Course Specification

(Postgraduate Programs)

Course Title:	**Physical Applications of Green Chemistry**
Course Code:	**CHM 6248**
Program:	Master of science in chemistry
Department:	Chemistry
College:	Science
Institution:	Imam Mohammad Ibn Saud Islamic University
Version:	*Course Specification Version Number*
Last Revision Date:	*Pick Revision Date.*

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A. General information about the course:

1. Course Identification:

1. Credit hours: 3 (3 Lectures, 0 Lab, 0 Tutorials)				
2. Course type				
A.	☐University	☐College	☐Department	☐Track
B.	☐Required		☒ Elective	
3. Level/year at which this course is offered: Level 1/Year 2				

4. Course General Description:

This course will provide a wealth of information to chemistry students involved in chemical synthesis and processing at the research, applied, and management levels and will also act as a catalyst in stimulating many more chemists to become involved in the design and use of chemical syntheses and processes in an environmentally responsible manner.

5. Pre-requirements for this course (if any):

Advanced Physical Chemistry – CHM 6141

6. Pre-requirements for this course (if any):

None

7. Course Main Objective(s):

- Know the environmental status and evolution and the Pollution and its prevention measures
- Understand the emerging greener technologies and alternative energy sources
- Be an expertise global warming and its effects
- Learn about the control and remedial measures of the greenhouse effect
- Know about designing greener processes and industrial case studies.

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100 %
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)……**	0
	Total	45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To recall knowledge of the principles and concepts of Green Chemistry**	**K1. *Phy.*; K3. *Phy.***	▪ Five hours/week lectures. ▪ Self-study Home-exam.	▪ Regular Exams ▪ Assignments ▪ Short Quizzes ▪ Oral Discussion Participation.
1.2	**To state the important application of Catalysis in Green Chemistry and Organic Solvents environmentally benign solutions and Renewable Resources.**	**K1. *Phy.*; K2. *Phy.*; K3. *Phy***	▪ Five hours/week lectures. ▪ *Think* to justify application of Catalysis in Green Chemistry and Renewable Resources, using available references (SDL) online. Open discussion.	▪ Oral Discussion marks ▪ Literatures Survey ▪ Mini-seminar. ▪ Participation.
1.3	**To outline the designing greener processes and industrial case studies**	**K1. *Phy.*; K3. *Phy***	▪ Five hours/week lectures. Group Discussion using available references (SDL) online.	▪ *Midterm.* ▪ *Assignments.* ▪ Group Discussions. ▪ Literatures Survey ▪ Mini-seminar. Participation.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.4	**To list the renewable Resources, and Emerging Greener Technologies, and Alternative Energy Sources.**	**K1. *Phy.*; K2. *Phy.*; K4. *Phy***	▪ Five hours/week lectures. Group Discussion on Renewable Resources, and Emerging Greener Technologies, using available references (SDL) online.	▪ *Assignments* ▪ Open Discussions. ▪ Literatures Survey ▪ Mini-seminar. Participation.
2.0	**Skills**			
2.1	**To explain the concepts of green chemistry and its applications.**	**S1. *Phy.*; S4. *Phy.***	▪ Lectures activity ▪ Self-study. Deep discussion on concepts and principles of green chemistry and its applications.	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Open Discussions. ▪ Participation Mini -seminar.
2.2	**To analyze emerging greener technologies and alternative energy sources needs and solutions.**	**S1. *Phy.*; S2. *Phy.*; S3. *Phy.***	▪ Practice some examples emerging greener technologies analysis achieving. ▪ Brainstorming . Self-study	▪ Questions in Lectures. ▪ Participation ▪ Oral Discussion Short Quizzes.
2.3	**To summarize Waste, Production, Problems and Prevention and treatment methods to act as sustainable material in green way.**	**S1. *Phy.*; S2. *Phy.***	▪ Lectures ▪ Oral Discussions. ▪ Brainstormin g. Self-study	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Oral Discussion. Participation.
2.4	**To operate communication to Green Chemistry as a tool for more health environment, and its applications, accompanying writing**	**S1. *Phy.*; S4. *Phy.***	▪ Group Discussion and Assignments. ▪ Suggest several examples of Green Chemistry as a	▪ Oral Discussion, Quizzes, and Exams. ▪ Giving marks for Oral

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	of mini- Reports, operating electronic mail, and Network in communicating with others.		tool for healthy environment, for reading, writing, and oral presentation in groups. Encourage students to use electronic mail to submit Home Exams and Assignments	Discussion in Lectures. Marks given for Assignments
3.0	**Values, autonomy, and responsibility**			
3.1	**To perform a scientific presentation, research, and work independently and integrate with a collaborated group, Using IT to acquire, analyze, and communicate information.**	**V1. *Phy.***	▪ Brainstorming. ▪ Exercises ▪ Group Discussion. ▪ Team work.	▪ Oral Discussion. ▪ Group Discussion ▪ Assignments.
3.2	**To demonstrate his ability to the effectively collaboration and inter-professionalism in class discussions or team works, as well as independently.**	**V1. *Phy.*; V2. *Phy*.**	▪ Small Group tasks ▪ Open discussion at classroom. ▪ Office hour guiding. Group Presentation of mini-projects.	▪ Participation ▪ Homework's Mini-project(s).

