German Jordanian University

School of Applied Medical Science

Department of Pharmaceutical and Chemical Engineering

Bachelor of Science in Pharmaceutical and Chemical Engineering (Dual-Study Track)

Study Plan 2022

I. Program Vision

Leadership in the field of pharmaceutical and chemical engineering in terms of teaching, scientific research, and social impact.

II. Program Mission

Providing students with distinctive education in pharmaceutical and chemical engineering based on hybrid integration of Pharmacy and Chemical Engineering to meet the needs of the pharmaceutical and chemical industries and provide novel and sustainable solutions to national and global challenges.

III. Program General Description

The Department of Pharmaceutical and Chemical Engineering (PCE) at the German Jordanian University (GJU) offers a five-year bachelor's degree program. The 180 credit hours (Cr Hr) are divided as follows: 21 Cr Hr represent compulsory university requirements as listed in Table 1.2, 6 Cr Hr represent dual study university requirements that listed in Table 1.3, 27 CH school requirements as listed in Table 2, 104 Cr Hr compulsory program requirements as listed in Table 3.1, 10 Cr Hr ancillary program requirements as listed in Table 3.2, and finally, 12 Cr Hr elective program requirements that must be selected from Table 3.3.

The PCE program at GJU is unique at the local and regional level, as it combines the disciplines of pharmacy and chemical engineering to prepare graduates to meet the needs of both the pharmaceutical and chemical industries. The PCE department is distinguished by its emphasis on practical and applied aspects of engineering and pharmaceutical sciences, with 12 laboratories equipped with the state-of-the-art equipment allowing for practical implementation of engineering principles that satisfies the needs of the pharmaceutical and chemical industries. Moreover, in the vicinity of the university, there are numerous pharmaceutical plants where our students can train, and our graduates can find suitable job opportunities.

At the Bachelor's level, all students in the Department of Pharmaceutical and Chemical Engineering must spend one year (fourth or fifth year) in Germany, studying for one semester at a partner university and fulfilling twenty weeks' internship in German companies or industries as a compulsory requirement of graduation. Additionally, the students may conduct their graduation projects in Germany.

Emphasizing the applied approach, the department offers a Dual Study Track for undergraduate program in Pharmaceutical and Chemical Engineering. In this track, students work and study at the same time. It is a reaction to two challenges: how to raise the employability of university graduates and how to provide the labor market with qualified employees who possess sound skills in practice and theory. Students will take place in alternating phases at two places; the GJU and one of our partner companies. Students will take their courses in the first and second semesters regularly at GJU and then spend the summer time at the partner company facilities for the first three years. The fourth and fifth years are similar to the regular track.

Graduates of the PCE program are qualified and prepared to work in a variety of labor markets, including Jordanian, German, and International markets. Graduates have the opportunity to work in a variety of industries, including pharmaceuticals, cosmetics, biochemicals, chemicals, refineries, petrochemicals, oil and gas, environmental, water and wastewater treatment, fertilizers, phosphates, potash, food, paints, polymers, and plastics, paper, and cement.

In addition, pharmaceutical and chemical engineering discipline enable graduates to take several roles in the industry. Some of these roles might include operation engineer, manufacturing engineer, process design

engineer, total quality management (GMP, validation, quality assurance, quality control), safety engineer, researcher, research and teaching assistant, sales engineer, marketing engineer, project manager, consultant, quality assurance engineer/manager, and quality control engineer/manager.

The following values constitute the main values that are emphasized throughout the program:

1. **Interdisciplinary program**: Establishing a learning environment that embraces diversity.
2. **Applied education**: Linking theory to application.
3. **Innovation**: promotes creative thinking and finding innovative solutions.
4. **Ethical principle**: Embodiment of ethical principles in our education, research, practice and service activities.

