



الجامعة الألمانية الأردنية  
German Jordanian University

# **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 2023**

# I. Program Objectives

Dual study pharmaceutical and chemical engineering program emphasizes the application of technologies and tools in the short time, and the ability to discover, acquire, and adapt new knowledge and skills in the long term, such that our graduates are prepared to:

1. Define, analyze, and solve various technical challenges using scientific methodologies related to pharmaceutical and chemical engineering.
2. Discover and understand the various tasks and roles of pharmaceutical and chemical engineers in the workplace.
3. Design various equipments used mainly in chemical/pharmaceutical industries, optimize operating conditions to maximize process efficiency, and contribute to routine process improvement by proposing suggestions and executing them when possible.
4. Expand their professional network both inside and outside the organization to work in multicultural teams.
5. A solid foundation of scientific knowledge and required skills in the labor market.
6. Efficiency in working in various pharmaceutical and chemical industries.
7. High ethical and professional principles.
8. The ability to reach leadership roles in various fields of specialization.
9. Continuous learning.
10. Ability to provide new and sustainable solutions to national and global challenges.

# II. Learning Outcomes

Dual study pharmaceutical and chemical engineering graduates bachelor's students with an understanding of fundamental pharmaceutical and chemical engineering and management concepts, methodologies, and technologies as demonstrated by:

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 perform supervised work and apply engineering knowledge in various work activities.
8. An ability to use pharmaceutical and chemical engineering tools in dealing with tasks and challenges.

## Course Delivery Methods

Courses are in one of the following three methods:

- **Face-to-Face (F2F) Method**

Courses that are taught through face-to-face learning and are delivered at the university campus.

- **Blended (BLD) Method**

Courses in which teaching consists of face-to-face learning and asynchronous E-learning. The face-to-face learning takes place at the university campus. Asynchronous E-learning takes place through activities, tasks, educational duties, and assignments through the virtual E-learning platforms (Moodle and MyGJU) without direct meetings with course instructors.

- **Online (OL) Method**

Courses in which teaching consists of synchronous E-learning and asynchronous E-learning. The synchronous E-learning takes place through interactive virtual meetings between instructors and students directly through the virtual E-learning platform (MS Teams). The asynchronous E-learning takes place through activities, tasks, educational duties, and assignments through the virtual E-learning platforms (Moodle and MyGJU) without direct meetings with course instructors.

## III. Assessment of learning outcomes.

The following methods of measuring student learning are used:

- Summative assessments such as tests, quizzes, and other graded course activities are used to measure student performance. They are cumulative and often reveal what students have learned at the end of a unit or the end of a course, lab or training. Within a syllabus, summative assessment includes the system for calculating individual student grades.
- Formative assessment such as any means by which students receive input and guiding feedback on their relative performance to help them improve. It can be provided face-to-face in office hours, in written comments on assignments, through rubrics, and through emails.

## IV. Admission Requirements

To apply for admission, the following minimum requirements must be met:

- **For applicants with Jordanian Certificates (Tawjihi):**

Jordanian General Secondary Education Certificate (Tawjihi), The acceptance rate is  $\geq$  80.

- **For applicants with Arab or Foreign Certificates:** an Equivalency issued by the Jordanian Ministry of Education, for any of the Arab or foreign certificates such as (IB, IGCSE/GCE, HSD & SAT II).

## Placement Tests

Applicants must sit for placement tests in the Arabic Language, the English Language, and Mathematics to determine whether the applicant may be required to take remedial courses in the mentioned subjects. Depending on the applicant scores in the placement tests, some of the following 3-credit-hour remedial courses are required:

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
ARB0099	Elementary Arabic	3	3	3	-	OL	Placement test
ENGL0098	Elementary English	3	3	3	-	F2F	Placement test
ENGL0099	Intermediate English	3	3	3	-	F2F	ENGL0098
MATH0099	Pre-Math	3	3	3	-	OL	Placement test
<b>Total</b>		<b>12</b>	<b>12</b>	<b>12</b>	<b>-</b>		

- Remedial courses are to be completed and passed within the first year of enrollment.
- Passing grade of remedial courses is 60%.
- ECTS (B.Sc.): is the European Credit Transfer and Accumulation, One ECTS is equivalent to 30 actual workload hours.

## V. Degree Requirements

The requirements to obtain a B.Sc. degree in Dual study Pharmaceutical and Chemical Engineering are the following:

- A minimum of 12 credit hours of elective courses are to be taken at a partner university in Germany.
- 37 credit hours of school requirements.
- 106 credit hours of program requirements.
- A minimum of 12 week in program partner companies each summer semester.
- A minimum of 20 weeks' internship in German companies or industries.

## VI. Framework for B.Sc. Degree (170 credit hours)

Classification		Credit Hours			ECTS		
		Compulsory	Elective	Total	Compulsory	Elective	Total
University Requirements	General	21	6	27	25	6	31
	Dual Studies	21	Dual Study University Requirements 6	27	12	-	12
School Requirements		37	0	37	62	0	62
Program Requirements		94	12	106	187	20	207
<b>Total</b>		<b>152</b>	<b>18</b>	<b>170</b>	<b>274</b>	<b>26</b>	<b>300</b>

### 1. University Requirements: (27 credit hours)

#### 1.1. Compulsory: (21 credit hours)

Course ID	Course Name		Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
					Lect.	Prac.		
ARB100	Arabic		3	3	3	-	OL	ARB0099
ENGL1001	Upper-Intermediate English		3	3	3	-	F2F	ENGL0099
ENGL1002	Advanced English		3	3	3	-	F2F	ENGL1001
GERL101B1	German I B1-Track		3	6	9	-	F2F	-
GERL102B1	German II	B1-Track	3	6	9	-	F2F	GERL101B1
GERL102B2		B2-Track						
MILS100	Military Science		3	2	3	-	OL	-
NE101	National Education		3	2	3	-	OL	-
NEE101	National Education in English							
<b>Total</b>			<b>21</b>	<b>25</b>	<b>33</b>	<b>-</b>		

## 1.2. Dual Study University Requirements: (6 Credit Hours)

Course ID	Course Name	Credit Hours	ECT S	Contact Hours	Type	Prerequisites / Co-requisites
DS101	Dual Study Practical I	3	3	12 Weeks	F2F	-
DS201	Dual Study Practical II	3	3	12 Weeks	F2F	DS101
DS301	Dual Study Practical III	0	6	12 Weeks	F2F	DS201
<b>Total</b>		<b>6</b>	<b>12</b>	<b>36 Weeks</b>	-	

DA: Department Approval

DS301 Prerequisite for GY.

## 2. School Requirements: (37 Credit Hours)

Course ID	Course Name		Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
					Lect.	Prac.		
MATH101	Calculus I		3	5	3	-	BLD	MATH0099
MATH102	Calculus II		3	5	3	-	F2F	MATH101
CS116	Computing Fundamentals		3	6	3	-	BLD	-
CS1160	Computing Fundamentals Lab		1	-	-	1	BLD	CS116
IE0141	Engineering Workshop		1	2	-	3	F2F	-
CHEM103	General Chemistry		3	5	3	-	F2F	-
CHEM106	General Chemistry Lab		1	2	-	3	BLD	CHEM103
PHYS103	Physics I		3	5	3	-	BLD	-
PHYS104	Physics II		3	5	3	-	F2F	PHYS103
PHYS106	General Physics Lab		1	2	-	3	BLD	PHYS103, PHYS104 <sup>co</sup>
MATH203	Applied Mathematics for Engineers		3	5	3	-	F2F	MATH102
MATH205	Differential Equations		3	5	3	-	F2F	MATH102
GERL201B1	German III	B1-Track	3	4	6	-	F2F	GERL102B1 or GERL102B2
GERL201B2		B2-Track						
GERL202B1	German IV	B1-Track	3	6	9	-	F2F	GERL201B1 or GERL201B2
GERL202B2		B2-Track						
BM371	Numerical Methods for Engineers		3	5	2	3	BLD	MATH203, MATH205 CS116
<b>Total</b>			<b>37</b>	<b>62</b>	<b>41</b>	<b>6</b>		

### 3. Program Requirements (106 credit hours)

#### 3.1. Program Requirements (Compulsory): (94 credit hours)

Course ID	Course Name		Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
					Lect.	Prac.		
PCE2101-DS	Analytical Chemistry		2	4	2	-	F2F	CHEM103
PCE281	Analytical Chemistry Lab		1	2	-	3	BLD	CHEM103, CHEM106, PCE2101-DS <sup>co</sup>
PCE222	Fluid Mechanics for Chemical and Medical Engineers		3	5	3	-	F2F	MATH203
PCE211	Introduction to Pharmaceutical and Chemical Engineering		1	2	1	-	BLD	CHEM103
PCE2201	Organic Chemistry for PCE		3	5	3	-	F2F	CHEM103
PCE2202	Organic Chemistry Lab for PCE		1	2	-	3	BLD	CHEM103, CHEM106, PCE2201 <sup>co</sup>
PCE242	Pharmaceutical Physical Chemistry		2	4	2	-	BLD	PCE221
PCE272	Pharmaceutical Physical Chemistry Lab		1	2	-	3	BLD	PCE221, PCE242 <sup>co</sup>
PCE212	Principles of Chemical Engineering		3	5	3	-	F2F	PCE221, PCE211
PCE221	Thermodynamics for Pharmaceutical and Chemical Engineering		3	5	3	-	F2F	MATH102
PCE3513	Biochemistry		3	4	3	-	BLD	PCE2201
PCE381	Biochemistry Lab		1	2	-	3	BLD	PCE2201, PCE2202, PCE3513 <sup>co</sup>
PCE332-DS	Chemical Engineering Economics		3	5	3	-	BLD	PCE212
PCE321	Chemical Reaction Engineering		3	5	3	-	F2F	PCE212
PCE362	Fluid, Heat and Reaction Engineering Lab		1	2	-	3	BLD	PCE222, PCE311, PCE321
GERL301B1	German V	B1-Track	3	6	9	-	F2F	GERL202B1 or GERL202B2
GERL301B2		B2-Track						GERL202B2
GERL302B1	German VI	B1-Track	3	6	6	-	F2F	GERL301B1 or GERL301B2
GERL302B2		B2-Track						GERL301B2
PCE3101	Instrumental Analysis		2	4	2	-	F2F	PCE2101-DS
PCE372	Instrumental Analysis Lab		1	2	-	3	BLD	PCE2101-DS, PCE281, PCE3101 <sup>co</sup>
PCE3201	Mass Transfer		3	4	3	-	F2F	PCE212
PCE343	Pharmaceutical Technology – Liquid Forms		3	4	3	-	BLD	PCE242
PCE373	Pharmaceutical Technology – Liquid Forms Lab		1	2	-	3	BLD	PCE242, PCE343 <sup>co</sup>
PCE344	Pharmaceutical Technology – Solid Forms		3	4	3	-	BLD	PCE242
PCE374	Pharmaceutical Technology – Solid		1	2	-	3	BLD	PCE242, PCE344 <sup>co</sup>

