



Course Specification of Pharmaceutical Organic Chemistry II

| I. Course Identification and General Information: | | | | | |
|---|--|--|-----|-----|-------|
| 1 | Course Title | Pharmaceutical Organic Chemistry II | | | |
| 2 | Course Number & Code: | Ph533 | | | |
| 3 | Credit hours: | C.H | | | Total |
| | | Th. | Pr. | Tr. | |
| | | 2 | 2 | | |
| 4 | Study level/ semester at which this course is offered: | 2 nd Level /1 st Semester | | | |
| 5 | Pre –requisite (if any): | General Pharmaceutical Chemistry & Pharmaceutical Organic Chemistry I | | | |
| 6 | Co –requisite (if any): | | | | |
| 7 | Program (s) in which the course is offered: | Bachelor of Pharmacy | | | |
| 8 | Language of teaching the course: | English | | | |
| 9 | The department in which the course is offered: | Department of Medicinal Chemistry, Pharmaceutical Organic and Analytical Chemistry | | | |
| 10 | Location of teaching the course: | Faculty of Pharmacy-Sana`a University | | | |
| 11 | Prepared by: | Dr. Mokhtar A. Al-Ghorafy | | | |
| 12 | Date of approval: | | | | |

II. Course description:

This course is intended to provide students with the fundamental knowledge of stereochemistry and aromatic compounds including the nomenclatures, properties, synthesis, chemical reactions and the pharmaceutical application of these compounds. The practical part includes the preparation of some aromatic compounds.



III. Intended learning outcomes (ILOs) of the course:

At the end of this course the students should be able to:

1. Define the concepts of aromaticity and the differences between benzenoid and non benzenoid compounds.
2. Recognize the nomenclatures of aromatic and polynuclear compounds.
3. Identify the functional groups in organic compounds and their use in some synthetic procedures of drugs
4. Understand some chemical and physical concepts and their effect on drug molecule characters
5. Outline the synthesis and chemical reactions of aromatic and polynuclear organic compounds.
6. Detect the difference between aromatic and non aromatic compounds using chemical reactions
7. Correlate the structure of organic molecules with their effect on the biological activity.
8. Suggest the suitable methods for synthesizing aromatic and polynuclear compounds of pharmaceutical interest.
9. Use laboratory reagents adequately and safely
10. Synthesize and Purify some aromatic compounds as starting material for synthesis of some drugs.
11. Synthesize and Purify some polynuclear compounds as starting material for synthesis of some drugs
12. Collaborate effectively in groups to solve some problems encountered in pharmaceutical organic chemistry.
13. Search and evaluate the literature from different sources including the library, internetetc
14. Manage and organize the time effectively and implement writing and presentation skills to explore the importance of aromatic compounds in pharmaceutical industry

IV. Intended learning outcomes (ILOs) of the course:

(A) Knowledge and Understanding:

Alignment Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs) in:
Knowledge and Understanding.

| Program Intended Learning Outcomes (Sub- PILOs) in: Knowledge and Understanding | Course Intended Learning Outcomes (CILOs) in: Knowledge and Understanding |
|--|--|
| After completing this program, students would be able to: | After participating in the course, students would be able to: |



| | | | |
|-----|---|-----|---|
| A1- | Recognize the principles of physical, chemical, clinical, social, behavioral, health and pharmaceutical sciences. | a1- | Define the concepts of aromaticity and the differences between benzenoid and non benzenoid compounds. |
| A2- | Recognize the physicochemical properties, preparation, structure activity relationship (SAR), toxicity and the modern methods of analysis of various substances of chemical and natural products of therapeutic potential as well as the basic principle of drug discovery, design and development. | a2- | Recognize the nomenclatures of aromatic and polynuclear compounds. |
| | | a3- | Identify the functional groups in organic compounds and their use in some synthetic procedures of drugs |
| | | a4- | Understand some chemical and physical concepts and their effect on drug molecule characters |
| | | a5- | Outline the synthesis and chemical reactions of aromatic and polynuclear organic compounds. |

Teaching And Assessment Methods For Achieving Learning Outcomes:

