Course Specification

(Postgraduate Programs)

Course Title:	**Chemistry of Organic Polymers and Petrochemicals**
Course Code:	**CHM 6226**
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.*

Table of Contents

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 1Year 2)				
4. Course General Description:				
This course covers selected special topics pertinent to research in polymer sciences and petrochemicals, covering the synthesis and properties of polymers, polymer forming processes, polymers applications and petrochemicals.				
5. Pre-requirements for this course (if any)**:**				
6121				
6. Co-requirements for this course (if any)**:**				
7. Course Main Objective(s):				
• **Develop an advanced understanding of organic polymer synthesis and relevant technology used.** • **Outline the polymer synthesis methods and modification or additives occurred.** • **Account for different classes of additives impact mechanisms.** • **Recognize the reaction mechanisms of polymerization process.** • **Choose analytical methods to characterize and interpret the polymerization reaction and the product.** • **Be familiar with structure, mechanical properties of polymers.** • **Summarize and account for Polymers for Advanced Technologies and Polymer Nanocomposites.**				

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 PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To recognize advanced Organic Synthesis of Polymers and Polymerization steps.**	**K1. *Org*.; K2. *Org*. K3. *Org*.**	▪ **Five hours/week lectures.** ▪ **Self-study Home-exam.**	▪ **Regular Exams** ▪ **Assignments** ▪ **Short Quizzes** ▪ **Oral Discussion Participation.**
1.2	**To memorize the characterization and properties of Polymer Spectroscopically,**	**K1. *Org*.; K2. *Org*. K4. *Org*.**	▪ **Five hours/week lectures.** ▪ **Think, and justify the full characterization**	▪ **Oral Discussion marks** ▪ **Literatures Survey**

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	Analytically and Mechanically.		and properties of polymer, using available references (SDL) online. Open discussion.	▪ Mini-seminar. Participation.
1.3	To outline Advanced Technology of Polymers, Polymer Nano-Composites and its impact in industry and life	K1. *Org*.; K2. *Org*. K3. *Org*.	▪ Five hours/week lectures. Group Discussion on advanced technology of polymers and impact on KSA using available references online using available references (SDL)	▪ Midterm. ▪ Assignments. ▪ Group Discussions. ▪ Literatures Survey ▪ Mini-seminar. Participation.
1.4	To state Feedstock Composition and Properties of Petrochemicals	K3. *Org*.; K4. *Org*.	▪ Five hours/week lectures. Group Discussion using available references (SDL.	▪ Assignments ▪ Open Discussions. ▪ Literatures Survey ▪ Mini-seminar. Participation.
2.0	**Skills**			
2.1	To analyze the isolated results of spectroscopy, analytical and mechanical measurements.	S1. *Org*.; S2. *Org*. S3. *Org*.	▪ Lectures activity ▪ Self-study Deep discussion on isolated polymers analysis.	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Open Discussions. ▪ Participation Mini -seminar.
2.2	To compare between polymerization types and the mechanical properties of isolated polymers	S1. *Org*.; S2. *Org*.	▪ Practice on polymer types its mechanical properties. ▪ Brainstorming. Self-study.	▪ Questions in Lectures. ▪ Participation ▪ Oral Discussion.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
				Short Quizzes.
2.3	To summarize advanced technology and application of polymers and its impact in industry and life	S1. *Org*.; S2. *Org*.	▪ Lectures ▪ Oral Discussions. ▪ Brainstorming. Self-study	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Oral Discussion. Participation.
2.4	To demonstrate Oral Communication for different the polymerization reactions techniques and their applications, accompanying writing of mini-Reports, operating electronic mail, and Network in communicating with others.	S1. *Org*.; S3. *Org*. S4 *Org*.	▪ Group Discussion and Assignments ▪ Introduce several examples for polymerization reactions techniques and its applications, which will require reading, writing, and oral presentation. Encourage students to use electronic mail to submit Home Exams and Assignments	▪ Oral Discussion. ▪ Quizzes, and Exams. ▪ Giving marks for Oral 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. *Org*.	▪ Brainstorming. ▪ Exercises ▪ Group Discussion. Team work.	▪ Oral Discussion. ▪ Group Discussion ▪ Assignments.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
3.2	To appraise effectively the collaboration and inter-professionalism in class discussions or team works, as well as independently.	V1. *Org.*; V2. *Org*.	▪ 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.	*Recall Basic Concepts*: Polymer Types, Classification of Polymers, Nomenclature, Polymer States and Properties.	3
2.	*POLYMER SYNTHESIS AND MODIFICATION, Step-Growth Polymerization*: Polymerization Kinetics, Inorganic Condensation Polymers, Dendrimers, Thermoset Polycondensation Polymers, Controlled Molecular Weight Condensation Polymers.	3
3.	*Free Radical Polymerization:* Basic Mechanism, Other Free Radical Reactions, Kinetics and Polymerization Rate, Molecular Weight and Molecular Weight Distribution, Controlled Radical Polymerization.	3
4.	*Coordination Polymerization:* Polymer Types, Catalyst Types, Coordination Polymerization Mechanism. *Copolymerization:* Types of Copolymers, Copolymer Composition, Reaction Conditions.	3
5.	*Anionic Polymerization:* Living Anionic Polymerization, General Considerations, Kinetics and Mechanism of Polymerization, Stereochemistry, Copolymerization of Styrenes and Dienes, Synthetic Applications of Living Anionic Polymerization.	3
6.	*Cationic Polymerizations:* Carbo-cationic Polymerization, Cationic Ring-Opening Polymerization. *Crosslinking:* Background on Polymer Networks, Main Chemical Routes for Synthesis of Polymer Networks, Characterization of Polymer Networks and Gels.	3
7.	*Polymer Additives: Antioxidants, PVC Heat Stabilizers, Light Stabilizers, Flame Retardants, Plasticizers, Scavenging Agents, Additives to Enhance Processing, Additives to Modify Plastic Surface Properties, Additives to Modify Polymer Chain Structures, Additives to Influence Morphology and Crystallinity of Polymers, Antimicrobials, Additives to*	6