	Forms Lab						
PCE312	Separation Processes	3	4	3	-	F2F	PCE311
PCE311	Transport Phenomena	3	5	3	-	F2F	PCE212, PCE222
PCE499	International Internship	12	30	20 weeks		F2F	Dept. approval
PCE5102	Chemical process dynamics and control	3	4	3	-	F2F	PCE321
PCE5103	Chemical process dynamics and control Lab	1	2	-	3	BLD	PCE321, PCE5102 <sup>co</sup>
PCE5105	Computer-Aided Plant Design	3	5	3	-	F2F	PCE312, PCE332-DS
PCE591	Graduation Project I	1	2	-	3	OL	Dept. approval
PCE592	Graduation Project II	2	6	-	6	BLD	PCE591
PCE541	Medicinal Chemistry	3	5	3	-	BLD	PCE3513
PCE5202	Pharmaceutical Packaging	2	4	2	-	BLD	PCE343 or PCE344
PCE5104-DS	Process Safety and Hazardous Waste Management	3	4	3	-	BLD	PCE312
PCE562	Separation Processes Lab	1	2	-	3	BLD	PCE312, PCE5101 <sup>co</sup>
PCE5201	Statistical Analysis and Quality Assurance	3	5	3	-	BLD	PCE344, MATH101
PCE5101	Unit Operations	3	5	3	-	F2F	PCE312
<b>Total</b>		<b>94</b>	<b>177</b>	<b>78</b>	<b>39</b>		

### 3.2. Program Requirements (Electives<sup>b</sup>): (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	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
PCE444	Antibiotics	3	6	3	-	BLD	BSC001
PCE401	Biotechnology	3	6	3	-	BLD	BSC001
PCE407	Chemical & Physical Sensors	3	6	3	-	BLD	BSC001
PCE431	Chemical Process Safety	3	6	3	-	BLD	BSC001
PCE422	Chemical Reaction Engineering II	3	6	3	-	BLD	BSC001
PCE405	Colloids and Surface Chemistry	3	6	3	-	BLD	BSC001
PCE406	Corrosion Engineering	3	6	3	-	BLD	BSC001
PCE491	Environmental Engineering	3	6	3	-	BLD	BSC001
PCE421	Fluid Mixing Technology	3	6	3	-	BLD	BSC001
PCE402	Gene Technology	3	6	3	-	BLD	BSC001
PCE5312	Industrial Processes Management and Industrial Safety	3	6	3	-	BLD	BSC001
PCE409	Introduction to Oil and Gas Production	3	6	3	-	BLD	BSC001
PCE404	Introduction to Polymer Science	3	6	3	-	BLD	BSC001
PCE413	Membrane Separation Processes	3	6	3	-	BLD	BSC001
PCE4001	Microbiology	3	6	3	-	BLD	BSC001
PCE448	Modern Drug Forms & Delivery Systems	3	6	3	-	BLD	BSC001

PCE412	Nanotechnology	3	6	3	-	BLD	BSC001
PCE403	Nutrition	3	6	3	-	BLD	BSC001
PCE445	Particle Technology	3	6	3	-	BLD	BSC001
PCE446	Pharmacokinetics	3	6	3	-	BLD	BSC001
PCE408	Shale Oil Production Processes	3	6	3	-	BLD	BSC001
PCE595	Special Field Projects	3	6	-	-	BLD	BSC001
PCE492	Special Topics in Pharmaceutical and Chemical Engineering I	3	6	3	-	BLD	BSC001
PCE493	Special Topics in Pharmaceutical and Chemical Engineering II	3	6	3	-	BLD	BSC001
PCE494	Special Topics in Pharmaceutical and Chemical Engineering III	3	6	3	-	BLD	BSC001
PCE495	Special Topics in Pharmaceutical and Chemical Engineering IV	3	6	3	-	BLD	BSC001
PCE593	Special Topics in Pharmaceutical and Chemical Engineering V	2	4	2	-	BLD	BSC001
PCE594	Special Topics in Pharmaceutical and Chemical Engineering VI	1	3	1	-	BLD	BSC001
PCE447	Toxicology	3	6	3	-	BLD	BSC001
ACC435	Accounting Ethics and Corporate Governance	3	4.5	3	-	F2F	BSC001
CEE512	Air Pollution Control	2	3	3	-	BLD	BSC001
CEE513	Air Pollution Control lab	1	2	-	3	F2F	BSC001
BM563	Artificial Organs and Limbs	3	5	3	-	BLD	BSC001
BM331	Biomaterials	3	5	3	-	BLD	BSC001
BM333	Biomaterials lab	1	2	-	3	BLD	BSC001
BM352	Biomedical Sensors and Transducers	3	5	3	-	BLD	BSC001
BM358	Biomedical Sensors and Transducers lab	1	2	-	3	BLD	BSC001
BM562	BioMEMS	3	5	3	-	F2F	BSC001
ENE537	Energy Efficiency, Management and Laws	3	5	3	-	BLD	BSC001
CEE500	Environmental Engineering and Sustainability Concepts	3	4	3	-	BLD	BSC001
ENE534	Low Carbon Buildings	3	5	3	-	F2F	BSC001
MGT418	Quality Management	3	4.5	3	-	F2F	BSC001
BM592	Selected Topics I	1	3	1	-	F2F	BSC001
BM593	Selected Topics II	2	4	2	-	F2F	BSC001
BM594	Selected Topics III	3	5	3	-	F2F	BSC001
CEE515	Water and Wastewater Treatment Engineering	3	5	3	-	F2F	BSC001
CEE516	Water and Wastewater Treatment Engineering lab	1	1	-	3	F2F	BSC001
<b>Total</b>		<b>12</b>	<b>30</b>				

## VII. Study Plan<sup>1</sup> Guide for the Bachelor Degree in Pharmaceutical and Chemical Engineering (Dual Study Track)

First Year					
First Semester Courses (19 CH)		Second Semester Courses (19 CH)			Summer Semester Courses (5 CH)
GERL101B1 German I B1 -Track (3CH)	GERL102B1	German II (3CH)	B1-Track	PCE2101-DS Analytical Chemistry (2CH)	
	GERL102B2		B2-Track		
ENGL1001 Upper-Intermediate English (3CH)	ENGL1002 Advanced English (3CH)			<b>DS101 Dual Studies Practical I (3CH)</b>	
MATH101 Calculus I (3CH)	MATH102 Calculus II (3CH)				
PHYS103 Physics I (3CH)	PHYS104 Physics II (3CH)				
CHEM103 General Chemistry (3CH)	PHYS106 General Physics Lab (1CH)				
CHEM106 General Chemistry Lab (1CH)	CS116 Computing Fundamental (3CH)				
ARB100 Arabic (3CH)	CS1160 Computing Fundamental lab I(1CH)				
	IE0141 Engineering Workshop (1CH)				
	PCE211 Introduction to Pharmaceutical and Chemical Engineering (1CH)				

Second Year						
First Semester Courses (13 CH)			Second Semester Courses (16CH)			Summer Semester Courses (6 CH)
GERL201B1	German III (3CH)	B1-Track	GERL202B1	German IV (3CH)	B1-Track	PCE332-DS Chemical Engineering Economics (3CH)
GERL201B2		B2-Track	GERL202B2		B2-Track	
PCE281 Analytical Chemistry Lab (1CH)			PCE2201 Organic Chemistry For PCE (3CH)			<b>DS201 Dual Studies Practical II (3CH)</b>
PCE221 Thermodynamics for Pharmaceutical and Chemical Engineering (3CH)			PCE2202 Organic Chemistry Lab for PCE (1CH)			
MATH203 Applied Mathematics for Engineers (3CH)			PCE212 Principles of Chemical Engineering(3CH)			
MATH205-Differential Equations (3CH)			PCE222 Fluid Mechanics for Chemical and Medical Engineers (3CH)			
			PCE242 Pharmaceutical Physical Chemistry (2 CH)			
			PCE272 Pharmaceutical Physical Chemistry Lab(1CH)			

<sup>1</sup> The following study plan guide assumes having passed all placement tests.

