

**Kingdom of Saudi Arabia**  
**The National Commission for**  
**Academic Accreditation & Assessment**



**COURSE SPECIFICATION**

**(Green Chemistry, 402490-2)**

**1435 / 1436 H**

## Course Specification

Institution: <b>Umm Al-Qura University</b>
College/Department: <b>Faculty of Applied Sciences / Chemistry Department</b>

### A. Course Identification and General Information

1. Course title and code: <b>Green Chemistry, 402490-2</b>
2. Credit hours: <b>2 hrs. (theoretical)</b>
3. Program(s) in which the course is offered. (If general elective available in many programs indicate this rather than list programs)  <b>Industrial Chemistry</b>
4. Name of faculty member responsible for the course:  <b>Prof. Dr Dr. Mohamed Rabie</b>
5. Level/year at which this course is offered: <b>7<sup>th</sup> / fourth year</b>
6. Pre-requisites for this course (if any): <b>Introduction to Polymer Science</b>
7. Co-requisites for this course (if any):
8. Location if not on main campus:

### B. Objectives:

<b>1. Summary of the main learning outcomes for students enrolled in the course:</b>  Introduce the concept and discipline of green chemistry and place its growth and expansion in a historical context from its birth in the early 1990's and further demonstrate the necessity and viability of the methods of green chemistry to the chemical sciences and related disciplines. Introduce the tools of green chemistry including the use of alternative feedstocks or starting materials, reagents, solvents, target molecules, and catalysts. Demonstrate how to evaluate a reaction or process and determine "greener" alternatives. Focus heavily on the application of innovative technology the development of "greener" routes to improve industrial processes and to produce important products.
<b>2. Briefly describe any plans for developing and improving the course that are being implemented. (eg increased use of IT or web based reference material, changes in content as a result of new research in the field):</b>

- Using smart classes for teaching in lectures.
- The students will be encouraged to prepare an essay or a report from literature by using the library, data base services, and/or internet to follow up and update the new topics of the green chemistry.

**C. Course Description (Note: General description in the form to be used for the Bulletin or Handbook should be attached):**

Lecture	Topics to be Covered		
	Topic	No of Weeks	Contact hours
1	Introduction to Green Chemistry	1	2
2	12 principles of green chemistry	2	4
3	Innovative green Technologies: Microwave, Ultrasound.....	1	2
4	Green synthetic methods: Solventless Reactions and Reactions in Water.	1	2
5	Green synthetic methods: Natural catalyst	1	2
6	Green synthetic methods: Ionic liquids – solvents of the future (synthesis, applications, recycling....)	2	4
7	Green synthetic methods: Reactions using solar energy	1	2
8	Green synthetic methods: Photochemistry reactions	1	2
9	Exam 1	1	2
10	Green synthetic methods: Reactions with microwave	1	2
11	Green synthetic methods: Reactions ultrasounds	1	2
12	Challenges and Prospects of Green Chemistry	1	2

13	Revision	1	2
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**2. Course components (total contact hours per semester):**

<b>Lecture:</b> 28	<b>Tutorial:</b> -	<b>Practical/Fieldwork/Internship:</b> -	<b>Other:</b> -
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**3. Additional private study/learning hours expected for students per week. (This should be an average for the semester not a specific requirement in each week): -**

**4. Development of Learning Outcomes in Domains of Learning**

**For each of the domains of learning shown below indicate:**

- A brief summary of the knowledge or skill the course is intended to develop;
- A description of the teaching strategies to be used in the course to develop that knowledge or skill;
- The methods of student assessment to be used in the course to evaluate learning outcomes in the domain concerned.