IV. Program Objectives

The educational objectives of the Pharmaceutical and Chemical Engineering Program at the German Jordanian University are to produce graduates who possess the following qualities:

1. A solid foundation of scientific knowledge and required skills in the labor market.
2. Efficiency in working in various pharmaceutical and chemical industries.
3. High ethical and professional principles.
4. The ability to reach leadership roles in various fields of specialization.
5. Continuous learning.
6. Ability to provide new and sustainable solutions to national and global challenges.

V. Learning Outcomes

Upon completion of this program, the student will have the following outcomes:

1. An ability to apply the principles of chemistry, physics, mathematics, and engineering in the development of various processes in the pharmaceutical and chemical industries.
2. An ability to communicate effectively through proficiency in three languages (Arabic, English, and German) and applying various communication skills.
3. An ability to work in various labor markets, such as the Jordanian, German and international markets.
4. An ability to apply ethical and professional principles in the presented technical solutions.
5. An ability to work in teams and cooperate to achieve plans and tasks.
6. An ability to analyze data, draw conclusions and use present new solutions.
7. An ability to learn continuously.

VI. Framework for B.Sc. Degree (180 credit hours)

Classification	Credit Hours			ECTS		
	Compulsory	Elective	Total	Compulsory	Elective	Total
University Requirements	21	6	27	31	6	37
School Requirements	27	0	27	43	0	43
Program Requirements	114	12	126	200	20	220
Total	**162**	**18**	**180**	**274**	**26**	**300**

1. University Requirements: (27 credit hours)

1.1. Prerequisite courses (6 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Prerequisites / Co-requisites
				Lect	Lab	
ARB099	Arabic 99[a]	0	0	3	-	-
ENGL099	English II[a]	0	0	3	-	-
	Total	**0**	**0**	**6**	**0**	

[a] Not required for students who pass a placement test

1.2. Compulsory: (21 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
ARB100	Arabic	3	3	Online	3	-	ARB099
ENGL101	English III	1	3	Face to face	3	-	ENGL099
ENGL102	English IV	1	3	Face to face	3	-	ENGL101
ENGL201	English V	2	3	Face to face	3	-	ENGL102
ENGL202	English VI	2	3	Face to face	3	-	ENGL201
GERL101B1	German I B1 track	3	6	Face to face	9	-	-
GERL102B1	German II B1 track	3	6	Face to face	9	-	GERL101B1
GERL102B2	German II B2 track	3	6		9	-	GERL101B1
MILS100	Military Science	3	2	Online	3	-	-
NE101 NEE101	National Education National Education (English)	3	2	Online	3	-	ARB099
	Total	**21**	**31**		**39**	**0**	

1.3. Dual Study University Requirments: (6 Credit Hours)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
DS101	Practical Course I	3	3		3	-	DA
DS201	Practical Course II	3	3		3	-	DS101, DA
	Total	**6**	**6**		**6**	**0**	

DA: Department Approval

2. School Requirements: (27 Credit Hours)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
GERL201B1	German III B1 track	3	4	Face to face	6	-	GERL102B1
GERL201B2	German III B2 track	3	4		6	-	GERL102B2
GERL202B1	German IV B1 track	3	6	Face to face	9	-	GERL201B1
GERL202B2	German IV B2 track	3	6		9	-	GERL201B2
MATH099	Pre-Math	0	0	Blended	3	0	-
MATH101	Calculus I	3	5	Blended	3	0	MATH099
MATH102	Calculus II	3	5	Face to face	3	0	MATH101
PHYS103	Physics I	3	5	Blended	3	0	-
PHYS104	Physics II	3	5	Face to face	3	0	PHYS103
PHYS106	General Physics Lab	1	2	Blended	0	3	PHYS104
CS116	Computing Fundamentals	3	6	Blended	3	0	-
CS1160	Computing Fundamentals Lab	1	0	Blended	0	1	CS116
CHEM103	General Chemistry I	3	5	Face to face	3	0	CHEM106
CHEM106	General Chemistry Lab	1	0	Blended	0	3	CHEM103
	Total	**27**	**43**		**36**	**7**	