Third Year						
First Semester Courses (16 CH)			Second Semester Courses (17 CH)			Summer Semester Courses (3 CH)
GERL301B1	German V (3 CH)	B1-Track	GERL302B1	German VI (3 CH)	B1-Track	PCE5104-DS Process Safety and Hazardous Waste Management (3 CH)
GERL301B2		B2-Track	GERL302B2		B2-Track	
PCE311 Transport Phenomena (3 CH)			PCE312 Separation Processes (3CH)			<b>DS301 Dual Studies Practical III (0CH)</b>
PCE3101 Instrumental Analysis (2 CH)			PCE344 Pharmaceutical Technology –Solid Forms (3 CH)			
PCE372 Instrumental Analysis Lab (1 CH)			PCE374 Pharmaceutical Technology –Solid Forms Lab (1CH)			
PCE321 Chemical Reaction Engineering (3CH)			PCE3513 Biochemistry (3CH)			
PCE343 Pharmaceutical Technology –Liquid Forms (3CH)			PCE381 Biochemistry Lab (1CH)			
PCE373 Pharmaceutical Technology –Liquid Forms Lab (1 CH)			PCE3201 Mass transfer (3CH)			

Fourth Year (in Germany)	
First Semester Courses (12 CH)	Second Semester Courses (12 CH)
four Elective Courses at German Partner University (12CH)	PCE499* International Internship (12 CH)

Fifth Year		
First Semester Courses (14 CH)	Second Semester Courses (18 CH)	
BM371 Numerical Methods for Engineers (3CH)	PCE362 Fluid, Heat and Reaction Engineering Lab (1CH)	
PCE5101 Unit Operations (3CH)	PCE5202 Pharmaceutical Packaging (2CH)	
PCE5102 Chemical process dynamics and control (3 CH)	PCE5201 Statistical Analysis and Quality Assurance (3CH)	
PCE5103 Chemical process dynamics and control Lab (1CH)	PCE541 Medicinal Chemistry (3CH)	
PCE5105 Computer-Aided Plant Design (3CH)	PCE562 Separation Processes Lab (1CH)	
PCE591 Graduation Project I (1CH)	MILS100 Military Science (3 CH)	
	NE101	National Education (3CH)
	NEE101	National Education in English (3CH)
	PCE592 Graduation Project II (2CH)	

## VI. Compulsory Courses Offered by the PCE Department

(arranged alphabetically)

<b>PCE2101-DS Analytical Chemistry</b>	<b>2 Cr Hr (2,0)</b>	<b>4 ECTS</b>
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24 hours of theoretical lectures cover the Chemical measurements, chemical equilibrium, activity and the systematic treatment of equilibrium, monoprotic acid-base equilibria, polyprotic acid-base equilibria, acid-base titrations, EDTA titrations, fundamentals of electrochemistry, reduction-oxidation titrations, gravimetric analysis, and precipitation titrations, The remaining 24 hours cover how to apply the analytical chemistry methods to a real problem within the student's dual studies partner company.

*Prerequisites: Chem103*

*Corequisites: -*

<b>PCE281 Analytical Chemistry Lab</b>	<b>1 Cr Hr (0,3)</b>	<b>2 ECTS</b>
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Statistical treatment of data, titration of strong dibasic base with strong acids (monoprotic and diprotic), titrations of strong acids/bases with weak bases/acids (monoprotic and polyprotic), determination of carbonate and bicarbonate in mixtures, buffer solutions and buffer capacity, EDTA determination of calcium in milk, redox titration of dichromate with iron(II), redox titration of permanganate with oxalate, determination of calcium as calcium oxalate, determination of chloride by Mohr's method, separation of permanganate and chromate by adsorption chromatography, separation of zinc and magnesium ions by ion exchange chromatography, gravimetric determination of iron as iron oxide.

*Prerequisites: Chem103, Chem106*

*Corequisites: PCE2101-DS*

<b>PCE3513 Biochemistry</b>	<b>3 Cr Hr (0,3)</b>	<b>4 ECTS</b>
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This course covers firstly an introduction about how the human body functions, and looks in detail at cellular events, from the developing embryo to the adult. Then, it covers the study of the principles of biochemistry by studying the molecular composition of the cell; proteins, enzymes, sugars, lipids, nucleic acids, vitamins, coenzymes, and enzymes. In addition, the course covers DNA replication and gene expression (transcription and translation). Lastly, an introduction about viruses is given.

*Prerequisites: PCE2201*

*Corequisites: -*

<b>PCE381 Biochemistry Lab</b>	<b>1 Cr Hr (0,3)</b>	<b>2 ECTS</b>
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The Biochemistry laboratory course will enable students to apply basic biochemistry lab techniques to solve problems. The methods/experiments included in this course are: Extraction/purification and characterization of the macromolecules [proteins (SDS lysis, determination of protein content and SDS-PAGE), carbohydrates, lipids and nucleic acids (DNA extraction, 260/280 nm spectrophotometry and gel electrophoresis)].

*Prerequisites: PCE2201*

*Corequisites: PCE3513*

<b>PCE332-DS Chemical Engineering Economics</b>	<b>3 Cr Hr (3,0)</b>	<b>5 ECTS</b>
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24 hours of theoretical lectures cover the Accuracy and purpose of capital cost estimates. Fixed and working capital estimate (total capital investment cost). Inflation. Rapid cost estimating methods. The factorial method of cost estimation: Lang factors, detailed factorial method. Estimation of the purchased equipment cost. Operating costs. Economics evaluation of projects: cash flow, tax and depreciation, discount cash flow,

rate of return, discount cash flow rate of return, sensitivity analysis. Computer methods for costing and project evaluation, The remaining 24 hours cover how to apply the chemical engineering methods to a real problem within the student's dual studies partner company.

Prerequisites: PCE212

Corequisites: -

<b>PCE5102 Chemical process dynamics and control</b>	<b>3 Cr Hr (3,0)</b>	<b>4</b>
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**ECTS**

This course covers the basic principles of process dynamic and control as applied to pharmaceutical and chemical engineering systems. The course is designed to provide students with a comprehensive understanding of the principles and techniques involved in the dynamic behavior and control of chemical processes. The course explores methods to address, analyze and design control systems for chemical processes based on their dynamic responses. Tools and techniques used to optimize the performance of these systems are also introduced. The course typically includes Introduction to process control, control objectives, examples of industrial control systems, process modelling including empirical, and data driven models, process dynamic (linear and nonlinear systems), transfer function analysis, stability analysis, control system design, feedback control, PID controllers, tuning methods. Also, the course provides examples on the applications of process control from chemical engineering processes such as reactors, heat exchangers, and distillation. Throughout the course, students will be attending the simulation lab of the course and may be required to complete homework, assignments, and projects.

Prerequisites: PCE321

Corequisites: -

<b>PCE5103 Chemical process dynamics and control lab</b>	<b>1 Cr Hr (0,3)</b>	<b>2 ECTS</b>
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Laboratory to introduce the concepts learned in the course through practical experiments using Software application such as Matlab and Simulink.

Prerequisites: PCE321

Corequisites: PCE5102

<b>PCE321 Chemical Reaction Engineering</b>	<b>3 Cr Hr (3,0)</b>	<b>5 ECTS</b>
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Overview of chemical reaction engineering. Kinetics of homogeneous reaction. Interpretation of batch reactors data. Introduction to reactor design. Ideal reactors for single reaction. Design of single reactions. Introduction to heterogeneous reactions. Solid catalyzed reactions.

Prerequisites: PCE212

Corequisites: -

<b>PCE5105 Computer-Aided Plant Design</b>	<b>3 Cr Hr (3,0)</b>	<b>5</b>
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**ECTS**

Project definition and organization. Input information and batch versus continuous. Input-output structure of the flowsheet. Recycle structure of the flowsheet. Separation system. Index flowsheet. Process flowsheet. Equipment sizing and design. Safety analysis. Safety and environmental analysis. Economic Evaluation. Considerations in the design of pharmaceutical plants; Site selection, layout, Cleanrooms, utilities, special production systems.

Prerequisites: PCE312, PCE332-DS

Corequisites:-

<b>PCE222 Fluid Mechanics for Chemical and Medical Engineers</b>	<b>3 Cr Hr (3,0)</b>	<b>5 ECTS</b>
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Fluid mechanics in chemical and medical engineering. Density, viscosity and surface tension. Fluid Statics. Mass, energy and momentum balances. Bernoulli's equation. Fluid friction in pipes. Flow in engineering equipment:

pumps and compressors. Non-Newtonian fluid flow in circular pipe.

*Prerequisites: MATH203*

*Corequisites: -*

**PCE362 Fluid, Heat and Reaction Engineering Lab** **1 Cr Hr (0,3)** **2 ECTS**

There are different experimental setup available in the laboratory to cover chemical engineering concepts heat transfer. Experiments are: Jacketed vessel with coil and stirrer, shell and tube heat exchanger, concentric tube heat exchanger, extended plate heat exchanger, Linear and radial heat conduction, combined convection radiation heat transfer, continuous stirred tank reactor, batch reactor, tubular reactor, diffusion coefficient, parallel and series pumps, losses in pipes, Reynolds number.

*Prerequisites: PCE222, PCE311, PCE321*

*Corequisites: -*

**CHEM103 General Chemistry I** **3 Cr Hr (3,0)** **5 ECTS**

Components of matter. Stoichiometry of formulas and equations. Major classes of chemical reactions (precipitation, acid-base, oxidation-reduction and reversible reactions). Gases and the kinetic theory. Thermochemistry: Energy flow and chemical change. Kinetics: Rates and mechanisms of chemical reactions. Equilibrium: The extent of chemical reactions. Acid-base equilibria. Ionic equilibria in aqueous systems.

*Prerequisites: -*

*Corequisites: -*

**CHEM106 General Chemistry Lab** **1 Cr Hr (0,3)** **2 ECTS**

Laboratory safety, first aid. Measurement and proper use of laboratory glassware. Density measurement. Basic separation techniques. Empirical Formula of an oxide. Classification of chemical reactions. Limiting reactant. Determination of acetic acid in vinegar. Molecular weight of a volatile liquid. Calorimetry. Kinetic study of reaction of peroxydisulfate and iodide ions.

*Prerequisites: -*

*Corequisites: Chem103*

**PCE591 Graduation Project I** **1 Cr Hr (0,0)** **2 ECTS**

Theoretical and/or experimental investigation of a problem in chemical/pharmaceutical engineering, or design and development of a chemical process. A student or a group of students undertake an independent project under the supervision of a faculty member. The general objectives are to improve the student's skills and creativity, and to give him/her the experience of problem solving with integration of chemical/pharmaceutical engineering principles.

*Prerequisites: Dept. Approval*

*Corequisites:-*

**PCE592 Graduation Project II** **2 Cr Hr (0,6)** **6 ECTS**

Completion of the same project started in PCE 591 with more details, theoretical and/or experimental work, design and calculations.

*Prerequisites: PCE591*

*Corequisites:-*

**PCE3101 Instrumental Analysis** **2 Cr Hr (2,0)** **4 ECTS**

Introduction to instrumental analysis, signals and noise, components of optical instruments, an introduction to ultraviolet- visible molecular spectrometry, applications of ultraviolet- visible molecular spectrometry, atomic absorption spectrometry, atomic x-ray spectrometry, molecular luminescence spectrometry, an introduction to electroanalytical chemistry, potentiometry, an introduction to chromatographic separations, gas chromatography, liquid chromatography, thermal methods. An introduction to nuclear magnetic resonance and mass spectrometry.

