



Course Specifications

| | |
|----------------------|--------------------------------|
| Course Title: | Organic Spectroscopy |
| Course Code: | 2044101-3 |
| Program: | Bachelor in Chemistry |
| Department: | Department of Chemistry |
| College: | College of Sciences |
| Institution: | Taif University |

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A. Course Identification

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| 1. Credit hours: 3 (2 Theoretical, 1 Lab) |
| 2. Course type |
| a. University <input type="checkbox"/> College <input type="checkbox"/> Department <input checked="" type="checkbox"/> Others <input type="checkbox"/> |
| b. Required <input checked="" type="checkbox"/> Elective <input type="checkbox"/> |
| 3. Level/year at which this course is offered: 10 th Level / 4 th Year |
| 4. Pre-requisites for this course (if any): Organic Chemistry 2 (2042203-3) |
| 5. Co-requisites for this course (if any): NA |

6. Mode of Instruction (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|----|-----------------------|---|------------|
| 1 | Traditional classroom | 3 Theoretical and 2 Practical hours/ Week | 100 % |
| 2 | Blended | - | - |
| 3 | E-learning | - | - |
| 4 | Distance learning | - | - |
| 5 | Other | - | - |

7. Contact Hours (based on academic semester)

| No | Activity | Contact Hours |
|----|-------------------|---------------|
| 1 | Lecture | 30 |
| 2 | Laboratory/Studio | 20 |
| 3 | Tutorial | |
| 4 | Others (specify) | |
| | Total | 50 |

B. Course Objectives and Learning Outcomes

1. Course Description

This course describes the principles spectroscopic techniques and instrumentation including; Infra-Red (IR), Ultraviolet (UV), Mass spectrometry (MS) and Nuclear magnetic resonance spectroscopy (NMR).

2. Course Main Objective

The course aims to elucidate the organic compounds' structures using combined spectral data (i.e. Infra-red, Ultra-violet, Mass and Nuclear magnetic resonance spectra).

3. Course Learning Outcomes

| | CLOs | Aligned PLOs |
|----------|---|--------------|
| 1 | Knowledge and Understanding: | |
| 1.1 | Identify the different types of spectra | K1 |
| 1.2 | Describe how to use different spectra in the identifications of organic compounds | K2 |
| 2 | Skills: | |
| 2.1 | Apply the rules for organic compounds' structures identification | S1 |

| CLOs | | Aligned PLOs |
|----------|---|--------------|
| 2.2 | Solve problems using organic spectroscopic criteria | S2 |
| 3 | Values: | |
| 3.1 | Work effectively in groups | V1 |

C. Course Content

| No | List of Topics | Contact Hours |
|--------------|--|---------------|
| 1 | Introduction to infra-red spectroscopy and vibration in organic molecules. | 3 |
| 2 | Characteristic IR spectral features of hydrocarbons. | 3 |
| 3 | Characteristic IR spectral features of oxygen and nitrogen containing compounds. | 3 |
| 4 | Color, absorption of the ultraviolet light, electronic excitation and factors in relation. Calculation of the absorption maximum in unsaturated natural products | 3 |
| 5 | Basic principles of the technique, natural abundance of isotopes, ionization and structure elucidation of hydrocarbons. Fragmentation mode of hydrocarbons. | 3 |
| 6 | Fragmentation mode and structure elucidation of oxygen-containing compounds. Fragmentation mode and structure elucidation of nitrogen and sulfur containing compounds. | 3 |
| 7 | Spinning of nuclei in a magnetic field, absorption, emission of radio frequency and the NMR spectrum | 3 |
| 8 | Spin coupling and chemical shift in ^1H NMR spectroscopy, ^1H NMR structure elucidation of hydrocarbons | 3 |
| 9 | ^1H NMR structure elucidation of functionalized hydrocarbons. | 3 |
| 10 | ^{13}C NMR based structure elucidation of organic compounds. | 3 |
| Total | | 30 |