3. Program Requirements (126 credit hours)

3.1. Program Requirements (Compulsory): (104 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
GERL301B1 GERL301B2	German V B1 track German V B2 track	3 3	6 6	Face to face	9 9	-	GERL202B1 GERL202B2
GERL302REG GERL302INT GERL302B2	German VI Regular German VI Intensive German VI B2 track	3 3 3	6 6 6	Face to face	6 9 6	-	GERL301B1 ,GERL302CH GERL301B1, GERL302CH GERL301B2, GERL302CH
BIO111	Human Biology	3	5	Online	3	0	-
PCE211	Introduction to Pharmaceutical and Chemical Engineering	1	2	Blended	1	0	CHEM103
IE0121	Probability and Statistics	3	4	Face to face	3	0	MATH101
PCE212	Principles of Chemical Engineering	3	5	Face to face	3	0	PCE221 PCE211
PCE221-DS	Thermodynamics for Pharmaceutical and Chemical Engineering	3	4	Face to face	3	0	MATH102
PCE222	Fluid Mechanics for Chemical and Medical Engineers	3	5	Face to face	3	0	MATH203
PCE242	Pharmaceutical Physical Chemistry	2	5	Blended	2	0	PCE221
PCE272	Pharmaceutical Physical Chemistry Lab	1	0	Blended	0	3	PCE221, PCE242
PCE251	Analytical Chemistry	3	5	Face to face	3	0	CHEM103
PCE281	Analytical Chemistry Lab	1	0	Blended	0	3	CHEM106, PCE251
PCE2523	Microbiology	3	5	Online	3	0	BIO111
PCE282	Microbiology Lab	1	0	Blended	0	1	PCE2523
PCE254	Organic Chemistry	2	4	Blended	2	0	CHEM103
PCE311	Transport Phenomena	3	4	Face to face	3	0	PCE212, PCE222
PCE312	Separation Processes	3	5	Face to face	3	0	PCE311
PCE321-DS	Chemical Reaction Engineering	3	4	Face to face	3	0	PCE212
BM325	Automatic Control Systems for Medical Applications	3	5	Face to face	3	0	MATH205 PHYS104
BM328	Automatic Control Systems for Medical Applications Lab	1	0	Blended	0	3	BM325
PCE332	Chemical Engineering Economics	3	5	Blended	3	0	PCE212
PCE341	Pharmaceutical Organic Chemistry	2	5	Blended	2	0	PCE254
PCE371	Pharmaceutical Organic Chemistry Lab	1	0	Blended	0	3	PCE341
PCE342	Instrumental Analysis	3	5	Face to face	3	0	PCE251

PCE372	Instrumental Analysis Lab	1	0	Blended	0	3	PCE281, PCE342
PCE343	Pharmaceutical Technology – Liquid Forms	3	6	Blended	3	0	PCE242
PCE373	Pharmaceutical Technology – Liquid Forms Lab	1	0	Blended	0	3	PCE343
PCE344	Pharmaceutical Technology – Solid Forms	3	6	Blended	3	0	PCE242
PCE374	Pharmaceutical Technology – Solid Forms Lab	1	0	Blended	0	3	PCE344
PCE3513	Biochemistry	3	5	Blended	0	3	BIO111 PCE254
PCE381	Biochemistry Lab	1	0	Blended	0	3	PCE3513
PCE362	Fluid, Heat and Reaction Engineering Lab	1	3	Blended	0	3	PCE222 PCE311 PCE321
DS301	Practical Course III	0	6	Face to face	0	160HR	DS201, DA
PCE511	Unit Operations and Industrial Safety	3	5	Face to face	3	0	PCE312
PCE499	International Internship	12	30	TBD	0	0	DA
PCE5322	Quality Assurance and Process Validation	2	3	Blended	2	0	PCE344
PCE5333-DS	Hazardous Waste and Risk Management	3	5	Blended	3	0	PCE2523 PCE282
PCE541	Medicinal Chemistry	3	4	Blended	3	0	PCE3513
PCE5423	Pharmaceutical Packaging Technology	3	5	Blended	3	0	PCE343
PCE543	Pharmaceutical Plant Design	3	5	Blended	3	0	PCE312 PCE332
PCE562	Separation Processes Lab	1	3	Blended	0	3	PCE511
PCE591	Graduation Project I	1	2	Blended	0	0	DA
PCE592	Graduation Project II	2	6	Blended	0	0	PCE591
	Total	**104**	**183**				