*Prerequisites: PCE2101-DS*  
*Corequisites: -*

<b>PCE372 Instrumental Analysis Lab</b>	<b>1 Cr Hr (0,3)</b>	<b>2 ECTS</b>
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Ultraviolet-Visible Spectroscopy: Photometric Titration, Food and Drug Analysis, Infrared Spectroscopy: Functional Group Determination, Atomic Spectroscopy: Determination of Metals in Water and Soil Samples, Potentiometry: Potentiometric Titration and Ion Selective Electrode Measurement, Thermal Analysis: Thermal Gravimetric Analysis and Differential Scanning Calorimetry, Chromatography: High Performance Liquid Chromatography and Gas Chromatography. Nuclear magnetic resonance and mass spectrometry.

*Prerequisites: PCE2101-DS, PCE281*  
*Corequisites: PCE3101*

<b>PCE499 International Internship</b>	<b>12 Cr Hr (0,0)</b>	<b>30</b>
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**ECTS**

Practical training for 6 months after the completion of at least 90 credit hours (See Practical Training Regulations of the College of Applied Medical Sciences).

*Prerequisites: Dept. Approval*  
*Corequisites:-*

<b>PCE211 Introduction to Pharmaceutical and Chemical Engineering</b>	<b>1 Cr Hr (1,0)</b>	<b>2 ECTS</b>
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Chemical engineering in the pharmaceutical industry: an introduction. Current challenges and opportunities in the pharmaceutical industry. Engineering calculations: units, dimensional homogeneity and dimensionless quantities. Process data presentation and analysis. Processes and process variables.

*Prerequisites: Chem103*  
*Corequisites: -*

<b>PCE3201 Mass Transfer</b>	<b>3 Cr Hr (3,0)</b>	<b>5 ECTS</b>
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Mechanisms of mass transfer. Mass transfer by molecular diffusion: Ficks Law, Transport properties of mixtures, differential equations of mass transfer: steady state and transient analysis. Drug dissolution. Convective Mass Transfer. The concept of mass transfer coefficient, mass transfer coefficient for different geometries: flat plate, single sphere, cylinder, and flow in pipes. Interphases mass transfer, the two films theory. Momentum, heat and mass transfer analogy.

*Prerequisites: PCE212*  
*Corequisites: -*

<b>PCE541 Medicinal Chemistry</b>	<b>3 Cr Hr (3,0)</b>	<b>5</b>
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**ECTS**

3D-structure of protein, protein data banks, PDB files and protein visualization. Enzymes, receptors, nucleic acids as drug targets. Drug discovery and design concepts and practical examples of computer aided drug design. Quantitative structure activity relationship models. Introduction about different microorganisms; their structure, function, growth, interaction with the environment, metabolism. Case studies and examples on anti-bacterial, antiviral, anticancer and other important drugs.

*Prerequisites: PCE3513*  
*Corequisites:-*

**PCE2201 Organic Chemistry for PCE** **3 Cr Hr (3,0)** **5 ECTS**

Bonding models for CH, simple CC and multiple CC bonds. The possibilities for isomer of open chained cyclic hydrocarbons including their dynamics (conformation). Electron structure of conjugated double bonds and aromatic  $\pi$ -systems. Stereoisomerism, chirality and enantiomers. Polar single and multiple bonds and the resulting electronic substituent effects. The most important classes of organic compounds including organic halogens, alcohols, aldehydes, ketones, ethers, epoxides, carboxylic acids, amines and the most important organic nitrogen compounds. Overview of various reaction types and initial mechanistic reaction observations. Heterocyclic and polycyclic aromatic compounds of pharmaceutical interest with examples related biologically active compounds.

*Prerequisites: Chem103*

*Corequisites: -*

**PCE2202 Organic Chemistry Lab for PCE** **1 Cr Hr (0,3)** **2 ECTS**

The course involves separation, purification and identification of organic compounds through their physical properties: melting point, distillation, crystallization, extraction, and chromatography; preparation of simple organic compounds; qualitative tests for selected classes of organic compounds.

*Prerequisites: Chem103Chem106*

*Corequisites: PCE2201*

**PCE5202 Pharmaceutical Packaging** **2 Cr Hr (3,0)** **4 ECTS**

Introduction. Types of packaging systems. Criteria for the selection of package type and package materials. Packaging evaluation. Dosage forms and package forms. Containers. Adhesives and inks. Closures: glass, plastic, metal, paper and board, films, foils and laminates, rubber compounds, cotton. Special type of delivery – Devices: Aerosols, Transdermal. Packaging of medical/surgical devices. Economic aspects.

*Prerequisites: PCE343 or PCE344*

*Corequisites:-*

**PCE242 Pharmaceutical Physical Chemistry** **2 Cr Hr (2,0)** **5 ECTS**

Introduction to physical pharmacy. Study the underpinning physicochemical sciences which pertain to the formulation of pharmaceutical products. Main themes: Pharmaceutical solutions: Colligative properties of solutions, Solutions equilibria: Solubility, Partitioning and distribution phenomena. The solid state: Solid state properties: The crystalline structure, Polymorphism and the amorphous state. Physicochemical properties which control complex formation including drug stability and factors affecting its shelf-life. Discussion of diffusion and interfacial phenomenon of adsorption will be included.

*Prerequisites: PCE221*

*Corequisites: -*

**PCE272 Pharmaceutical Physical Chemistry Lab** **1 Cr Hr (0,3)** **2 ECTS**

Determination of molar mass using the ideal gas law. Partial molar volumes. Boiling point elevation. Boiling point diagram of a binary mixture. Miscibility gap in a ternary system. Kinetics of saccharose inversion. Reaction rate and activation energy of the acid hydrolysis of ethyl acetate. Single electrode potential. Effect of ionic strength on solubility of benzoic acid in water. Adsorption isotherm. Reaction rate of acetic acid and magnesium Determining surface tension using the ring method. Viscosity measurement.

*Prerequisites: PCE221*

*Corequisites: PCE242*

**PCE343 Pharmaceutical Technology – Liquid Forms** **3 Cr Hr (3,0)** **5 ECTS**

This course includes the major liquid dosage forms (solutions, injectables and dispersed systems including emulsions, suspensions and aerosols) and types of semisolid dosage forms like ointments, pastes and gels. The

principles of biopharmaceutics including formulation and drug delivery design will be approached for each form. On the basis of physiochemistry knowledge the students will be trained to formulate and how to control pharmaceutical dosage forms. Preparation evaluation, storage and packaging will be also discussed.

*Prerequisites: PCE242*

*Corequisites:-*

**PCE373 Pharmaceutical Technology – Liquid Forms Lab 1 Cr Hr (0,3) 2 ECTS**

The laboratory course will serve as a foundation course for applying the knowledge and skills to practice the science and practice of pharmaceutical compounding. Special emphasis is given on preparation of dosage formulations in a laboratory scale while keeping the industrial practice in view. Evaluation tests are also included for every formulation; this includes practical implementation and use of some solid-state characterization techniques.

*Prerequisites: PCE242*

*Corequisites: PCE343*

**PCE344 Pharmaceutical Technology – Solid Forms 3 Cr Hr (3,0) 5 ECTS**

This course includes the major conventional pharmaceutical solid dosage forms intended for oral use and forms for rectal use. It is designed to provide a practical understanding to the solid dose manufacture and the theory behind Processes and technologies for manufacturing the finished solid dosage forms including granulation, blending and milling, powder transfer, compression, coating, powder transfer and contaminant. An introduction to the GMP requirements for the formulation, scale up and optimization of finished Dose Forms, and Validation requirements as it applies to solid dose formulations will be also included.

*Prerequisites: PCE242*

*Corequisites: -*

**PCE374 Pharmaceutical Technology – Solid Forms Lab 1 Cr Hr (0,3) 2 ECTS**

This laboratory course will concentrate on solid dosage forms and will build on the knowledge obtained from various earlier pharmacy relevant courses including fundamentals of PCE 343. It will ensure competency of skills to drug analysis, solid dosage preparation, pharmaceutical and pharmacokinetic calculations. An appreciation of the practical experience of the scope of various analytical and characterization techniques with the opportunity to design, undertake measurement protocols, description of the concepts associated with the drug performance will be included.

*Prerequisites: PCE242*

*Corequisites: PCE344*

**PCE212 Principles of Chemical Engineering 3 Cr Hr (3,0) 5 ECTS**

This course is designed to introduce the Chemical Engineering students the basic chemical engineering concepts and methods of system analysis. The topics in this course will include introduction to engineering calculations, process and process variable, fundamentals of material balances, single- and multi-phase systems, and energy balances related to reactive and non-reactive systems. Some case studies of chemical process industries will also be analyzed in more details.

*Prerequisites: PCE221, PCE211*

*Corequisites: -*

**PCE5104-DS Process Safety and Hazardous Waste Management 3 Cr Hr (3,0) 5 ECTS**

24 hours of theoretical lectures cover the Introduction to safety and loss prevention. Hazardous waste sources, properties and classification, storage, transport, fate and transport of contaminants. Hazardous waste minimization and pollution prevention options. Treatment and disposal methods. HAZOP and risk analyses for process systems. Safety codes and checklist consideration in design and operation. Layers of protection analysis and incident investigations. The remaining 24 hours cover how to apply the process safety and

Hazardous Waste management methods to a real problem within the student's dual studies partner company.

*Prerequisites: PCE312*

*Corequisites:-*

**PCE312 Separation Processes 3 Cr Hr (3,0) 5 ECTS**

Fluid mechanics in chemical and medical engineering. Density, viscosity and surface tension. Fluid Statics. Mass, energy and momentum balances. Bernoulli's equation. Fluid friction in pipes. Flow in engineering equipment: pumps and compressors. Non-Newtonian fluid flow in circular pipe.

*Prerequisites: PCE311*

*Corequisites: -*

**PCE562 Separation Processes Lab 1 Cr Hr (0,3) 2 ECTS**

Conduct experiments applying separation processes concepts. Spray dryer, tray dryer, fixed and fluidized bed, batch distillation, cooling tower, single stage evaporation unit, liquid-liquid extraction, filtration unit with plate and frame, reverse osmosis, solid-liquid extraction.