Alignment Learning Outcomes of Knowledge and Understanding to Teaching and Assessment Methods:

| Course Intended Learning Outcomes (CILOs) in Knowledge and Understanding After participating in the course, students would be able to: | | Teaching strategies/methods to be used | Methods of assessment |
|---|---|---|--|
| a1- | Define the concepts of aromaticity and the differences between benzenoid and non benzenoid compounds. | Lecture method , Computer based teaching and learning, group discussion and tutorial | Oral Exam, Quizzes, Attendance, Participation, Short answers, reports, homework, and Written exam. |
| a2- | Recognize the nomenclatures of aromatic and polynuclear compounds. | | |
| a3- | Identify the functional groups in organic compounds and their use in some synthetic procedures of drugs | | |
| a4- | Understand some chemical and physical concepts and their effect on drug molecule characters | | |
| a5- | Outline the synthesis and chemical reactions of aromatic and polynuclear organic compounds. | | |



(B) Intellectual Skills:

Alignment Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs) in: **Intellectual skills**

| Program Intended Learning Outcomes (Sub-PILOs) in Intellectual skills | | Course Intended Learning Outcomes (CILOs) of Intellectual Skills | |
|---|--|--|---|
| After completing this program, students would be able to: | | After participating in the course, students would be able to: | |
| B1- | Consolidate the chemical, biochemical and physiological principles to construct the pharmacophores of the structure and their effect on the stability, pharmacokinetic and pharmacodynamic profiles of the drug. | b1- | Detect the difference between aromatic and non aromatic compounds using chemical reactions |
| B2- | Categorize the synthetic and natural drugs according to their mechanism of action, systemic effect, therapeutic uses, contraindication and toxicity. | b2- | Correlate the structure of organic molecules with their effect on the biological activity. |
| | | b3- | Suggest the suitable methods for synthesizing aromatic and polynuclear compounds of pharmaceutical interest |

Teaching And Assessment Methods For Achieving Learning Outcomes:

Alignment Learning Outcomes of Intellectual Skills to Teaching Methods and Assessment Methods:

| Course Intended Learning Outcomes (CILOs) in Intellectual Skills. | | Teaching strategies/methods to be used. | Methods of assessment |
|---|---|---|--|
| After participating in the course, students would be able to: | | | |
| b1- | Detect the difference between aromatic and non aromatic compounds using chemical reactions | Lecture method, Computer based teaching and learning Group Discussion, Problem solving sessions | Oral Exam, Quizzes, Attendance, Participation, Short answers, reports, homework, and Written exam. |
| b2- | Correlate the structure of organic molecules with their effect on the biological activity. | | |
| b3- | Suggest the suitable methods for synthesizing aromatic and polynuclear compounds of pharmaceutical interest | | |

(C) Professional and Practical Skills.



| Alignment Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs) in: Professional and Practical Skills | | | |
|---|---|--|---|
| Program Intended Learning Outcomes (Sub- PILOs) in Professional and Practical Skills | | Course Intended Learning Outcomes (CILOs) in Professional and Practical Skills | |
| After completing this program, students would be able to: | | After participating in the course, students would be able to: | |
| C1- | Operate different pharmaceutical equipments and instruments and use emerging technologies in design, synthesis, pre-formulation, formulation, packaging, storage and analysis of pharmaceutical products according to GLP, GSP and cGMP guidelines. | c1- | Use laboratory reagents adequately and safely |
| C2- | Handle and dispose chemicals and pharmaceutical preparations including radiopharmaceuticals safely and effectively. | c2- | Synthesize and Purify some aromatic compounds as starting material for synthesis of some drugs.. |
| C5- | Conduct research studies and utilize the results in different pharmaceutical fields. | c3- | Synthesize and Purify some polynuclear compounds as starting material for synthesis of some drugs |
| Teaching And Assessment Methods For Achieving Learning Outcomes: | | | |
| Alignment Learning Outcomes of Professional and Practical Skills to Teaching and Assessment Methods: | | | |
| Course Intended Learning Outcomes (CILOs) in Professional and Practical Skills After participating in the course, students would be able to: | | Teaching strategies/methods to be used | Methods of assessment |
| c1- | Use laboratory reagents adequately and safely | Lecture method, Practical sessions and group discussion | Practical works, homework, practical exam and practical reports. |
| c2- | Synthesize and Purify some aromatic compounds as starting material for synthesis of some drugs.. | | |
| c3- | Synthesize and Purify some polynuclear compounds as starting material for synthesis of some drugs | | |
| (D) General / Transferable Skills: | | | |



| Alignment Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs) in: General and Transferable skills | | | |
|--|---|--|---|
| Program Intended Learning Outcomes (PILOs) in General / Transferable skills | | Course Intended Learning Outcomes (CILOs) in General / Transferable skills | |
| After completing this program, students would be able to: | | After participating in the course, students would be able to: | |
| D3- | Develop financial, market management, writing, presentation and time management skills as well as creativity, critical thinking, problem solving and decision making abilities. | d1- | Collaborate effectively in groups to solve some problems encountered in pharmaceutical organic chemistry. |
| D5- | Apply information and communication technology and working effectively in a team. | d2- | Search and evaluate the literature from different sources including the library, internetetc |
| | | d3- | Manage and organize the time effectively and implement writing and presentation skills to explore the importance of aromatic compounds in pharmaceutical industry |