3.2. Program Requirements (Ancillary): (10 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
IE121	Workshop	1	2	Face to face	0	3	-
MATH203	Applied Mathematics for Engineers	3	5	Face to face	3	0	MATH102
MATH205	Differential Equations	3	5	Face to face	3	0	MATH102
BM371	Numerical Methods for Engineers	3	5	Blended	2	3	-
	Total	**10**	**17**				

3.3. Program Requirements (Electives[b]): (12 credit hours)

A minimum of 12 credit hours of engineering coursework are required. This list is open for modifications based on school council decisions.

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
PCE401	Biotechnology	3	5	Blended	3	0	PCE321 PCE2523 BSC001
PCE402	Gene Technology	3	5	Blended	3	0	PCE3513 BSC001
PCE403	Nutrition	3	5	Blended	3	0	BIO111 BSC001
PCE404	Introduction to Polymer Science	3	5	Blended	3	0	PCE254 BSC001
PCE405	Colloids and Surface Chemistry	3	5	Blended	3	0	PCE242 BSC001
PCE406	Corrosion Engineering	3	5	Blended	3	0	PCE242 BSC001
PCE407	Chemical & Physical Sensors	3	5	Blended	3	0	PCE342 BSC001
PCE408	Shale Oil Production Processes	3	5	Blended	3	0	BSC001
PCE409	Introduction to Oil and Gas Production	3	5	Blended	3	0	BSC001
PCE412	Nanotechnology	3	5	Blended	3	0	PCE344 BSC001
PCE413	Membrane Separation Processes	3	5	Blended	3	0	PCE312 BSC001
PCE421	Fluid Mixing Technology	3	5	Blended	3	0	PCE222 BSC001
PCE422	Chemical Reaction Engineering II	3	5	Blended	3	0	PCE321 BSC001
PCE431	Chemical Process Safety	3	5	Blended	3	0	BSC001
PCE444	Antibiotics	3	5	Blended	3	0	PCE2523 BIO111
PCE5312	Industrial Processes Management and Industrial Safety	3	5	Blended	3	0	PCE332 BSC001
PCE445	Particle Tchnology	3	5	Blended	3	0	PCE344 BSC001
PCE446	Pharmacokinetics	3	5	Blended	3	0	PCE 321 BSC001
PCE447	Toxicology	3	5	Blended	3	0	BIO111 BSC001
PCE448	Modern Drug Forms & Delivery Systems	3	5	Blended	3	0	BIO111 BSC001
PCE491	Environmental Engineering	3	5	Blended	3	0	PCE251 BSC001
PCE492	Special Topics in Pharmaceutical and Chemical Engineering I	3	5	Blended	3	0	BSC001
PCE493	Special Topics in Pharmaceutical and Chemical Engineering II	3	5	Blended	3	0	BSC001

PCE494	Special Topics in Pharmaceutical and Chemical Engineering III	3	5	Blended	3	0	BSC001
PCE495	Special Topics in Pharmaceutical and Chemical Engineering IV	3	5	Blended	3	0	BSC001
PCE593	Special Topics in Pharmaceutical and Chemical Engineering V	2	4	Blended	2	0	BSC001
PCE594	Special Topics in Pharmaceutical and Chemical Engineering VI	1	3	Blended	1	0	BSC001
PCE595	Special Field Projects	3	5	Blended	0	0	BSC001
WEEM528	Air Pollution Control	4	5	Blended	4	0	BSC001
WEEM545	Water and Wastewater Treatment	3	5	Blended	3	0	BSC001
MGT525	Project Management	3	5	Blended	3	0	PCE332 BSC001
TME553	Reliability and Quality Control	3	5	Blended	3	0	BSC001
	Total	**12**	**20**				