C. Course Content:

No	List of Topics	Contact Hours
1.	***Principles and Concepts of Green Chemistry***: Introduction on Green Chemistry. Reducing Toxicity: Measuring Toxicity	**4**

2.	***Waste: Production, Problems and Prevention***: Introduction, Some Problems Caused by Waste, Sources of Waste from the Chemical Industry, The Cost of Waste, Waste Minimization Techniques: Physical Treatment, Chemical Treatment, Biotreatment Plants**.**	**5**
3.	***Catalysis and Green Chemistry:*** Introduction to Catalysis, Heterogeneous Catalysts: Comparison of Catalyst Types, Basics of Heterogeneous Catalysis, Zeolites and the Bulk Chemical Industry, Heterogeneous Catalysis in the Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Homogeneous Catalysis, Biocatalysis, Photocatalysis.	**8**
4.	***Organic Solvents:*** Environmentally Benign Solutions: Organic Solvents and Volatile Organic Compounds, Solvent-free Systems, Water as a Reaction Solvent: Water-based Coatings, Ionic Liquids: Ionic Liquids as Catalysts, Ionic Liquids as Solvents.	**5**
5	***Renewable Resources:*** Biomass as a Renewable Resource, Energy: Fossil Fuels, Energy from Biomass, Solar Power, Other Forms of Renewable Energy, Fuel Cells, Chemicals from Renewable Feedstocks: Chemicals from Fatty Acids, Polymers from Renewable Resources, Some Other Chemicals fiom Natural Resources.	**4**
6	***Emerging Greener Technologies and Alternative Energy Sources:*** Design for Energy Efficiency, Photochemical Reactions Processes: Advantages of and Challenges Faced by Photochemical, Examples of Photochemical Reactions, Chemistry Using Microwaves: Microwave Heating, Microwave-assisted Reactions, Sonochemistry and Green Chemistry, Electrochemical Synthesis: Examples of Electrochemical Synthesis**.**	**7**
7	***Designing Greener Processes:*** Conventional Reactors: Batch Reactors, Continuous Reactors, Inherently Safer Design: Minimization, Simplification, Substitution, Moderation, Limitation, Process Intensification: Some PI Equipment.	**6**
8	***Industrial Case Studies***: A Brighter Shade of Green, Greening of Acetic Acid Manufacture, EPDM Rubbers, Vitamin C, Leather Manufacture: Tanning, Fat liquoring, dyeing to be Green: Some Manufacturing and Products Improvements, Dye Application, Polyethene: Radical Process, Ziegler-Natta Catalysis, Metallocene Catalysis, Eco-friendly Pesticides: Insecticides.	**6**
Total		45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Class Activities (Open Discussion, Mini-reports, Oral Presentation, solving questions)	weekly	30 %
2.	Midterm Exam	9th week	30 %
3.	Final Exam	17 th week	40 %
4.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	***Green Chemistry, an introduction,*** Lancaster, M., R.S.C paperbacks Cambridge, 2002. ISBN-13: 978-1847558732 ***Green Chemistry Education. Changing the Course of Chemistry,*** Anastas, P. T.; Levy, I. J.; Parent, K. E. American Chemical Society 2009, ISBN-13: 978-0841274471
Supportive References	None
Electronic Materials	• Green Chemistry • Environmental Science & Technology • Journal of Hazardous Materials • ACS Sustainable Chemistry & Engineering • Chemosphere Saudi Digital Library
Other Learning Materials	• Blackboard • Multimedia associated with the text book and the relevant websites.

3. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology equipment (projector, smart board, software)	**The rooms are equipped with data show, Smart Board,** **WI-FI access.**
Other equipment (depending on the nature of the specialty)	**None**

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of students assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory-GCC)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
	Course Responsible	
The extent to which CLOs have been achieved	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.

Assessment Areas/Issues	Assessor	Assessment Methods
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	Council of Chemistry Department
REFERENCE NO.	10 (No. 2/10)
DATE	21/04/1444- 15/11/2022