Teaching And Assessment Methods For Achieving Learning Outcomes:

| Alignment Learning Outcomes of General and Transferable skills to Teaching and Assessment Methods. | | | |
|--|---|--|------------------------|
| Course Intended Learning Outcomes (CILOs) in General and Transferable Skills | | Teaching strategies/methods to be used. | Methods of assessment |
| After participating in the course, students would be able to: | | | |
| d1- | Collaborate effectively in groups to solve some problems encountered in pharmaceutical organic chemistry. | Small group discussions, Tutorials and Practical sessions. | Homework, and reports. |
| d2- | Search and evaluate the literature from different sources including the library, internetetc | | |
| d3- | Manage and organize the time effectively and implement writing and presentation skills to explore the importance of aromatic compounds in pharmaceutical industry | | |

V. Course Content:



1 – Course Topics/Items:

a – Theoretical Aspect

| Order | Topic List / Units | CILOs (symbols) | Sub-topic List | Number of weeks | Contact hours |
|-------|---|------------------|---|-----------------|---------------|
| 1. | Introduction of Aromatic Chemistry | a 1, b1-3, d1-3 | - Definition of aromatic compounds, aromaticity. Huckl rule and properties of aromatic compounds. - Nomenclature of aromatic -The effect of aromaticity on stability and chemical properties of drugs | 2 | 4 |
| 2. | Reaction of Aromatic Compounds - Effect of Substituent | a2-5, b1-3, d1-3 | -Halogenations -Nitration -sulphonation -Friedel-Craft alkylation and acylation Donating and withdrawing mechanism and their effect on the chemical properties of drugs | 2 | 4 |
| 3. | Aryl Halide | a2-5, b1-3, d1-3 | -Nomenclature -Properties -Synthesis -Reactions -The structure activity of halide and their effect on the physical and chemical characters of drugs | 1 | 2 |
| 4. | Phenols | a2-5, b1-3, d1-3 | Structure, acidity character .nomenclature, preparation ,reactions and uses -The structure activity of phenol in drugs | 1 | 2 |
| 5. | -Aromatic Aldehydes and Ketones | a2-5, b1-3, d1-3 | Structure, reactivity .nomenclature, preparation and reaction and their application in drug development | 2 | 4 |
| 6. | Mid-term Exam | a1-5, b1-3 | | 1 | 2 |



| | | | | | |
|--|--------------------------------|------------------|--|-----------|-----------|
| 7. | - Aromatic Carboxylic Acids | a2-5, b1-3, d1-3 | -Acidity -Nomenclature -synthesis -Reactions the structure activity of carboxylic acid in the physical and chemical characters of drugs | 2 | 4 |
| 8. | Aromatic Amines | a2-5, b1-3, d1-3 | -structure ,nomenclature ,synthesis reaction, diazonium salt ,basicity and uses the structure activity of amine in the physical and chemical properties of drugs | 2 | 4 |
| 9. | Polynuclear Aromatic Compounds | a2-5, b1-3, d1-3 | -Naphthalene, anthracene Phenanthrene Pharmaceutical importance of polynuclear compounds | 2 | 4 |
| 10. | Final Exam | a1-5, b1-3 | | 1 | 2 |
| Number of Weeks /and Units Per Semester | | | | 16 | 32 |

b - Practical Aspect

| Order | Tasks/ Experiments | CILOs (symbols) | Number of Weeks | Contact Hours |
|-------|---|-----------------|-----------------|---------------|
| 1. | Synthesis of aspirin | c1, c2,d1-3 | 1 | 2 |
| 2. | Preparation of salicylamide | c1, c2,d1-3 | 1 | 2 |
| 3. | Preparation of acetanilide | c1, c2,d1-3 | 1 | 2 |
| 4. | Nitration of acetanilide | c1, c2,d1-3 | 1 | 2 |
| 5. | Preparation of p-nitroaniline | c1, c2,d1-3 | 1 | 2 |
| 6. | Preparation of sulfanilic acid | c1, c2,d1-3 | 1 | 2 |
| 7. | Mid-Exam | c1-2 | 1 | 2 |
| 8. | Preparation of benzoic acid oxidation of benzyl alcohol | c1, c2,d1-3 | 1 | 2 |