[b]International Internship is a prerequisite for all elective courses

TBD: To be Determined

BSC001: Registered in Germany

VI.Module Description

Bachelor

Module Title					Module Code
Thermodynamics for Pharmaceutical and Chemical Engineering					PCE221-DS

Compulsory Module	X	**Year of Study**	2	**Semester Hours**	3
Elective Module		**Spring Semester**		**Workload**	150
Optional Module		**Winter Semester**		**ECTS**	4
Pre-university		**Summer Semester**	X	**Remedial**	

Pre-programm

Examination

Portfolio:
30% Practical project
30% Midterm exam
40% Final exam

Responsible Lecturer(s) (Instructor)

Dr. Ibrahem Altarawneh

Course	Mode of Delivery	Contact Time	Self-Study
Thermodynamics for Pharmaceutical and Chemical Engineering	Face-to-face: /Intensive	24	126

Duration of Study:
One semester.

Allocation of Workload Hours:

- Presence time in lectures: 24 hours.
- Data gathering and analysis for the project from the company: 26 hours.
- Preparation for midterm: 25 hours.
- Preparation for final exam: 25 hours.
- Prepration of the semester projects:50 hours.

Learning Outcomes:
By the end of this module, the student will be able to express the ILOs (Intended Learning Outcomes) of the module in terms of:

Knowledge and understanding**:**

By the end of this module, the student will be able to:

- Understand the differences between closed and open systems.
- Compute the thermodynamics properties of pure gases, liquids and their mixtures.
- Identify the thermodynamic equilibrium between different phases.
- Apply the first and second law of thermodynamics to determine heat and work requirements for a chemical process.

Intellectual skills:

By the end of this module, the student will be able to:

- Understand, interpret and analyse a chemical process. This can be done by classifying the process, applying the first and second laws of thermodynamic.

Professional skills:

By the end of this module, the student will be able to:

- Gain basic background needed for other courses such as Principles of Chemical Engineering, Fluid Mechanics, Separation, Unit operations, Chemical Reaction Engineering, Process Dynamic and Control.
- Adopt this knowledge in their professional applications for designing, running, and/or modifying an industrial chemical process.
- Identify and formulate problems in chemical engineering thermodynamics and suggest appropriate solutions.

General and transferable skills:

By the end of this module, the student will be able to:

- Assess their own strengths and weaknesses through group working.
- Adjust future performance in light of their self-assessment.

Module Contents:

Part I: Measured thermodynamic properties and other basic concepts, thermodynamic property tables, reversible and irreversible processes, process efficiency, PVT relationship and equations of state, empirical equations of state (van der Waals, Redlich-Kwong), generalized correlations.

Part II: The first law of thermodynamics, applications of the first law of thermodynamics to closed and open systems, thermochemical data for internal energy and enthalpy, reversible processes in closed systems, open-system energy balances, thermodynamic cycles.

Part III: Entropy and the second law of thermodynamics, directionality of processes/ spontaneity, the second law of thermodynamics, the second law of thermodynamics for closed and open systems, calculation of entropy for closed and open systems, calculation of entropy for ideal gases. The mechanical energy balance and the Bernoulli equation, vapor-compression cycles, refrigeration cycles, Carnot cycle.

Planned Learning Activities and Teaching Methods:

- Data show lectures combined with small films for clarifications.
- Open discussion sessions.
- Tutorials.
- Information collection from different sources.
- Scientific video shows.
- Reports and assignments.