*Prerequisites: PCE312*

*Corequisites: PCE5101*

**PCE5201 Statistical Analysis and Quality Assurance 3 Cr Hr (3,0) 5 ECTS**

Quality improvement, its importance, dimensions and costs. Statistical quality control: Basic statistical tools, testing hypotheses and confidence intervals, simple comparative experiments, analysis of variance (Anova), control charts (x-bar, S, and charts), analysis of charts, process capability. Principles of TQM and trend in quality management. The IOS model and its requirements and specifications, and ISO application.

*Prerequisites: PCE344, MATH101*

*Corequisites:-*

**PCE221 Thermodynamics for Pharmaceutical and Chemical Engineering 3 Cr Hr (3,0) 5 ECTS**

Development of fundamental thermodynamic property relations and complete energy and entropy balances. Analysis of heat pumps and engines and use of combined energy-entropy balance in flow devices. Calculation and application of total and partial properties in physical and chemical equilibria. Prediction and correlation of physical/chemical properties of various states and aggregate.

*Prerequisites: MATH102*

*Corequisites: -*

**PCE311 Transport Phenomena 3 Cr Hr (3,0) 5 ECTS**

A fundamental course in heat transfer processes and an introduction to mass transfer. It introduces the student to precise formulation of transport using the conservation principles and flux expressions. Topics include Introduction to conductive, convective and radiative mechanisms of heat transfer. Conduction heat transfer. Steady heat conduction. Boundary and initial conditions. Convective heat transfer. Analysis of convective heat transfer in external and internal flow. Empirical correlations for convective heat transfer in laminar and turbulent flow. Simultaneous heat and mass transfer. Heat exchangers. Introduction to diffusive and convective mass transfer. One dimensional steady-state mass transfer in common geometries.

*Prerequisites: PCE212, PCE222*

*Corequisites: -*

**PCE5101 Unit Operations****3 Cr Hr (3,0)****5 ECTS**

This course is a combination of two parts; the first one is an application of fluid mechanics, phase transition, and transport phenomena in chemical engineering. It deepens the students' knowledge of the unit operations with a focus on adsorption, crystallization, evaporation, leaching, liquid - liquid extraction and membrane separation.

*Prerequisites: PCE312*

*Corequisites: -*

VIII. **Elective Courses Offered by PCE Department**\* (arranged alphabetically)

\* The prerequisite for all of the following is BSc001

<b>PCE444 Antibiotics ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Introduction to antibiotics and antibacterial chemotherapy. Classification and structure-activity relationship of antibiotics and antibacterial agents. Epidemiology of resistance to antibacterial agents. Development of an antibiotic. Inhibitors of $\beta$ -lactamases, DNA-gyrase. Codrugs. Coumarin antibiotics. Development of resistance and the use of multiple antibacterials during an infection. Drug interactions. Antibacterials and bioterrorism. Clinical quality assurance and the international development of new anti-infective agents.		
<b>PCE401 Biotechnology 6 ECTS</b>	<b>3 Cr Hr (3,0)</b>	
The tasks of biotechnology in the pharmaceutical industry, agriculture, food industry. Biotechnological methods and processes. Fermentation process and reactors. Processing of biotechnological products for applications from intra and extracellular products to packaging. What are enzymes, their biotechnological production, their applications in medicine, diagnostics, food production, pharmacy, agriculture and research. Biotechnological production of biomass, low molecular weight products and macromolecules and also biotransformations.		
<b>PCE407 Chemical &amp; Physical Sensors ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Definitions and basic concepts of chemical sensor technology, physio-chemical basics of sensor technology, dividing sensors into classes, properties and design of sensors, general fields of application, types of detection in sensors, sensor systems and applications, sensors as parts of Microsystems. Definition and basic concepts of physical sensor technology, general fields of application.		
<b>PCE431 Chemical Process Safety ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
This course will cover safety subjects that are considered core for process safety. Subjects include toxicology, industrial hygiene, sources of toxic releases, gas dispersion, fires and explosions, relief valves and their sizing, flaring, hazard identification and risk assessment.		
<b>PCE422 Chemical Reaction Engineering II ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Nonideal flow. Mixing of fluids. Fluid-particle reactions. Fluid-fluid reactions. Deactivating catalysts.		
<b>PCE405 Colloids and Surface Chemistry ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Nature of colloidal dispersions. Thermodynamics of surfaces. Transport properties of suspensions. Particle size and shape. Adsorption onto solid surfaces. Electrically charged interfaces. Particle interaction and coagulation. Rheology of colloidal dispersions.		
<b>PCE406 Corrosion Engineering ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Electrochemical and metallurgical aspects of corrosion. Forms of corrosion. Modern theory of corrosion and its application. Iron and steel corrosion. Corrosion prevention. Case studies.		
<b>PCE491 Environmental Engineering ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>

Legal framework in the fields of water, soil and air. Sampling techniques in the different environmental domains. Online analytical processes. Legal framework in the fields of water, soil and air. Sampling techniques in the different environmental domains. Online analytical processes.

<b>PCE421 Fluid Mixing Technology</b> <b>ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Theory of mixing processes in laminar and turbulent flows. Practical aspects of mixing processes (equipment selection, design, scale-up). Mechanical design of fluid mixers. Heat transfer in agitated vessels.		
<b>PCE402 Gene Technology</b> <b>ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Introduction; transfer of genetic information into proteins: transcription/ translation; tools of the genetic engineer; host organisms and properties; cloning; polymerase chain reaction; applications in genetic engineering.		
<b>PCE5312 Industrial Processes Management and Industrial Safety</b> <b>ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Operations and supply chain management. Quality and quality management. Process capability and statistical control. Designing products. Process design technology. Capacity and facilities planning. Human Resources in Operations Management. Managing projects. Strategic supply chain management and design. Forecasting.		
<b>PCE409 Introduction to Oil and Gas Production</b> <b>ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Process Overview: facilities, main process sections, utility Systems. Reservoir and Wellheads: crude oil and natural gas, the reservoir, exploration and drilling, the well, wellhead, artificial lift, well workover, intervention and stimulation, unconventional sources of oil and gas. The Oil and Gas Process: manifolds and gathering, separation, gas treatment and compression, oil and gas storage, metering and export. Utility systems: control and safety systems, power generation and distribution, flare and atmospheric ventilation, Instrument air, water systems, chemical treatment.		
<b>PCE404 Introduction to Polymer Science</b> <b>ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Definitions and classification, nomenclature, basic concepts on structure and on thermal and mechanical behavior. Polycondensation and polyaddition, radical, ionic and metal catalyzed polymerization. Copolymerization. Chemical modification of polymers. Polymer blends and new developments. Equipment and additives, processing of plastics. Disposal and recycling. Natural macromolecular substances and their most important technical and pharmaceutical derivatives. The characterization of polymers.		
<b>PCE413 Membrane Separation Processes</b> <b>ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Introduction; classification; definitions. Membranes: materials, preparation, modules, characterization, transport Mechanisms. Membrane Processes: microfiltration, ultrafiltration, nanofiltration, reverse osmosis, dialysis, electrodialysis, pervaporation, gas separation, liquid membranes, other techniques, membrane reactors.		
<b>PCE4001 Microbiology</b> <b>ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
The study of the nature of microorganisms; their structure, function, growth, interaction with the environment, metabolism and genetics. The study of viruses, fungi, cyanobacteria and different types of bacteria. Also, it studies the relationship between deferent microorganisms, the ability of some of them to fix atmospheric nitrogen, the diseases caused by bacteria and the economic importance of microorganisms.		

<b>PCE448 Modern Drug Forms &amp; Delivery Systems</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
<b>ECTS</b>		
Therapeutic systems, nanoparticles, nanosuspensions, microemulsions, Self-Macro Emulsifying Delivery Systems (SMEDDS), multiple emulsions. Special Adsorbates. Biopharmaceutical in vitro models of drug release investigation of several drug delivery systems and in vitro absorption models, exploitation of drug release and absorption investigations, biopharmaceutical aspects of application sites and drug delivery systems, investigation of plasma concentration curve, bioavailability.		
<b>PCE412 Nanotechnology</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
<b>ECTS</b>		
Basic Concepts; Molecular Structures; Macromolecular Structures; Surfaces and Interfaces; Properties of Nanostructures; Nanofabrication; Characterization of Nanostructures and Nanomaterials; Nanomaterials and Applications; Thin Films; Nanoparticles; Nano Porous Structures; Nanotubes and Fibers; Nanocomposites; Nanosystems .		
<b>PCE403 Nutrition</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
<b>ECTS</b>		
This Course is designed to make the student aware of their food environment in relation to nutrition and disease. The course also deals with the description of balanced diet and the influence of food habits on health and physical performance.		
<b>PCE445 Particle Technology</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
<b>ECTS</b>		
Particle size analysis. Single particles in a fluid. Multiple particle systems. Fluid flow through a packed bed of particles. Fluidization. Pneumatic transport and standpipes. Separation of particles from a gas: gas cyclones. Storage and flow of powders. Mixing and segregation. Particle size reduction. Size enlargement. Fire and explosion hazards of fine powders.		
<b>PCE446 Pharmacokinetics</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
<b>ECTS</b>		
Introduction to Pharmacokinetics and Pharmacodynamics, Passage of Drug through Membranes, Drug Absorption, Drug Distribution, Drug Elimination.		
<b>PCE408 Shale Oil Production Processes</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
<b>ECTS</b>		
Origin and properties of oil shale. Oil shale resources in Jordan. The chemical and physical nature of kerogen, the precursor to oil shale. Mining and reporting oil shale. In situ retorting. Refining shale oil. The environmental aspects of shale.		
<b>PCE595 Special Field Projects</b>	<b>3 Cr Hr (0,0)</b>	<b>6</b>
<b>ECTS</b>		
Title and course contents of the topic must be approved by the Department's Council and preannounced by the Department.		
<b>PCE492 Special Topics in Chemical/Pharmaceutical Engineering I</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
<b>ECTS</b>		
Title and course contents of the topic must be approved by the Department's Council and preannounced by the Department.		
<b>PCE493 Special Topics in Chemical/Pharmaceutical Engineering II</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
<b>ECTS</b>		
Title and course contents of the topic must be approved by the Department's Council and preannounced by the Department.		