| | | | | |
|--|---|-------------|-----------|-----------|
| 9. | Preparation of α -nitronaphthalene | c1, c3,d1-3 | 1 | 2 |
| 10. | Preparation of naphthalene picrate | c1, c3,d1-3 | 1 | 2 |
| 11. | Preparation of Anthracene picrate | c1, c3,d1-3 | 1 | 2 |
| 12. | Acylation of β -naphthol and Crystallization of 2-naphthylacetate | c1, c3,d1-3 | 2 | 4 |
| 13. | Final Exam | c1-3 | 1 | 2 |
| Number of Weeks /and Units Per Semester | | | 16 | 32 |

VII. a-Teaching Strategies Of The Course:

Lecture method, computer based teaching and learning group discussion, brainstorming and Problem solving sessions, tutorial, Practical sessions and group discussion

b- Assessment Methods:

Oral Exam, Quizzes, Attendance, Participation, Short answers, reports, homework, and Written exam
Practical works, practical exam and practical reports.

VII. Assignments:

| No. | Assignments | Aligned CILOs (symbols) | Week Due | Mark |
|-----|----------------------|--------------------------|-------------------------------|------|
| | Homework Assignments | a2, a3, a5, b2, b3, d1-3 | Sporadic through the semester | 10 |
| | Reports | c2-4, d1-3 | | |

VIII. Schedule of Assessment Tasks for Students During the Semester:

| No. | Assessment Method | Week Due | Mark | Proportion of Final Assessment | Aligned Course Learning Outcomes (CILOs symbols) |
|-----|--|-------------------------------|------|--------------------------------|--|
| 1 | Attendance, Participation, reports and quizzes | All Weeks | 10 | 7% | a1,a4,a5, b1,b3, d1-3 |
| | Oral Tests and Homework-assignments | Sporadic through the semester | 10 | 7% | a2, a3, a5, b2, b3, d1-3 |



| | | | | | |
|--------------|---|------------------|------------|-------------|--------------|
| 2 | Attendance, Practical Reports and Practical mid-semester exam | 7 th | 30 | 20% | c1-3 |
| 3 | Theoretical mid-semester exam | 9 th | 30 | 20% | a1-5, b1- b3 |
| 5 | Final Exam (theoretical) | 16 th | 50 | 33% | a1-5, b1-3 |
| 6 | Final Exam (practical) | 16 th | 20 | 20% | c1-3 |
| Total | | | 150 | 100% | |

IX. Students' Support:

| Office Hours/week | Other Procedures (if any) |
|----------------------------|---------------------------|
| Two contact hours per week | None |

X. Learning Resources:

1- Required Textbook(s) (maximum two).

- 1- R. T. Morrison and R. N. Boyd. 2002. Organic Chemistry, 6th edition, Pearson Prentice Hall of India Pvt. Ltd, New Delhi.
- 2- Francis A. Carey and Richard J. Sundberg. 2001. Advanced Organic Chemistry; Part B: Reactions and Synthesis, 4th edition, Wiley and Sons., Inc. New York.
- 3- Michael Heidelberger. 1923. Advanced Laboratory Manual of Organic Chemistry, The chemical catalog company, inc. New York.

2- Recommended Books and Reference Materials.

1. L. Finar., ,1963. Organic Chemistry: The Fundamental Principles, 4th edition, longman green and company ltd. London.
2. John McMurry. 2011, " Fundamentals of Organic Chemistry " Seventh Edition, Brooks/Cole 20 Davis Drive, Belmont.
3. Jerry and March., 2007,. Advanced Organic Chemistry ; reaction, mechanism and structure, 6th edition, John Wiley & Sons, Inc., Hoboken, New Jersey
4. Janice Gorzynski Smith. 2011, ." Organic Chemistry", Third Edition, McGraw-Hill, a business unit of The McGraw-Hill Companies, New York.
5. K.-H. Hellwich · C. D. Siebert, "Stereochemistry Workbook" 2006, Springer-Verlag Berlin Heidelberg , Berlin.