**a. Knowledge:**

**(i) Description of the knowledge to be acquired:**

- 1- Understanding the aromaticity rules in organic compounds.
- 2- Understand of different types of aromatic and poly aromatic compounds.
- 3- Knowledge and understanding the chemical and physical properties of benzene.
- 4- Understanding basic rules of reactivity and orientation in electrophilic substitution reactions.
- 5- Knowledge of chemical reactions of different classes of aromatic compounds.
- 6- Understanding the mechanisms of electrophilic aromatic substitution in different classes of aromatic compounds and polyaromatic compounds
- 7- Understanding of classification of heterocyclic compounds.
- 8- Knowledge of basics of nomenclature of different classes of heterocyclic compounds
- 9-Understanding the chemical reactivity of the heterocyclic compounds

10-Memorize the different method of synthesis of heterocyclic compounds

11-Understanding Basicity and acidity in heterocyclic compounds

12-Knowledge of Reactions of five-, six-membered and their benzofused heterocyclic compounds: electrophilic substitution, nucleophilic substitution and cycloaddition reactions.

**(ii) Teaching strategies to be used to develop that knowledge:**

- Using open discussion to link the previous knowledge to the current and future topics.
- The students use the internet to prepare an essay about a recent advances related to the course of aromatic chemistry and heterocyclic chemistry.

**(iii) Methods of assessment of knowledge acquired:**

- Homework .
- Oral tests.
- Assignments.

**b. Cognitive Skills:**

**(i) Cognitive skills to be developed**

- To acquire skills to different types of aromatic and heterocyclic compounds.
- To acquire skills to know different classes of heterocyclic molecules.
- Developing skills of drawing and nomenclature of aromatic and heterocyclic compounds by IUPAC rules.
- Understanding of the different types of organic reactions of aromatic and heterocyclic compounds.
- Understanding of the properties of aromatic and heterocyclic compounds.

**(ii) Teaching strategies to be used to develop these cognitive skills:**

- Using brain storming at the beginning of each lecture in order to stimulate the students towards the new topic of the course.
- Enhancing open discussion during the lecture.

**(iii) Methods of assessment of students cognitive skills:**

Assignments and homework.

**c. Interpersonal Skills and Responsibility:****(i) Description of the interpersonal skills and capacity to carry responsibility to be developed:**

- Divide the student in to teams to perform some joint reports.
- The development of the student to accepts the opinion of his colleague in his participation to perform an active presentation for the topic related to the course, and evaluate the results to find out the response of students for the collective cooperation.

**(ii) Teaching strategies to be used to develop these skills and abilities:**

- Encourage the solving problems in groups during lecture.
- Making open discussion about certain recent topic of the course.

**(iii) Methods of assessment of students interpersonal skills and capacity to carry responsibility:**

Homework and group reports.

**d. Communication, Information Technology and Numerical Skills:****(i) Description of the skills to be developed in this domain:**

- Communicate effectively in oral and written forms.
- Using information and communication technologies.
- Using basic mathematical and statistical techniques.

**(ii) Teaching strategies to be used to develop these skills:**

- ❖ Using computer lab.
- ❖ Visiting the Central Library.
- ❖ Using international information network.
- ❖ Visiting research centers.

**(iii) Methods of assessment of students numerical and communication skills:**

<ul style="list-style-type: none"> <li>○ Ask questions in the tests to explanation for simple statistical information.</li> <li>○ Assessing the duties associated with suitable use of communication skills and numerical.</li> </ul>
<b>e. Psychomotor Skills (if applicable):</b>
<b>(i) Description of the psychomotor skills to be developed and the level of performance required:</b> Non-requirement in the curriculum.
<b>(ii) Teaching strategies to be used to develop these skills:</b> Non-requirement in the curriculum.
<b>(iii) Methods of assessment of students psychomotor skills:</b> Non-requirement in the curriculum.