<b>PCE494 Special Topics in Chemical/Pharmaceutical Engineering III</b> ECTS	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Title and course contents of the topic must be approved by the Department's Council and preannounced by the Department.		
<b>PCE495 Special Topics in Chemical/Pharmaceutical Engineering IV</b> ECTS	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Title and course contents of the topic must be approved by the Department's Council and preannounced by the Department.		
<b>PCE593 Special Topics in Chemical/Pharmaceutical Engineering V</b> ECTS	<b>2 Cr Hr (2,0)</b>	<b>4</b>
Title and course contents of the topic must be approved by the Department's Council and preannounced by the Department.		
<b>PCE594 Special Topics in Chemical/Pharmaceutical Engineering VI</b> ECTS	<b>1 Cr Hr (1,0)</b>	<b>3</b>
Title and course contents of the topic must be approved by the Department's Council and preannounced by the Department.		
<b>PCE447 Toxicology</b> ECTS	<b>3 Cr Hr (3,0)</b>	<b>6</b>
Disposition of toxic compounds, metabolism of foreign compounds, types of exposure and response, drugs as toxic substances, industrial toxicology, food additives and contaminants, pesticides, environmental pollutants, natural products, household products, toxicity testing and risk assessment.		

## IX. Courses Offered by Other Departments

(arranged

alphabetically)

<b>BM563 Artificial Organs and Limbs</b>	<b>3 Cr Hr (3,0)</b>	<b>6 ECTS</b>
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Introduction to electrically and pneumatically driven extracorporeal and totally implantable ventricular assist devices or the Total Artificial Heart; Analysis and design of replacements for the heart, kidneys, and lungs, artificial ear and artificial eye. Specification and realization of structures for artificial organ systems; Understand the individual and synergistic function of the major natural ("internal") organs; Understand the major organ replacement systems currently available; and the major problems associated with replacing failed organs in Cardiovascular system, Renal system, Pulmonary system, Hepatic system Endocrine system, Neural prostheses (Muscular-skeletal prostheses). An introduction to the designing and evaluation of prosthetics (artificial limbs), and orthotics (braces and splints). Biocompatibility of materials used in Orthopedic and dental applications

*Prerequisites: BSC001*

<b>BM331 Biomaterials</b>	<b>3 Cr Hr (3,0)</b>	<b>5 ECTS</b>
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A lecture and laboratory course that introduces a series of materials; including metals; ceramics; glass; polymers; and composites; These materials are compared with the natural materials; with consideration given to issues of mechanical properties; biocompatibility; degradation of materials by biological systems; and biological response to artificial materials; The interaction and response of body cells, proteins, and immune system to the biomaterials. Particular attention is given to materials for the total hip prosthesis; dental restoration; and implantable medical devices. Topics include fundamentals of materials science and engineering integrated into biology for the better regeneration of tissue.

*Prerequisites: BSC001*

<b>BM333 Biomaterials Lab</b>	<b>1 Cr Hr (0,3)</b>	<b>2 ECTS</b>
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Three hours of laboratory, Co-requisite: Biomaterials (BME347). A Laboratory to introduce the concepts learned in the course through practical experiments.

*Prerequisites: BSC001*

<b>BM352 Biomedical Sensors and Transducers</b>	<b>3 Cr Hr (3,0)</b>	<b>5 ECTS</b>
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Theory and principles of biosensor design and application in medicine for chemical and biological measurements; Analysis and selection of physical; electrical; mechanical; thermal; and chemical transduction mechanisms which form the basis of the biosensor design; Introduction to Precision; Error in Measurement; Calibration; Analysis of Experimental Data; Principles and fundamental properties of transducers (dynamics; linearity; hysteresis; and frequency range); Transducer interfacing and signal conditioning; material biocompatibility; and packing, Selected examples: micro fluidics; bioelectronics; pressure sensors; temperature sensors and electrochemical sensors.

*Prerequisites: BSC001*

<b>BM358 Biomedical Sensors and Transducers Lab</b>	<b>1 Cr Hr (0,3)</b>	<b>2 ECTS</b>
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The aim of this lab is to gain insight into working of such sensors which can be used in day-to-day life. moreover, the student will take measurements for many sensors using the Arduino Uno and the LabVIEW to study the characteristic and the relation between the input and output. Topics covered include temperature measurement using Arduino UNO then using a LabVIEW, Light dependent resistor using the Arduino, sound level sensor, magnetic field sensor, PH sensor, light sensor, thermocouple, and gas pressure sensor. Moreover, the students have the ability to be familiar with LabVIEW and the Arduino while take the measurement of each sensor.

*Prerequisites: BSC001*

<b>BM562 BioMEMS</b>	<b>3 Cr Hr (3,0)</b>	<b>5 ECTS</b>
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Introduction to what BioMEMS are and what advantages they bring versus current methods; Microfluidic principles to be considered in the design of BioMEMS; Micro and nanosystem used in advanced analytical techniques for microfluidic devices; implantable chips; non-invasive biomedical sensors; DNA chips and microelectronic array system; Applications as microsensors and microactuators; Lab-on-a-chip devices; Fabrication techniques; including silicon and "soft" techniques; The course will also discuss some of the most popular polymer materials used.

*Prerequisites: BSC001*

<b>BM371 Numerical Methods for Engineers</b>	<b>3 Cr Hr (3,0)</b>	<b>5 ECTS</b>
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Fundamentals of error analysis, numerical solutions of linear and nonlinear equations, numerical solution of system of equations, curve fitting, numerical integration and differentiation, numerical solution of ordinary differential equations. Application of numerical methods using relevant software packages.

*Prerequisites: MATH203, MATH205, CS116*

<b>BM592 Selected Topics I</b>	<b>1 Cr Hr (1,0)</b>	<b>3 ECTS</b>
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Title and course contents of the topic should be in a biomedical engineering related field and must be approved by the Department's Council and pre-announced by the Department.

*Prerequisites: BSC001*

<b>BM593 Selected Topics II</b>	<b>2 Cr Hr (2,0)</b>	<b>4 ECTS</b>
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Title and course contents of the topic should be in a biomedical engineering related field and must be approved by the Department's Council and pre-announced by the Department.

*Prerequisites: BSC001*

<b>BM594 Selected Topics III</b>	<b>3 Cr Hr (3,0)</b>	<b>5</b>
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**ECTS**

Title and course contents of the topic should be in a biomedical engineering related field and must be approved by the Department's Council and pre-announced by the Department.

*Prerequisites: BSC001*

## X. Courses offered by Other Schools

(arranged alphabetically)

### **ACC435 Accounting Ethics and Corporate Governance** **3 Cr Hr (3,0)** **4.5 ECTS**

The class starts with introducing and defining corporate governance, key theoretical models and how the definition of corporate governance can be varied according to its objectives to the stakeholders that are intended to be served by corporate governance mechanisms and to the ownership structure prevails in different environment. Control vs. ownership is shown, how the separation between the control and ownership might impact different corporate governance mechanisms and how it might play crucial role in addressing agency conflict from the classical agency theory point of view. Different ownership structures (concentrated, dispersed) and control mechanisms (weak, strong) are introduced, and it is shown how different combinations might be achieved in different environments, especially the combination of dispersed ownership and strong control and the mechanisms that violate one-share-one vote right to achieve such this combination. Module Title Module Code Accounting Ethics and Corporate Governance ACC435 Compulsory Module Year of Study 3 Semester Hours 3 Elective Module X Spring Semester X Workload 135 Optional Module Winter Semester X ECTS 4.5 Pre-university Pre-program Remedial Examination 30% Mid-term exam 30% Quizzes & project & presentation 40% Final exam Responsible Lecturer(s) Dr. Ahmad Abu Dawleh Course Mode of Delivery Contact Time Self-study Accounting Ethics and Corporate Governance Face-to-face 45 90 The definition of accounting ethics, code of professional conduct and moral development are introduced. The definition of accounting is given, and external auditing as profession and how accountants' decisions might affect different stakeholders in the environment surrounding the company are illustrated. After that the definition of accounting ethics and the emergence of professional conduct especially after the accounting scandals that happened after 2002 such as Enron are developed in more depth. Decision making in accounting while dealing with an ethical dilemma is discussed. Then the stakeholders that have interests with the company and might be affected by accountants' decisions are covered. In addition, the question is answered how the accountant must deal with the pressure that many stakeholders may exercise to serve their interests at the expense of other stakeholders.

*Prerequisites: BSc001*

### **ENGL1002 Advanced English** **3 Cr Hr (3,0)** **3 ECTS**

**Advanced English** is the last of the English levels at the German Jordanian University to arm graduates with the best command of the English language in its varied aspects: Reading, Writing, Speaking, Listening and Understanding. It is aimed at students who successfully pass **Upper-Intermediate English** and it is three credit hours. This level focuses on a higher level of enhancement of their language. Students can address any audience, through delivering a persuasive speech, making an informative presentation, or analyzing controversial News through News Analysis. The students' Thesis Statements are backed up with: mistake-free language, persuasive logic and verified statistics, numbers and facts to convince the audience with their points of view. Other tools are enhanced involving their language, including specific terminology, tone, intonation and body language to make them acquire the best outcome. Students can also address any topic in writing. With the language skills provided in this level, GJU graduates become more equipped with outstanding abilities and get better chances in the work market, in addition to their knowledge and education in the major fields. The assessment of the students applies Bloom's Taxonomy where the learning objectives are classified according to the different domains including: learning (remembering), understanding, applying, analyzing, evaluating, the creating. Upon finishing this level, all students are eligible to receive an English language proficiency letter indicating their level according to the Common European Framework Reference for Languages (CEFR) varying between B2, C1 or C2 according to the grade they get upon finishing this level.