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|---|---|
| 6. Lectures Notes and Practical Manual. | |
| 3- Electronic Materials and Web Sites etc. | |
| 1- | http://www.chemaxon.com/marvin |
| 2- | www.orgsyn.org . |
| 3- | |
| XI. Facilities Required: | |
| 1 - Accommodation: | <ul style="list-style-type: none"> - Well-equipped lecture halls with data show facilities, whiteboards, net connection, etc. - Well-equipped laboratories with all required equipment and reagents. |
| 2 - Computing resources: | <ul style="list-style-type: none"> - Computer laboratory with internet facilities. |
| XII. Course Improvement Processes: | |
| 1- Strategies for obtaining student feedback on effectiveness of teaching | |
| | <ul style="list-style-type: none"> ▪ Student-based assessment of the effectiveness of teaching using a questionnaire designed by the Quality Assurance Unit at the end of the semester. ▪ Meeting with students and faculty (once per semester). |
| 2- Other Strategies for Evaluation of Teaching by The Instructor or by the department. | |
| | <ul style="list-style-type: none"> ▪ Assessment of the course syllabus and contents by the teachers using a questionnaire designed by the Quality Assurance Unit of the university at the end of the semester. ▪ Regular meeting and discussion of the course content between the Head of Department and the teaching staff of the course (for theory and practice). |
| 3- Processes for Improvement of Teaching. | |
| | <ul style="list-style-type: none"> ▪ Revision of the course specification and its teaching strategies every three academic years after consideration of all issues raised by the teachers and/or students during regular meetings and discussions. ▪ Exploring any possible defects in the course that might be encountered by the teaching staff and their mitigation in subsequent improved versions of course specification. |
| 4- Processes for Verifying Standards of Students' Achievement | |
| | <ul style="list-style-type: none"> ▪ Checking of a sample of students' work by an independent faculty member. |



| | |
|--|---|
| | <ul style="list-style-type: none"> Periodic exchange and check marking of a sample of students' assignments with a faculty member from another institution. Adoption of scoring rubrics to assess the students' achievement (both for ongoing or summative assessments). Regular follow-up of laboratory logbooks to assess the practical achievement of students. |
| 5- Procedures for Periodically Reviewing of Course Effectiveness and Planning for Improvement | |
| | <ul style="list-style-type: none"> Student rating and feedback Peer rating and feedback Regular meeting of the Curriculum Committee of the faculty. |
| 6- Course Development Plans | |
| | <ul style="list-style-type: none"> Conducting regular workshops for the staff for improving their course specification skills. Regular revision of course specification and syllabus items. |

XIII. Course Policies: (including plagiarism, academic honesty, attendance etc)

The University Regulations on academic misconduct will be strictly enforced. Please refer to -----

| | |
|----------|---|
| 1 | Class Attendance: <ul style="list-style-type: none"> Attendance of all lectures and practical sessions is required. Unexcused absence exceeding 25% of the lectures or practical sessions will disqualify the student from entering the final exam. |
| 2 | Tardy: <p>- Roll will be called in the very beginning of each lecture and practical class. Retardation for more than three weeks without a reasonable excursion, the student involved shall not be allowed to attend the class any longer and consequently shall be considered to be absent.</p> |
| 3 | Exam Attendance/Punctuality: <ul style="list-style-type: none"> Exam attendance is obligatory unless being excused by the department and faculty. Absence from assignments or exams will be dealt with according to the general policy of the university. |
| 4 | Assignments & Projects: <ul style="list-style-type: none"> Assignments: Written and oral; Laboratory logbook signed by the responsible demonstrator. Projects: Not applicable. |



| | |
|---|---|
| 5 | Cheating: <ul style="list-style-type: none"> Punishment of cheating will be according to the general policy of the university in this respect. |
| 6 | Plagiarism: <ul style="list-style-type: none"> Plagiarism in written essays, reports, etc. is not accepted, and students who plagiarize the works of others will be punished according to the general policy of the university. |
| 7 | Other policies: <ul style="list-style-type: none"> General policies of the Students' Affairs of the University and the Quality Assurance Unit. |

Course Plan of Pharmaceutical Organic Chemistry II

| I- Information about Faculty Member Responsible for the Course: | | | | | | | |
|---|---------------------------|--------------|-----|-----|-----|-----|-----|
| Name of Faculty Member | Dr. Mokhtar A. Al-Ghorafy | Office Hours | | | | | |
| Location & Telephone No. | 770010749 | SAT | SUN | MON | TUE | WED | THU |
| E-mail | Alghorafi2030@yahoo.com | 2h | | | | | |