	Enhance Thermal Conductivity, Active Protection Additives, Animal Repellents, Markers, Blowing Agents, Trends in Polymer Additives	
8.	*New Polymerization Processes: Polymerizations in Benign or Green Solvents, Alternative Energy Sources for Polymerization Processes, Polymerization in Micro reactors*	2
9.	*Polymer Spectroscopy and Compositional Analysis: Elemental Analysis, Infrared Spectroscopy, Nuclear Magnetic Resonance of Polymers in Solution, Mass Spectrometry. Small-Angle X-Ray Scattering of Polymer Systems: Polymer Morphology, Small-Angle X-Ray Scattering, Analysis in Reciprocal Space, Analysis in Real Space.*	4
10.	*Structure and Mechanical Properties of Polymers: Structure of Polymer Chains, Mechanical Properties of Polymers, Mechanical Properties of Polymer Composites.*	3
11.	*Principles of Polymer Processing: Compounding, Extrusion, Bottle Blowing, Injection Molding. Polymer Blends: Miscibility in Polymer Blends, Compatibility in Polymer Blends, Preparation of Polymer Blends, Factors Influencing the Morphology of a Polymer Blend, Properties of Polymer Blends, Applications of Polymer Blends.*	3
12.	*POLYMERS FOR ADVANCED TECHNOLOGIES, Conducting Polymers: The Structures of Conducting Polymers, Charge Storage, Doping, Charge Transport, Syntheses, Conducting Polymers.*	3
13.	*Dendritic Polymers: Dendrimers, Hyper branched Polymers, Dendri graft Polymers. Polymer Nanocomposites: Polyester/Clay Nanocomposites, Polyolefin/Clay Nanocomposites, Polystyrene/Clay Nanocomposites, Polymer/Carbon Black Nanocomposites, Nanoparticles of Barium Sulfate, Polymer/Graphene Nanocomposites.*	3
14.	*PETROCHEMICALS* *The Petrochemical Industry: The Petrochemical Industry, Petrochemicals, Primary Petrochemicals, Products and End Use, Production of Petrochemicals.* *Feedstock Composition and Properties: Natural Gas, Composition and Properties, Natural Gas Liquids, Gas Condensate, Gas Hydrates, Other Types of Gases, Biogas, Coalbed Methane, Coal Gas, Geopressurized Gas, Landfill Gas, Refinery Gas, Synthesis Gas, Tight Gas, Petroleum, Composition and Properties., Opportunity Crude Oil, High Acid Crude Oil, Foamy Oil, Tight Oil, Other Petroleum-Derived Feedstocks, Naphtha, Kerosene, Fuel Oil, Gas Oil.*	3
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 (1)	9th week	30%
4.	Final Exam	17th week	40%
5.	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	*Handbook of Polymer Synthesis, Characterization, and Processing,* Saldívar-Guerra, E.; Vivaldo-Lima, E John Wiley & Sons, Inc., 2013. ISBN: 9780470630327. *Handbook of Petrochemical Processes*, James G. Speight, Taylor Francis. 2019. ISBN: 9780429155611.
Supportive References	*Introduction to Polymer Science and Chemistry: A Problem Solving Approach*, M. Chanda, CRC Press, (2013). ISBN 9781466553842 - CAT# K15289 *Textbook of Polymer Science*, F. W. Billmeyer, 3rd Ed., Wiley-Interscience, (1984). ISBN: 978-0-471-03196-3 *Polymer Science and Technology*, J. R. Fried, , 2nd Ed., Prentice-Hall, (2003). ISBN-10: 0137039557
Electronic Materials	• Progress in Polymer Science • Polymer Chemistry • European Polymer Journal • Journal of Polymer Science, Part A: Polymer Chemistry Saudi Digital Library
Other Learning Materials	• Blackboard • Multimedia associated with the text book and the relevant websites

2. 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.

Items	Resources
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	Course Responsible	Direct: Exams - Course e-Portfolio. Indirect: Second examiner checklist-Course report.
	Program Leaders	Indirect: Exams.
The extent to which CLOs have been achieved	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	
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