Lab Content

| No | List of Topics | Contact Hours |
|----|--|---------------|
| 1 | Introduction of Organic spectroscopy (How solved the problems generally of IR, UV, Mass, ^1H NMR, and ^{13}C NMR | 2 |
| 2 | IR problems to identify the function groups of Aliphatic hydrocarbon (alkane); Alicyclic; Alkenes; Alkynes. | 2 |
| 3 | Mono substituted aromatic hydrocarbon; Di-substituted aromatic (Meta-substituted) hydrocarbon; Di-substituted aromatic (Para-substituted) hydrocarbon. | 2 |
| 4 | Aliphatic ether; aromatic ether; Aldehyde; Ketones; Carboxylic acids | 2 |
| 5 | Ester; Acid anhydride; Acid chloride; Primary amines; Secondary and tertiary amines | 2 |
| 6 | IR problems for unknown compounds | 2 |
| 7 | UV- problems for unknown compounds and how to calculate the max. wave length. | 2 |
| 8 | ^1H NMR- problems for unknown compounds and how to calculate the number of hydrogen. | 2 |
| 9 | ^{13}C NMR- problems for unknown compounds and how to calculate the | 2 |

| | | |
|--------------|--|-----------|
| | number of carbons | |
| 10 | Mass spectrum- problems for unknown compounds and know base peak and molecular ion peak. | 2 |
| Total | | 20 |

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|------|---|------------------------|--------------------------|
| 1.0 | Knowledge and Understanding | | |
| 1.1 | Identify the different types of spectra | Lecture | Written exam |
| 1.2 | Describe how to use different spectra in the identifications of organic compounds | Lecture | Written exam |
| 2.0 | Skills | | |
| 2.1 | Apply the rules for organic compounds' structures identification. | Discussion | Homework Assignments |
| 2.2 | Solve problems using organic spectroscopic criteria | Problem-Solving | Practical tasks and Exam |
| 3.0 | Values | | |
| 3.1 | Work effectively in groups | Collaborative Learning | Individual presentations |

2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|--------------------------|---------------------|--------------------------------------|
| 1 | Homework Assignments | Throughout Semester | 5% |
| 2 | Individual presentations | Throughout Semester | 5% |
| 3 | Mid Term Exam | 6 | 20% |
| 4 | Practical tasks | Throughout Semester | 25% |
| 5 | Final practical Exam | 10/11 | 5% |
| 6 | Final exam | 11/12 | 40% |

*Assessment task (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

Commitment to the rules of the Academic Advising Department at the university in accordance with the academic guidance manual approved by the university and the attached forms, there are different arrangements made by teaching staff to support student consultations including;

- Office hours: 8 hours per a week for each academic member.
- Academic guidance: an academic member has a number of students to guide them throughout degree journey.

F. Learning Resources and Facilities

1. Learning Resources

| | |
|---------------------------------------|---|
| Required Textbooks | <ul style="list-style-type: none">Organic Spectroscopy L. D. S. Yadav Kluwer (2005), Latest Edition. Springer Netherlands. ISBN: 978-94-017-2508-8. https://tinyurl.com/bnzhcyaad |
| Essential References Materials | <ul style="list-style-type: none">Spectroscopic identification of organic compounds, Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce (2014), Latest Edition. Wiley (USA). ISBN: 978-0-470-61637-6. https://tinyurl.com/2uyztiu3 |
| Electronic Materials | <ul style="list-style-type: none">Saudi Digital Library (SDL) https://apps.tu.edu.sa/sdl/default.aspx |
| Other Learning Materials | <ul style="list-style-type: none">Learning Management System (Blackboard)Computer programs for graphing organic compounds and chemical reactions (Chem draw, Chem sketch) |

2. Facilities Required

| Item | Resources |
|--|--|
| Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.) | A classroom with movable tables and chairs conducive to group discussion and teamwork. |
| Technology Resources (AV, data show, Smart Board, software, etc.) | Data show, smart board |
| Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | <ul style="list-style-type: none">NMR spectrometer.UV Spectrometer. |

G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---------------------------|---|
| Effectiveness of Teaching and assessment | Students | Survey (indirect method) |
| Extent of achievement of course learning outcomes | Program leader | Reports (Direct method) |
| Quality of learning resources | Peer referees Students | Reports (Direct method) Survey (indirect method) |

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)

Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify))

Assessment Methods (Direct, Indirect)

H. Specification Approval Data

| | |
|----------------------------|--|
| Council / Committee | Department Council/ Quality assurance committee |
| Reference No. | 2-5-1444 |
| Date | 01/11/2022 |