| II- Course Identification and General Information: | | | | | | |
|--|---|---|---------|-----|--------|-----|
| 1- | Course Title: | Pharmaceutical Organic Chemistry II | | | | |
| 2- | Course Number & Code: | Ph533 | | | | |
| 3- | Credit hours: | C.H | | | | C.H |
| | | Th. | Seminar | Pr. | F. Tr. | Th. |
| | | 2 | | 2 | | 2 |
| 4- | Study level/year at which this course is offered: | 2 nd Level /2 nd Semester | | | | |
| 5- | Pre –requisite (if any): | General Pharmaceutical Chemistry & Pharmaceutical Organic Chemistry I | | | | |
| 6- | Co –requisite (if any): | - | | | | |
| 7- | Program (s) in which the course is offered | Bachelor of Pharmacy | | | | |
| 8- | Language of teaching the course: | English | | | | |



| | | |
|-----|---|--|
| 9- | System of Study: | Semesters |
| 10- | Mode of delivery: | Regular |
| 11- | Location of teaching the course: | Faculty of Pharmacy- Sana`a university |

III- Course description:

This course provides students with the fundamental knowledge of stereochemistry and aromatic compounds including the nomenclatures, properties, synthesis, chemical reactions and the pharmaceutical application of these compounds. The practical part includes the preparation of some aromatic compounds.

IV- Intended learning outcomes (ILOs) of the course:

At the end of this course the students should be able to:

1. Define the concepts of aromaticity and the differences between benzenoid and non benzenoid compounds.
2. Recognize the nomenclatures of aromatic and polynuclear compounds.
3. Identify the functional groups in organic compounds and their use in some synthetic procedures of drugs
4. Understand some chemical and physical concepts and their effect on drug molecule characters
5. Outline the synthesis and chemical reactions of aromatic and polynuclear organic compounds.
6. Detect the difference between aromatic and non aromatic compounds using chemical reactions
7. Correlate the structure of organic molecules with their effect on the biological activity.
8. Suggest the suitable methods for synthesizing aromatic and polynuclear compounds of pharmaceutical interest.
9. Use laboratory reagents adequately and safely
10. Synthesize and Purify some aromatic compounds as starting material for synthesis of some drugs.
11. Synthesize and Purify some polynuclear compounds as starting material for synthesis of some drugs
12. Collaborate effectively in groups to solve some problems encountered in pharmaceutical organic chemistry.
13. Search and evaluate the literature from different sources including the library, internet ...etc
14. Manage, organize the time effectively and implement writing and presentation skills to explore the importance of aromatic compounds in pharmaceutical industry



V- Course Content:

1 – Course Topics/Items:

a – Theoretical Aspect

| Order | Topic List / Units | CILOs (symbols) | Sub-topic List | Week Due | Contact hours |
|-------|---|------------------|---|----------|---------------|
| 1) | Introduction of Aromatic Chemistry | a 1, b1-3, d1-3 | - Definition of aromatic compounds, aromaticity. Huckl rule and properties of aromatic compounds. - Nomenclature of aromatic -The effect of aromaticity on stability and chemical properties of drugs | 1,2 | 4 |
| 2) | Reaction of Aromatic Compounds - Effect Of Substituent | a2-5, b1-3, d1-3 | -Halogenations -Nitration -sulphonation -Friedel-Craft alkylation and acylation Donating and withdrawing mechanism and their effect on the chemical properties of drugs | 3,4 | 4 |
| 3) | Aryl Halide | a2-5, b1-3, d1-3 | -Nomenclature -Properties -Synthesis -Reactions -The structure activity of halide and their effect on the physical and chemical characters of drugs | 5 | 2 |
| 4) | Phenols | a2-5, b1-3, d1-3 | Structure, acidity character .nomenclature, preparation ,reactions and uses | 6 | 2 |



| | | | | | |
|--|---------------------------------|------------------|--|-------|---|
| | | | -The structure activity of phenol in drugs | | |
| | -Aromatic Aldehydes and Ketones | a2-5, b1-3, d1-3 | Structure, reactivity .nomenclature, preparation and reaction and their application in drug development | 7,8 | 4 |
| | 6Mid Exam | a1-5, b1-3 | | 9 | 2 |
| | - Aromatic Carboxylic Acids | a2-5, b1-3, d1-3 | -Acidity -Nomenclature -synthesis -Reactions the structure activity of carboxylic acid in the physical and chemical characters of drugs | 10,11 | 4 |
| | Aromatic Amines | a2-5, b1-3, d1-3 | -structure ,nomenclature ,synthesis reaction, diazonium salt ,basicity and uses the structure activity of amine in the physical and chemical properties of drugs | 12,13 | 4 |
| | Polynuclear Aromatic Compounds | a2-5, b1-3, d1-3 | -Naphthalene, anthracene Phenanthrene Pharmaceutical importance of polynuclear compounds | 14,15 | 4 |
| | Final Exam | a1-5, b1-3 | | 16 | 2 |