<b>5. Schedule of Assessment Tasks for Students During the Semester:</b>			
<b>Assessment</b>	<b>Assessment task (eg. essay, test, group project, examination etc.)</b>	<b>Week due</b>	<b>Proportion of Final Assessment</b>
<b>1</b>	Class activities, Attendances and Duties	Throughout the Term	<b>10%</b>
<b>2</b>	Mid-Term Exam (s)	5-14	<b>40%</b>
<b>3</b>	Final Exam	End of the Term	<b>50%</b>
<b>4</b>	<b>Total</b>		<b>100%</b>

#### **D. Student Support:**

<b>1. Arrangements for availability of faculty for individual student consultations and academic advice. (include amount of time faculty are available each week):</b> <ul style="list-style-type: none"> <li>• We have faculty members to provide counseling and advice.</li> <li>• Office hours: During the working hours weekly.</li> <li>• Academic Advising for students.</li> </ul>
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#### **E. Learning Resources:**

<b>1. Required Text(s):</b> Physical Organic chemistry, Abdullaziz Kojh and Ahmed Shwali.
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**2. Essential References:**

1-Lancaster, M.; *Green Chemistry an Introductory Text*, Royal Society of Chemistry, Cambridge, UK 2002. ISBN 0-85404-620-8.

2- Cann, M.C.; Connelly, M.E. *Real World Cases in Green Chemistry*, American Chemical Society: Washington DC. 2000. ISBN 0-8412-3733-6 (Paperback) (RWCGC).

3- Anastas, P. T.; Warner, J. C. *Green Chemistry: Theory and Practice*. Oxford Univ. Press: Oxford, 1998.

Matlack, A. S. *Introduction to Green Chemistry*. Marcel Dekker: New York, 2001

**3- Recommended Books and Reference Material (Journals, Reports, etc) (Attach List):**

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**4- Electronic Materials, Web Sites etc...:**

- <http://www.chemweb.com>
- <http://www.sciencedirect.com>
- <http://www.rsc.org>

**5- Other learning material such as computer-based programs/CD, professional standards/regulations:**

- Microsoft PowerPoint, Microsoft Word, Microsoft Excel.
- Videos on organic chemistry.

**F. Facilities Required:**

**Indicate requirements for the course including size of classrooms and laboratories (ie number of seats in classrooms and laboratories, extent of computer access etc.):**

**1. Accommodation (Lecture rooms, laboratories, etc.):**

- Classrooms capacity (30) students.
- Providing hall of teaching aids including computers and projector.

- **Computing resources:** Room equipped with computer and projector

**3. Other resources (specify --eg. If specific laboratory equipment is required, list requirements or attach list):**

No other requirements.



## **G. Course Evaluation and Improvement Processes:**

<p><b>1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching:</b></p> <ul style="list-style-type: none"><li>➤ Complete the questionnaire evaluation of the course in particular.</li></ul>
<p><b>2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department:</b></p> <ul style="list-style-type: none"><li>✓ Observations and the assistance of colleagues.</li><li>✓ Independent evaluation for extent to achieve students the standards.</li><li>✓ Independent advice of the duties and tasks.</li></ul>
<p><b>3. Processes for Improvement of Teaching:</b></p> <ul style="list-style-type: none"><li>• Workshops for teaching methods.</li><li>• Providing new tools for learning.</li><li>• The application of e-learning.</li><li>• Exchange of experiences internal and external.</li></ul>
<p><b>4. Processes for Verifying Standards of Student Achievement (eg. check marking by an independent faculty member of a sample of student work, periodic exchange and remarking of a sample of assignments with a faculty member in another institution):</b></p> <ul style="list-style-type: none"><li>▪ Check marking of a sample of exam papers, or student work.</li><li>▪ Exchange corrected sample of assignments or exam basis with another staff member for the same course in other faculty.</li></ul>
<p><b>5. Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement:</b></p> <ul style="list-style-type: none"><li>❖ Periodic Review of the contents of the syllabus and modify the negatives.</li><li>❖ Consult other staff of the course.</li><li>❖ Hosting a visiting staff to evaluate of the course.</li><li>❖ Workshops for teachers of the course.</li></ul>