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**SCHOOL OF PHARMACY AND HEALTH SCIENCES**

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**COURSE:** CHE 2300: Carbonyl Compounds and Derivatives

**CREDIT:** 3.0 units

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**COURSE DESCRIPTION**

The purpose of this course is to equip the learner with principles and strategies in the synthesis of organic compounds and explain the application of the compounds in pharmacy.

**Purpose of Course**

The course will require the learners to apply knowledge gained in CHE 2305 to establish different synthetic strategies used in preparing new molecules, or converting one functional group to another. This course lays the foundation in synthetic organic chemistry, which the learner will use in subsequent course eg Medicinal chemistry.

**Link to University Mission and Program Learning Outcomes:**

**High order thinking.** The ability to collect, analyze and evaluate information and formulate conclusions. Students develop and demonstrate the ability to think critically, analytically and creatively.

**Literacy.** Competence in oral, written, quantitative, and technological skills. Students develop and demonstrate competency in oral and written communication as well as demonstrate scientific, quantitative and technological literacy.

**Global understanding and multicultural perspective.** Awareness, knowledge and appreciation of both the diversity and commonality of cultures. Students acquire these perspectives through formal study of languages, history, literature and the arts and through working, studying and living cooperatively in a racially, ethnically, and culturally diverse environment. Further, students acquire an understanding of economic, historical, political, geographic and environmental relationships on a global basis

**Preparedness for career.** Mastery of a field of knowledge and its multi-cultural and multinational application. Such mastery is accomplished through both formal study and various experiential forms of learning such as internships and field experiences.

**Leadership and ethics.** As part of their growth and development, students formulate and articulate the ethical standards and develop the leadership skills which will guide their professional and personal lives.

**Community service and development.** A sense of being part of a community and a desire to be of service to it. Students are given opportunities to participate in community service, citizenship, or social action projects or activities.

## Course Learning Outcomes

At the end of the course, the student should be able to:

1. Describe various strategies for syntheses of C-C, C-N, C-O and C-S bonds
2. Identify electron-rich and electron-poor sites within molecules by using the concepts of electronegativity, inductive effects and resonance effects
3. Apply curly arrow notation to describe the standard organic chemistry reaction mechanisms: substitution, elimination, and addition reactions.
4. Prepare and characterize structures, and reactions of alkene, alkyne and alkyl halide compounds.
5. Identify products and reagents in reactions involving carbonyl compounds.
6. Propose synthetic routes of various carbonyl compounds.
7. Prepare carbonyl derivatives

## COURSE CONTENT

### WEEK 1

Course Learning Outcomes: 1,2,3,4

- Overview and description of the course
- Review of alcohols and alkyl halides
- Nucleophilic Substitution Reactions (Klein, pp 292 – 320, 875 – 882, Bruice pp 426 – 447)
  - S<sub>N</sub>1 and S<sub>N</sub>2
  - Preparation of alcohol and alkyl halides via S<sub>N</sub>1 and S<sub>N</sub>2
  - Mechanism of S<sub>N</sub>1 and S<sub>N</sub>2

### WEEK 2

Course Learning Outcomes:1,2,3,4

- Nucleophilic Substitution Reactions (Klein, pp 292 – 320, 875 – 882, Bruice pp 426 – 447)
  - Aromatic electrophilic substitution reactions
  - Halogenation of alkanes (Bruice pp 570 - 572)
- Elimination Reactions (Klein, pp 356 – 382, Bruice pp 448 - 480)
  - E1 and E2
  - Preparation of alkenes via E1 and E2
  - Mechanism of E1 and E2

### WEEK 3

Course Learning Outcomes:2,3,4

- Addition reactions of alkenes (Klein, pp 405 – 428, Bruice pp 271 - 295)
  - Addition of H-X, X-X, and H-OH
  - Markovnikov's rule

### WEEK 4

Course Learning Outcomes:2,3,4,5 (Klein pp 1045-1071)

- Review of alkenes and carbonyl containing compounds
- Strategies for synthesis of C-C bond
  - Diels Alder
  - Stereoselectivity of Diels-Alder reaction

Quiz 1

## WEEK 5

Course Learning Outcomes: 1,3,5,6,7 (Klein pp 1103-1128 )

- Strategies for synthesis of C-C bond
  - Enolate chemistry
  - Stereoselective aspects of alkylation
  - Kinetic and thermodynamic control
  - Wittig Reaction