Number of Weeks /and Units Per Semester

16 32

b - Practical Aspect

| Order | Tasks/ Experiments | CILOs (symbols) | Week Due | Contact Hours |
|-------|-----------------------------|-----------------|----------|---------------|
| | Synthesis of aspirin | c1, c2,d1-3 | 1 | 2 |
| | Preparation of salicylamide | c1, c2,d1-3 | 2 | 2 |
| | Preparation of acetanilide | c1, c2,d1-3 | 3 | 2 |
| | Nitration of acetanilide | c1, c2,d1-3 | 4 | 2 |



| | | | | |
|--|---|-------------|-----------|-----------|
| | Preparation of p-nitroaniline | c1, c2,d1-3 | 5 | 2 |
| | Preparation of sulfanilic acid | c1, c2,d1-3 | 6 | 2 |
| | Mid-Exam | c1-2 | 7 | 2 |
| | Preparation of benzoic acid oxidation of benzyl alcohol | c1, c2,d1-3 | 8 | 2 |
| | Preparation of α -nitronaphthalene | c1, c3,d1-3 | 9 | 2 |
| | Preparation of naphthalene picrate | c1, c3,d1-3 | 10 | 2 |
| | Preparation of Anthracene picrate | c1, c3,d1-3 | 11,12 | 4 |
| | Acylation of β -naphthol and Crystallization of 2-naphthylacetate | c1, c3,d1-3 | 13,14 | 4 |
| | Revision | c1-3,d1-3 | 15 | 2 |
| | Final Exam | c1-3 | 16 | 2 |
| Number of Weeks /and Units Per Semester | | | 16 | 32 |

VIII. a-Teaching Strategies Of The Course:

Lecture method, computer based teaching and learning group discussion, brainstorming and Problem solving sessions, tutorial, Practical sessions and group discussion

b- Assessment Methods:

Oral Exam, Quizzes, Attendance, Participation, Short answers, reports, homework, and Written exam
Practical works, practical exam and practical reports.

VII. Assignments:

| No. | Assignments | Aligned CILOs (symbols) | Week Due | Mark |
|-----|----------------------|-------------------------|-------------------------------|------|
| | Homework Assignments | a2, a3, a5, b2, b3,d1-3 | Sporadic through the semester | 10 |
| | Reports | c2-4, d1-3 | | |

XIV. Schedule of Assessment Tasks for Students During the Semester:

| No. | Assessment Method | Week Due | Mark | Proportion of Final Assessment | Aligned Course Learning |
|-----|-------------------|----------|------|--------------------------------|-------------------------|
| | | | | | |



| | | | | | Outcomes (CIOs symbols) |
|--------------|---|-------------------------------|------------|-------------|--------------------------|
| 1 | Attendance, Participation, reports and quizzes | All Weeks | 10 | 7% | a1,a4,a5, b1,b3, d1-3 |
| | Oral Tests and Homework-assignments | Sporadic through the semester | 10 | 7% | a2, a3, a5, b2, b3, d1-3 |
| 2 | Attendance, Practical Reports and Practical mid-semester exam | 7 th | 30 | 20% | c1-3 |
| 3 | Theoretical mid-semester exam | 9 th | 30 | 20% | a1-5, b1- b3 |
| 5 | Final Exam (theoretical) | 16 th | 50 | 33% | a1-5, b1-3 |
| 6 | Final Exam (practical) | 16 th | 20 | 20% | c1-3 |
| Total | | | 150 | 100% | |

XV. Students' Support:

| Office Hours/week | Other Procedures (if any) |
|----------------------------|---------------------------|
| Two contact hours per week | None |

XVI. Learning Resources:

1- Required Textbook(s) (maximum two).

- 4- R. T. Morrison and R. N. Boyd. 2002. Organic Chemistry, 6th edition, Pearson Prentice Hall of India Pvt. Ltd, New Delhi.
- 5- Francis A. Carey and Richard J. Sundberg. 2001. Advanced Organic Chemistry; Part B: Reactions and Synthesis, 4th edition, Wiley and Sons., Inc. New York.
- 6- Michael Heidelberger. 1923. Advanced Laboratory Manual of Organic Chemistry, The chemical catalog company, inc. New York.

2- Recommended Books and Reference Materials.