Recommended or Required Reading:

Textbook:

Koretsky, M. D.: Engineering and Chemical Thermodynamics, Wiley, 2nd edition, 2012

Reference books:

- Smith, J. M., Van Ness, H. C. & Abbott, M. M.,: Introduction to Chemical Engineering Thermodynamics, McGraw-Hill, 7th edition, 2005.
- Cengel ,Y. A. & Boles, M. : “Thermodynamics: An Engineering Approach, Mc Graw-Hill, 7th edition, 2011.

Usability of the Module:

Thermodynamics is considered as the backbone of chemical engineering. The knowledge gained from this module qualifies students to undertake advanced courses in chemical engineering. The module sets base for many subjects like fluid mechanics, mass/heat transfer, and chemical reaction engineering.

Prerequisites and Co-requisites:

MATH102: Calculus II (prerequisite)

Language of Instruction:

English (or if a Flying Faculty from Germany is available, then either English or German or both)

Recommended Optional Programme Components:

None

Bachelor

Module Title	Module Code
Chemical Reaction Engineering	PCE321-DS

Compulsory Module	X	**Year of Study**	3	**Semester Hours**	3
Elective Module		**Spring Semester**		**Workload**	150
Optional Module		**Winter Semester**		**ECTS**	4
Pre-university		**Summer Semester**	X	**Remedial**	

Pre-programm

Examination

Portfolio:
30% Practical project
30% Midterm exam
40% Final exam

Responsible Lecturer(s)

Dr. Ziad Abu El-Rub

Course	Mode of Delivery	Contact Time	Self-Study
Chemical Reaction Engineering	Face-to-face/Intensive	24	126

Duration of Study:
One semester.

Allocation of Workload Hours:

- Presence time in lectures: 24 hours.
- Data gathering and analysis for the project from the company: 26 hours.
- Preparation for midterm: 25 hours.
- Preparation for final exam: 25 hours.
- Prepration of the semester projects:50 hours.

Learning Outcomes:
By the end of this module, the student will be able to:

- Develop rate laws for reactor design based on reaction data from a reactor or set of reactors.
- Make comparisons of ideal reactor types (batch, plug flow, and mixed flow).
- Predict reactor performance in situations where the observed reaction rate is significantly influenced by internal mass transfer in porous heterogeneous catalysis.

Module Contents:
The module introduces the third-year students to an overview of chemical reaction engineering. Kinetics of homogeneous reactions. Interpretation of batch reactors data. Introduction to reactor design. Ideal reactors for a single reaction. Design of single reactions. Introduction to heterogeneous reactions. Solid catalyzed reactions.

Planned Learning Activities and Teaching Methods:

- Lectures with intensive discussions;
- Exercises in class.

Recommended or Required Reading:

- Levenspiel, O.: Chemical Reaction Engineering, John Wiley & Sons, 3rd edition, 1999.
- Fogler H. S.: Elements of Chemical Reaction Engineering, Prentice-Hall International Series, 6th edition, 2020.
- Salmi, T. O., Mikkola, J.-P. & Wärnå, J. P.: Chemical Reaction Engineering and Reactor Technology, Chapman and Hall/CRC, 2nd Edition, 2019.

Usability of the Module:
This module is a building block for different courses of higher levels that form the identity of pharmaceutical and chemical engineers in terms of providing him/her with the necessary knowledge to design chemical reactors, which are the heart of chemical processes. It also helps understand the various influences that affect the design of the reactor such as temperature, reaction rate, catalyst, and mass transfer.

Prerequisites and Co-requisites:
PCE212: Principles of Chemical Engineering (prerequisite)

Language of Instruction:

English

Recommended Optional Program Components:
None

Bachelor

Module Title	Module Code
Hazardous Waste and Risk Management	PCE5333-DS

Compulsory Module	X	**Year of Study**	3	**Semester Hours**	3
Elective Module		**Spring Semester**		**Workload**	150
Optional Module		**Winter Semester**		**ECTS**	5
Pre-university		**Summer Semester**	X	**Remedial**	

Pre-Programm

Examination

Portfolio:
30% Practical project
30% Midterm exam
40% Final exam

Responsible Lecturer(s)

Prof. Dr. Munib Saket

Course	Mode of Delivery	Contact Time	Self-Study
Hazardous Waste and Risk Management	Face-to-face/Intensive	24	126

Duration of Study:
One semester.

