHill, 7th edition, 2008.

**3. Course Plan:**

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| --- | --- | --- | --- | --- |
| **Lec. No.** | Learning objectives | Topics to be Covered | **Learning Outcomes** | **Chapter in the Text Book** |
| 1-2 | Basic terminology and representation of organic reactions | Homolytic, heterolytic fission of bonds, concept of electrophiles and nucleophiles; how to write organic reaction mechanisms; movement of arrows; curved and fish-hook arrows; examples | Understanding of basic organic reactions  and drawing reactions realistically towards creative organic chemistry; Representing the movement of  electrons in reactions by curly arrows | **T1:** Ch. 4, pg. 55-59  **R1:** Ch. 5, pg. 116-131.  Lecture notes |
| 3-4 | Reactive intermediates: carbocations | Carbocations: Structure & stability, generation and reactions | Detailed analysis on the generation, character, type and role of the useful intermediate carbocation in organic reactions, application in organic synthesis with stereochemical outcome | **T1:** Ch. 4, pg. 64-69.  Lecture notes |
| 5 | Reactive intermediates: carbanions | Carbanions: Structure & stability, generation and reactions | Idea about another intermediate and difference between cation and anion intermediates in terms of the synthesis, behavior etc. Use of such intermediate in organic reactions | **T1:** Ch. 4, pg. 69-72.  Lecture notes |
| 6-7 | Reactive intermediates: free radicals | Free radicals: Structure & stability, generation and reactions | Intermediate with a free electron and their reactions follow different rules than ionic intermediates, Idea of polymerization. | **T1:** Ch. 4, pg. 81-86.  Lecture notes |
| 8-10 | Reactive intermediates: others | Carbenes; nitrenes: generation, stability, and fate | Substrate Conditions to generate carbenes, Carbenes are neutral species with only six electrons, electrophilic nature, insertion reaction and application in organic synthesis and modern development; How different these are with the ionic intermediates.  Same information related to nitrene is expected to be gained as nitrenes are the nitrogen analogue of carbenes. | **T1:** Ch. 4, pg. 72-78.  Lecture notes |
| 11-13 | Aromatic chemistry | Aromatic nucleophilic substitutions; Aromatic electrophilic substitutions; SNAr mechanism; benzyne mechanism; | Concept of aromaticity, Understanding the ways to functionalize the aromatic ring and its usefulness to generate medicines and functional materials | **T1:**  Ch. 5C, pg. 262-283;  Ch. 9, pg. 488-502.  **R1:** Ch. 23 , pg. 589-604.  Lecture notes |
| 14-17 | Thermodynamics and kinetics of reactions | Thermodynamic and kinetic control; Hammond postulate; methods to determine mechanisms (Hammett equation, kinetic isotopic effect); examples | Importance in proposing mechanism, how the thermodynamic and kinetic parameters help to determine the feasibility of reactions (the speed and energy), how a reaction rate can vary with different substitution. | **T1:** Ch. 4, pg. 97-102.  **R1**: Ch. 13, pg.319-330.  Ch. 22, pg. 554-556.  Ch. 41, pg.1090-1101.  **R2:** Ch. 6, pg.208-215,  217-219, 226.  Lecture notes |
| 18-21 | Alkyl and aryl halides | Synthesis and reactions of alkyl and aryl halides | How this halides are related to our daily needs and the chemistry behind the fact | **T1:** Ch. 8, pg. 426-462.  Ch. 9, pg. 482-485.  Lecture notes |
| 22-25 | Alcohols, phenol and ethers | Synthesis, reactivity; applications of Grignard reagents for synthesis; diols, acid/base catalysed ring opening | The chemistry involved in the naturally occurring functional groups that contain polar C-O bond, the distinct reactivity of these functional groups will be understood. | **T1:** Ch. 10, pg. 507-537.  Ch. 11, pg. 545-562.  Lecture notes (epoxides) |
| 26-28 | Amines and nitro compounds | Synthesis, basicity and reactions | Many interesting natural products and widely used drugs are amines; hence such functional group chemistry will be learnt. | **T1:** Ch. 15, pg. 696-736.  and  Lecture Notes  (Nitro compounds) |
| 29-37 | Carbonyl compounds | Synthesis, reactivity, enolates, malonate and ethyl acetoacetate synthesis  Aldol, Crossed Aldol and Claisen  condensation; Conjugate addition reactions of α, β-unsaturated carbonyl compounds with special reference to Michael addition, Mannich reaction, Wittig reaction | Concept about the most important functional group because its electon-deficient carbons and easily broken π-bond . The important name reactions and their applications in organic synthesis to synthesize medicinally useful molecules. | **T1:** Ch. 12, pg. 571-611.  **R1:** Ch. 21, pg.524-541.  Lecture notes (malonate &  ethyl acetoacetate) |
| 38-40 | Carboxylic acid & derivatives | Synthesis, reactions, conversion for acid to other derivatives | Enrich with this interesting functional groups in terms of preparation, features important products such as aspirin | **T1:** Ch. 13, pg. 624-648;  Ch. 14, Pg. 657-685.  Lecture notes |
| 41-42 | Carbohydrates | Introduction and their reactions | Concept on the largest group of organic molecules in nature, the basic structures and reactions of carbohydrates | T1: Ch. 26, pg. 1228-1236,  1244-1253.  Lecture notes |

**4. Evaluation:**

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| --- | --- | --- | --- | --- |
| **Component** | Duration | **Weightage (%)** | **Date and Time** | **Nature of Component** |
| Mid Sem test | 90 min. | 30 | 18/10/2021 9.00 - 10.30AM | Closed Book |
| Tutorial tests | continuous | 20 | Continuous | **open** |
| Seminar/interaction/assignment | continuous | 10 |  | **open** |
| Comprehensive Examination | 120 min | 40 | 11/12 FN | **Closed book** |

**5.** **Make-up(s) will be granted only for genuine reasons.**

**6.** **Chamber consultation hours:** : To be announced

**7.** **Notices:** All the notices pertaining to this course will be displayed on **Department of** **Chemistry Notice Board only**.

8. **Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-Charge

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