## WEEK 6

Course Learning Outcomes: 1,2,3 (Klein pp 663 – 667, 984 - 1027)

- Review of amines
- Strategies for synthesis of C-N bond
  - Preparation of amines via substitution reactions
  - Azide synthesis
  - Gabriel Synthesis
  - Synthesis of amines via reductive amination

## WEEK 7

Mid-Semester Exam

## WEEK 8

- Strategies for synthesis of C-S bonds
  - Preparation of thiols via  $S_N2$  reactions
  - Preparation of sulphides via oxidation reaction

## WEEK 9

Course Learning Outcomes: 3,5,6,7 (Klein pp 663 – 667, 984 - 1027)

- Strategies for synthesis of carbonyl containing compounds
  - Preparation of aldehydes and ketones
  - Reactions of carboxylic acids
  - Reactions of acyl chlorides

## WEEK 10

Course Learning Outcomes: 3,5,6,7 (Klein pp 663 – 667, 984 - 1027)

- Strategies for synthesis of carbonyl containing compounds
  - Reactions of acid anhydrides
  - Reactions of esters
  - Reactions of amides
- Use of protecting groups in Organic Chemistry

## WEEK 11

Course Learning Outcomes: 3,5,6,7

- Enolate Chemistry
- Alpha Carbon Chemistry

Quiz 2

## WEEK 12

Revision

## WEEK 13

Final Exam

## WEEK 14

Final Exam

### TEACHING METHODS

1. Lectures will be conducted using PowerPoint presentations, white board and marker, and class discussions.
2. Lectures will be given in class to explain to students various topics in organic chemistry.
3. Lectures will take a participatory approach where the instructor will involve students by frequently asking them questions that are meant to keep them alert and trigger class discussions
4. **Assignment criteria:** Students will be given several individual or group research assignments on topics relevant to the course. These could include lectures, discovery learning, problem-based learning, experimental learning, group-based learning, independent studies and e-learning.
5. The instructor will be free to answer questions from students in the course of the lectures and available during office hours for consultations.

### CORE and RECOMMENDED READING MATERIALS

#### CORE TEXTS

1. Klein, D., Organic Chemistry, 2<sup>nd</sup> Edition, Wiley, 2015
2. Bansal, Raj K. Heterocyclic chemistry
3. Jacobi, Peter A., Introductory Heterocyclic Chemistry

#### Recommended Texts

1. Bruice, P. Y. (2013). Organic Chemistry, 7<sup>th</sup> Edition. Pearson Prentice Hall.

### COURSE EVALUATION

Attendance and participation	10%
Individual/Group Assignments	20%
Continuous Assessment Test/Quiz	10%
Practicals	15%
Mid-Semester Exam	20%
Final Exam	25%
Total	100%

### KEY INSTITUTIONAL ACADEMIC POLICIES

Your attention is drawn to the following university policies:

#### 1. Attendance

"The university expects regular class attendance by all students. More than seven absences from class will result in an automatic grade F

Each student is responsible for all academic work missed during absences" (Page 45, University Catalogue).

## 2. Acts of misconduct

"The code of conduct prohibits certain acts of misconduct by students enrolled at the university. The following acts are examples of violations:

**Fabrication** – any falsification or invention of data, citation, or other authority in an academic exercise.

**Plagiarism** – any passing of another's ideas, words, or work as one's own unauthorized collaboration – collaboration in any academic exercise unless the faculty member has stated that such collaboration is permitted.

**Previously Submitted Work:** presenting work prepared for and submitted to another course

Any **intentional giving or use of external assistance** during an examination without the express permission of the faculty member giving the examination.

Students should note the following are key policies as outlined in the University Catalogue and Students Handbook

### 3. For the course to be considered complete student should:

- Sit in for two Quizzes,
- Hand in all assignments (individual and group). Assignments should be done and submitted on the due dates shown
- Undertake all examinations (Mid semester, and End semester)
- No make ups are given for tests assignments and exams except in instances allowed by university policy (See university policy on make up and special exams)

4. No student will be allowed to sit for examinations if they show up 20 minutes after the examination has been administered (See the university policy)

## GRADING

A	90 - 100
A-	87 - 89
B+	84 - 86
B	80 - 83
B-	77 - 79
C+	74 - 76
C	70 - 73
C-	67 - 69
D+	64 - 66
D	62 - 63
D-	60 - 61
F	0 - 59