Allocation of Work load Hours:

- Presence time in lectures: 24 hours.
- Data gathering and analysis for the project from the company: 26 hours.
- Preparation for midterm: 25 hours.
- Preparation for final exam: 25 hours.
- Prepration of the semester projects:50 hours.

Learning Outcomes:
By the end of this module, the student will be able to express the ILOs (Intended Learning Outcomes) of the module in terms of:
Knowledge and Understanding:

At the end of this Module, students will be able to:

- Know the types and classifications of hazardous waste, hazardous waste material classification and characterization.

Intellectual skills:

At the End of this Module, students will be able to:

- Identify how to manage hazardous material and understand methods of treatment of toxic materials.
- Identify the physical hazards of chemicals, and categorize chemicals according to their hazards and physical characteristics.
- Define toxicity as it relates to humans and hazardous chemicals and list the elements of risk assessment. Explain the pathways for transport of hazardous materials in various environments.

Professional and practical skills:

At the End of this Module, students will be able to:

- Understand to evaluate the capabilities of a community to effectively manage a hazardous materials incident.
- Define toxicity as it relates to humans and hazardous chemicals and list the elements of risk assessment.describe the processes involved in hazardous waste treatment and management.

Competencies:

At the End of this Module, students will be able to:

- Apply information technology skills, etc.
- Work with a team in a certain project.
- Demonstrate critical thinking and problem solving in different theoretical and practical situations.

Module Contents

A.Hazardous waste management

- Hazardous materials classification.
- Characteristics of hazardous wastes.
- Waste generation Rates by Industry.
- Hazardous waste disposal practice.
- Medical waste Disposal.
- Waste to energy.
- Jordan Waste.

B. Hazard and risk identification

- Concept definitions.
- Hazards forms.
- Human errors.
- Risk analysis.
- Health risk association with Hazardous waste.

C. Process safety management

D. Hazardous waste management programs

E. Estimation of Hazardous waste Quantity

Planned Learning Activities and Teaching Methods:

- Lectures and discussions;
- Videos about packaging;
- Presents of Projects.

Recommended or Required Reading:

- Whittaker, D.: Integrated Waste Management: A Sustainable Approach. **2018.** ISBN 978163299571
- Pichetel, J.: Waste Management Practices : Municipal, Hazardous. And Industrial, 2nd edition, CRC Press, Feb 26, **2014.**
- Kellog, K.: 100 Ways to Go Zero Waste Paperback-, Countryman Press, April 2, **2019**, ISBN-10 1682683311.
- Rao, M.N., Sultan, R., Kota, S.H.: Solid and Hazardous Waste Management, Science and Engineering, 1st edition, **2016,** ISBN eBook: 9780128097342**.**
- Environmental Materials and Waste. Resource Recovery and Pollution Prevention. **2016**, Pages 149-177

Usability of the Module:

This module will help students; understanding to evaluate the capabilities of a community to effectively manage a hazardous materials incident. Define toxicity as it relates to humans and hazardous chemicals , Medical waste disposal and list the elements of risk assessment.describe the processes involved in hazardous waste treatment and management. Also it includes the Integrated solid waste management and explain the factors that contribute to the solid Waste problem. and waste to energy outlook for Jordan and regional countries.

This will help other modules to built upon the skills acquired in this module as Packaging module which classify the Hazard of the materials used and can cause occupational hazard.

Prerequisites and Co-requisites

PCE2523: Microbiology (prerequisite)

PCE282**:** Microbiology **lab** (prerequisite)

Language of Instruction

English

Recommended Optional Program Components

None