*Prerequisites: ENGL1001*

<b>CEE512 Air Pollution Control</b>	<b>2 Cr Hr (2,0)</b>	<b>3</b>
<b>ECTS CEE513 Air Pollution Control Lab.</b>	<b>1 Cr Hr (0,3)</b>	<b>2</b>

**ECTS**

Air pollution control law and regulations. Air pollution measurement; Emission estimates. Meteorology for air pollution control engineers. Air pollution concentration models. Designing air pollution control systems and equipment. Combustion and control systems (Particulate pollutants; primary particulates; Vocs; SOx and NOx). Air pollutants and global climate.

This course is integrated with the lab to cover the practical part including Air pollutants measurement methods and used devices: Particulate Matter, Carbon Monoxide, Sulfur Oxides and Nitrogen Oxides devices. The efficiency for an air pollutant control device (Cyclone). Design a software to estimate the emissions and predict the maximum concentration based on Gaussian Plume Model.

*Prerequisites: BSC001*

<b>MATH203 Applied Mathematics for Engineers</b>	<b>3 Cr Hr (3,0)</b>	<b>5</b>
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**ECTS**

Vector analysis in Cartesian coordinates; Curvilinear coordinates and transformations to Cartesian, Spherical, and Cylindrical coordinates; line integrals, surface integrals, Green's theorem, Gauss's divergence theorem, and Stokes's theorem. Scalar and vector potential. Review of Series. Linear Algebra; Matrices and linear equations; Matrices and Linear Operators; Determinants, Eigenvalues and eigenvectors. Complex Numbers and Complex Variable; Representation of complex numbers, DeMoivre's formula, Powers and roots of complex numbers, Functions of complex variable.

*Prerequisites: MATH102*

<b>ARB100 Arabic</b>	<b>3 Cr Hr (3,0)</b>	<b>3</b>
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**ECTS**

This course aims to improve the student's competence in the various linguistic skills in terms of reading, comprehension, and taste. This is achieved through the study of selected texts with many implications that raise issues in spelling, grammar, composition, meaning, and inference, and the use of an old and modern thesaurus.

*Prerequisites: ARB0099*

<b>ARB099 Basic Arabic 99</b>	<b>3 Cr Hr (3,0)</b>	<b>3</b>
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**ECTS**

This course aims to develop student's ability to read, comprehend, literary analyze, grammatically analyze, linguistically analyze, poetically analyze, and rhetorically analyze texts properly. The course also includes a selection of Arabic literature in poetry and prose representing different literary ages, in addition to several common forms of writing such as scientific article, news article, and others.

*Prerequisites: -*

<b>MATH101 Calculus I</b>	<b>3 Cr Hr (3,0)</b>	<b>5</b>
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**ECTS**

This course introduces the student to the calculus of single-valued functions. Topics include: limits, continuity, rates of change, rules for differentiating, differentials and local linear approximations, maxima and minima problems, L'Hôpital's rule, related rates, logarithmic and implicit differentiation, inverse trigonometric and hyperbolic functions, Rolle's Theorem, the mean-value theorem, and applications of derivatives and integrals. An overview of integration, basic techniques for integration, algebraic techniques of integration and applications of integrations are also included.

*Prerequisites: MATH099*

<b>MATH102 Calculus II</b>	<b>3 Cr Hr (3,0)</b>	<b>5</b>
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**ECTS**

Sequences and series, power series, convergence theorems: integral, ratio, and alternating - series tests, Polar coordinates, and functions, integration and differentiation of polar functions, Vectors in three

dimensional space, spherical and cylindrical coordinates, Vector-valued functions, Partial derivatives, Multiple integrals, Topics in vector calculus.

*Prerequisites: MATH101*

<b>CS116 Computing Fundamental ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>6</b>
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Basic computer skill; Programming concepts; algorithms: data types, arithmetic, logical, relational, Boolean, and assignment operators, simple input and output statements; programming control structures; data structures: single and multidimensional arrays; character strings; functions; pointers; file structures and representation. Based on programming language such as C.

*Prerequisites: -*

<b>CS1160 Computing Fundamental lab ECTS</b>	<b>1 Cr Hr (0,1)</b>	<b>0</b>
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3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered: Programming concepts; algorithms: data types, arithmetic, logical, relational, Boolean, and assignment operators, simple input and output statements; programming control structures; data structures: single and multidimensional arrays; character strings; functions; pointers; file structures and representation. Based on programming language such as C.

*Prerequisites: -  
Corequisites: CS116*

<b>MATH205 Differential Equations ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>5</b>
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First-order ordinary differential equations, Second-order ordinary differential equations, System of ODEs. Solution Techniques including Laplace transforms, Fourier series: eigenvalue problems and expansions in orthogonal functions. Partial differential equation: classification, separation of variables, solution by series and transform methods. Models in Applied Mathematics; Applications to illustrate typical problems and methods of applied mathematics in solid and fluid mechanics, fields of physics, dynamics and vibrations, wave phenomena, diffusion phenomena, heat conduction, and biological processes.

*Prerequisites: MATH102*

<b>ENGL0098 Elementary English ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>3</b>
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Students will focus on English at an elementary level through the receptive skills of reading and listening and the productive skills of writing and speaking. **Elementary English** is aimed at students who have achieved a grade of between 0 and 60 on the English Placement Test. This course is zero credit hours. This course enables students to contribute their own knowledge or experience in speaking activities, and use the language correctly. The exposure to a wide variety of listening material with a variety of accents, including some non-native speakers of English improves their level. **Elementary English** integrates the focus on individual sounds of word and sentence stress where students are encouraged to copy the rhythm of English. Pronunciation is also integrated into Grammar and Vocabulary activities.

*Prerequisites: -*

<b>ENE537 Energy Efficiency, Management and Laws ECTS</b>	<b>3 Cr Hr (3,0)</b>	<b>5</b>
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Technical and physical processes involved in energy usage in: residential, commercial, industrial and transport sectors; economic tools required to justify expenditure on energy efficiency programs; "whole system" design and analysis; policy and environmental requirements to enhance implementation of energy efficiency measures;

*Prerequisites: BSC001*

<b>IE0141 Engineering Workshop</b>	<b>1 Cr Hr (0,3)</b>	<b>2</b>
<b>ECTS</b>		

*General safety in the workshop; Engineering materials and their classifications; Measuring devices and their accuracy; Theoretical background and practical exercises covering the following topics: carpentry, welding, mechanical fasteners, drilling, metal cutting, sheet-metal working, maintaining electrical and plumbing systems.*

*Prerequisites:-*

<b>CEE500 Environmental engineering and sustainability concepts</b>	<b>3 Cr Hr (3,0)</b>	<b>4</b>
<b>ECTS</b>		

Concepts related to environmental engineering, including the fundamental laws of mass and energy and Environmental systems and applications (water resources and water/ wastewater treatment, air pollution and control, and solid waste management). Concepts of sustainability and its incorporation in environmental engineering systems, sustainable development goals, Sustainable design for environmental systems (Green Engineering, the complex environmental issues related to sustainable engineering, concepts and analytical methods/models, and resources for evaluating and comparing sustainability implication of engineering activities, develop sustainable engineering solutions. Environmental assessment for engineering processes and activities will be introduced (Environmental impact assessment and Life cycle assessment).

*Prerequisites: BSC001*

<b>PHYS106 General Physics Lab</b>	<b>1 Cr Hr (0,3)</b>	<b>2</b>
<b>ECTS</b>		

Developing a good understanding of a few important concepts in Mechanics, Electricity, and Magnetism. Learning to apply these concepts to familiar and unfamiliar situations and Gaining the ability to reason qualitatively and quantitatively. This lab consists of 12 experiments, six in Mechanics and six in Electricity and Magnetism.

*Prerequisites: -  
Corequisites: PHYS104*

<b>GERL101B1 German I B1 track</b>	<b>3 Cr Hr (9,0)</b>	<b>6 ECTS</b>
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By the end of this module, the student will be able to:

- Comprehend very familiar, everyday expressions and very simple sentences and structures related to areas of most immediate relevance according to the discretionary standards in the Common European Framework of Reference for Languages (CEFR) at the Level A1.1 (beginners without preknowledge).
- Introduce herself/himself and others, express likes and dislikes, fill out a personal form, ask questions and give answers in present and partially in past tense, set private and semi-official appointments, describe people and things and express frequency and quantity in a very basic way both orally and in writing.
- Communicate with native speakers on a very basic level if those involved in the conversation speak slowly and clearly and are willing to support the non-native speaker.

*Prerequisites: Intensive pre-course (only for 1st semester of an academic year)*

<b>GERL102B1 German II B1 track</b>	<b>3 Cr Hr (9,0)</b>	<b>6</b>
<b>ECTS</b>		

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

- Understand and use familiar, everyday expressions and very simple sentences and structures related to areas of most immediate relevance according to the discretionary standards in the Common European Framework of Reference for Languages (CEFR) at the level A1.2 (basic users).

- Introduce herself/himself and others, express likes and dislikes, fill out a personal form, ask questions and give answers in present and past tense, set private and official appointments, describe people and things, ask for directions, express frequency and quantity in a basic way both orally and in writing.

- Communicate with native speakers on a very basic level if those involved in the conversation speak slowly and clearly and, if need be, are willing to support the non-native speaker.

*Prerequisites: GERL101B1*

**GERL102B2 German II B2 track**  
**ECTS**

**3 Cr Hr (9,0)**

**6**

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

- Understand and use familiar, everyday expressions and simple sentences and structures related to areas of most immediate relevance according to the discretionary standards in the Common European Framework of Reference for Languages (CEFR) at the level A1.2 and, partially, A2.1 (basic users).
- Talk about their academic and/or professional background, describe their living conditions, express likes and dislikes, ask questions and give answers in present and past tense, ask for help and support, make suggestions and give advice, express pity, sorrow and hopes, express frequency and quantity in a basic way both orally and in writing.
- Introduce herself/himself and others, express likes and dislikes, fill out a personal form, ask questions and give answers in present and past tense, set private and official appointments, describe people and things, ask for directions, express frequency and quantity in a basic way both orally and in writing.
- Communicate with native speakers on a basic level if those involved in the conversation speak slowly and clearly and, if need be, are willing to support the non-native speaker.