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| 7. L. Finar., 1963. Organic Chemistry: The Fundamental Principles, 4 th edition, longman green and company ltd. London. |
| 8. John McMurry. 2011, " Fundamentals of Organic Chemistry " Seventh Edition, Brooks/Cole 20 Davis Drive, Belmont. |
| 9. Jerry and March., 2007,. Advanced Organic Chemistry ; reaction, mechanism and structure, 6 th edition, John Wiley & Sons, Inc., Hoboken, New Jersey |
| 10. Janice Gorzynski Smith. 2011,." Organic Chemistry", Third Edition, McGraw-Hill, a business unit of The McGraw-Hill Companies, New York. |
| 11. K.-H. Hellwich · C. D. Siebert, "Stereochemistry Workbook" 2006, Springer-Verlag Berlin Heidelberg , Berlin. |
| 12. Lectures Notes and Practical Manual. |

3- Electronic Materials and Web Sites etc.

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| 4- http://www.chemaxon/marvin |
| 5- www.orgsyn.org . |
| 6- |

XVII. Facilities Required:

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|---------------------------------|--|
| 1 - Accommodation: | <ul style="list-style-type: none"> - Well-equipped lecture halls with data show facilities, whiteboards, net connection, etc. - Well-equipped laboratories with all required equipment and reagents. |
| 3 - Computing resources: | <ul style="list-style-type: none"> - Computer laboratory with internet facilities. |

XVIII. Course Improvement Processes:

6- Strategies for obtaining student feedback on effectiveness of teaching

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| <ul style="list-style-type: none"> ▪ Student-based assessment of the effectiveness of teaching using a questionnaire designed by the Quality Assurance Unit at the end of the semester. ▪ Meeting with students and faculty (once per semester). |
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7- Other strategies for evaluation of teaching by the instructor or by the department.

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| <ul style="list-style-type: none"> ▪ Assessment of the course syllabus and contents by the teachers using a questionnaire designed by the Quality Assurance Unit of the university at the end of the semester. ▪ Regular meeting and discussion of the course content between the Head of Department and the teaching staff of the course (for theory and practice). |
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8- Processes for Improvement of Teaching.



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| | <ul style="list-style-type: none"> Revision of the course specification and its teaching strategies every three academic years after consideration of all issues raised by the teachers and/or students during regular meetings and discussions. Exploring any possible defects in the course that might be encountered by the teaching staff and their mitigation in subsequent improved versions of course specification. |
| 9- Processes for Verifying Standards Of Students' Achievement | |
| | <ul style="list-style-type: none"> Checking of a sample of students' work by an independent faculty member. Periodic exchange and check marking of a sample of students' assignments with a faculty member from another institution. Adoption of scoring rubrics to assess the students' achievement (both for ongoing or summative assessments). Regular follow-up of laboratory logbooks to assess the practical achievement of students. |
| 10- Procedures for Periodically Reviewing of Course Effectiveness and Planning for Improvement | |
| | <ul style="list-style-type: none"> Student rating and feedback Peer rating and feedback Regular meeting of the Curriculum Committee of the faculty. |
| 6- Course Development Plans | |
| | <ul style="list-style-type: none"> Conducting regular workshops for the staff for improving their course specification skills. Regular revision of course specification and syllabus items. |

XIX. Course Policies: (including plagiarism, academic honesty, attendance etc)

The University Regulations on academic misconduct will be strictly enforced. Please refer to -----

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| 1 | <p>Class Attendance:</p> <ul style="list-style-type: none"> Attendance of all lectures and practical sessions is required. Unexcused absence exceeding 25% of the lectures or practical sessions will disqualify the student from entering the final exam. |
| 2 | <p>Tardy:</p> <p>- Roll will be called in the very beginning of each lecture and practical class. Retardation for more than three weeks without a reasonable excursion, the student involved shall not be allowed to attend the class any longer and consequently shall be considered to be absent.</p> |



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| 3 | Exam Attendance/Punctuality: <ul style="list-style-type: none">Exam attendance is obligatory unless being excused by the department and faculty.Absence from assignments or exams will be dealt with according to the general policy of the university. |
| 4 | Assignments & Projects: <ul style="list-style-type: none">Assignments: Written and oral; Laboratory logbook signed by the responsible demonstrator.Projects: Not applicable. |
| 5 | Cheating: <ul style="list-style-type: none">Punishment of cheating will be according to the general policy of the university in this respect. |
| 6 | Plagiarism: <ul style="list-style-type: none">Plagiarism in written essays, reports, etc. is not accepted, and students who plagiarize the works of others will be punished according to the general policy of the university. |
| 7 | Other policies: <ul style="list-style-type: none">General policies of the Students' Affairs of the University and the Quality Assurance Unit. |