*Prerequisites: GERL101B1*

**GERL201B1 German III B1 track**  
**ECTS**

**3 Cr Hr (6,0)**

**4**

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

- Understand and use familiar, frequently used expressions and simple sentences and structures related to areas of a wider immediate relevance according to the discretionary standards in the Common European Framework of Reference for Languages (CEFR) at the level A2.1 (basic users).
- Talk about their academic and/or professional background, describe their living conditions, express likes and dislikes, ask questions and give answers in present and past tense, ask for help and support, make suggestions and give advice, describe health problems and talk with medical doctors and nurses, express pity, sorrow and hopes, express frequency and quantity in a basic way both orally and in writing.
- Communicate with native speakers within simple and familiar tasks requiring a simple and direct exchange of information on familiar and routine matters.

*Prerequisites: GERL102B1*

**GERL201B2 German III B2 track**  
**ECTS**

**3 Cr Hr (6,0)**

**4**

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

- Distinguish between familiar expressions, sentences and structures related to areas of immediate relevance and more elaborated components like the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the Common European Framework of Reference for Languages (CEFR) at the level A2.1 and A2.2 (basic users).
- Talk about their academic and/or professional background, describe their living conditions, express likes and dislikes, ask questions and give answers in present and past tense, ask for help and support, make suggestions and give advice, describe health problems and talk with medical doctors and nurses, express

pity, sorrow and hopes, describe simple statistics, express frequency and quantity in a basic way both orally and in writing, express feelings of happiness, joy and discomfort and write personal emails and letters, understand and produce comments, blogs and reports.

- Communicate with native speakers in simple and familiar tasks requiring a simple and direct exchange of essential information on familiar and routine matters.

*Prerequisites: GERL102B2*

#### **GERL202B1 German IV B1 track**

**3 Cr Hr (9,0)**

**6**

##### **ECTS**

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

- Distinguish between familiar expressions, sentences and structures related to areas of immediate relevance and more elaborated components like the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the Common European Framework of Reference for Languages (CEFR) at the level A2.2 (basic users) and, partially, at the level B1.1 (independent user).

- Talk about personal experiences with languages, express feelings of happiness, joy and discomfort, describe own media consumption habits, describe travel experiences, convince others, describe and report in official situations, describe statistics, write formal invitations and short emails, make suggestions and talk about future events and situations, describe dreams hopes and ambitions and briefly

give reasons or explanations for opinions and plans.

- Communicate with native speakers about essential points and ideas in familiar contexts.
- Understand the characteristics of the official B1 exam according to the CEFR and use strategies to overcome obstacles while solving said exam.

*Prerequisites: GERL201B1*

#### **GERL202B2 German IV B2 track**

**3 Cr Hr (9,0)**

**6**

##### **ECTS**

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

- Understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the Common European Framework of Reference for Languages (CEFR) at the level B1.1 and B1.2 (independent user).

- Deal with most situations likely to arise whilst traveling in an area where German is spoken, produce simple connected texts on topic which are familiar or of personal interest, describe experiences and events, dreams, hopes and ambitions and briefly give reasons and explanations for opinions and plans.

- Understand the main point of many radio or TV programmes on current events and topics, understand the description of events, feelings and wishes in personal letters, write personal letters/texts describing experiences and impressions, write straightforward connected texts on topics which are familiar or of personal interest.

- Communicate with native speakers about essential points and ideas in familiar contexts and about topics of personal or partially professional interest.

- Follow a lecture or talk within her/his field, provided the subject matter is familiar and the presentation straightforward and clearly structured.

- Understand simple technical information, such as operating instructions for everyday equipment.

- Understand all characteristics of the official B1 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and all its components.

*Prerequisites: GERL201B2*

<b>GERL301B1 German V B1 track</b>	<b>3 Cr Hr (9,0)</b>	<b>6</b>
<b>ECTS</b>		

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

- Understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the Common European Framework of Reference for Languages (CEFR) at the level B1.1 and B1.2 (independent user).
- Deal with most situations likely to arise whilst traveling in an area where German is spoken, produce simple connected texts on topic which are familiar or of personal interest, describe experiences and events, dreams, hopes and ambitions, statistics, and briefly give reasons and explanations for opinions and plans.
- Understand the main point of many radio or TV programmes on current events and topics, understand the description of events, feelings and wishes in personal letters, write personal letters/texts describing experiences and impressions, write straightforward connected texts on topics which are familiar or of personal interest.
- Communicate with native speakers about essential points and ideas in familiar contexts and about topics of personal or partially professional interest.
- Follow a lecture or talk within her/his field, provided the subject matter is familiar and the presentation straightforward and clearly structured.
- Understand simple technical information, such as operating instructions for everyday equipment.
- Understand all characteristics of the official B1 exam according to the CEFR and use a variety of strategies to overcome obstacles while solving said exam and all its components.

*Prerequisites: GERL202B1*

<b>GERL301B2 German V B2 track</b>	<b>3 Cr Hr (9,0)</b>	<b>6</b>
<b>ECTS</b>		

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

- Largely understand and produce rather complex texts on both concrete and abstract topics, including technical discussions in her/his field of specialisation and according to the discretionary standards in the Common European Framework of Reference for Languages (CEFR) at the level B2.1 (independent user).
- Interact with an initial degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party.
- Largely understand standard spoken language, live or broadcast, on both familiar and unfamiliar topics normally encountered in personal, social, academic or vocational life.
- Show a relatively high controlled degree of grammatical control without making errors which cause misunderstanding and with the growing ability to correct most of her/his mistakes.
- Largely follow essentials of lectures, talks, reports and other forms of academic/professional presentation which are propositionally and linguistically complex.
- Understand announcements and messages on concrete and abstract topics spoken in standard dialect at

normal speed.

- Scan quickly through long texts, locating relevant details and understand and exchange complex information and advice on the full range of matters related to her/his occupational role.
- Understand the main characteristics of the official B2 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and its different components.

*Prerequisites: GERL202B2*

**GERL302B2 German VI B2 track**  
**ECTS**

**3 Cr Hr (6,0)**

**6**

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

- Understand and produce rather complex texts on both concrete and abstract topics, including technical discussions in her/his field of specialisation and according to the discretionary standards in the Common European Framework of Reference for Languages (CEFR) at the level B2.2 (independent user).
- Interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party.
- Understand standard spoken language, live or broadcast, on both familiar and unfamiliar topics normally encountered in personal, social, academic or vocational life.
- Show a highly controlled degree of grammatical control without making errors which cause misunderstanding and with the growing ability to correct most of her/his mistakes.
- Follow essentials of lectures, talks, reports and other forms of academic/professional presentation which are propositionally and linguistically complex.
- Understand announcements and messages on concrete and abstract topics spoken in standard dialect at normal speed.
- Scan quickly through long texts, locating relevant details and understand and exchange complex information and advice on the full range of matters related to her/his occupational role.
- Understand all characteristics of the official B2 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and its different components.
- Successfully manage the application process for a six months internship in Germany which is part of the obligatory 'German Year' for all GJU students. The process consists of finding and understanding a suitable add in accordance with the students' major, writing a convincing CV and cover letter, and mastering an effective and mostly fluent interview, departing spontaneously, taking initiatives, expanding ideas with little help or prodding from the interviewer.
- Successfully manage the most significant situations which the student, in accordance with the currently studied major, encounters during her/his theoretical and practical semester in Germany. This process is being achieved within a technical language training focussing on action orientated and communicative scenarios like following lectures, taking notes, summarizing academic and technical texts, writing official emails and texts related to academic and vocational encounters, holding presentations, communicating both verbally and in writing with professors, university staff, students as well as with colleagues and customers during an internship.
- Understand the concept of general intercultural phenomena, reflect and understand the differences between culture and cultural standards in Jordan and in Germany, understand the concept of 'culture shock' and potentially cope with its different stages, reflect about appropriate and inappropriate behaviour in

Germany as well as understand the concepts of open-mindedness and 'culture clash'.

*Prerequisites: GERL301B2*

**GERL302INT German VI Intensive**  
**ECTS**

**3 Cr Hr (9,0)**

**6**

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

- Successfully manage the application process for a six months internship in Germany which is part of the obligatory 'German Year' for all GJU students. The process consists of finding and understanding a suitable add in accordance with the students' major, writing a convincing CV and cover letter, and mastering an effective and mostly fluent interview, departing spontaneously, taking initiatives, expanding ideas with little help or prodding from the interviewer.
- Successfully manage the most significant situations which the student, in accordance with the currently studied major, encounters during her/his theoretical and practical semester in Germany. This process is being achieved within a technical language training focussing on action orientated and communicative scenarios like following lectures, taking notes, summarizing academic and technical texts, writing official emails and texts related to academic and vocational encounters, holding presentations, communicating both verbally and in writing with professors, university staff, students as well as with colleagues and customers during an internship.
- Understand the concept of general intercultural phenomena, reflect and understand the differences between culture and cultural standards in Jordan and in Germany, understand the concept of 'culture shock' and potentially cope with its different stages, reflect about appropriate and inappropriate behaviour in Germany as well as understand the concepts of open-mindedness and 'culture clash'.
- Understand all characteristics of the official B1 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and its different components.

*Prerequisites: GERL301B1*

**GERL302REG German VI Regular**  
**ECTS**

**3 Cr Hr (6,0)**

**6**

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

- Successfully manage the application process for a six months internship in Germany which is part of the obligatory 'German Year' for all GJU students. The process consists of finding and understanding a suitable add in accordance with the students' major, writing a convincing CV and cover letter, and mastering an effective and mostly fluent interview, departing spontaneously, taking initiatives, expanding ideas with little help or prodding from the interviewer.
- Successfully manage the most significant situations which the student, in accordance with the currently studied major, encounters during her/his theoretical and practical semester in Germany. This process is being achieved within a technical language training focussing on action orientated and communicative scenarios like following lectures, taking notes, summarizing academic and technical texts, writing official emails and texts related to academic and vocational encounters, holding presentations, communicating both verbally and in writing with professors, university staff, students as well as with colleagues and customers during an internship.
- Understand the concept of general intercultural phenomena, reflect and understand the differences between culture and cultural standards in Jordan and in Germany, understand the concept of 'culture shock' and potentially cope with its different stages, reflect about appropriate and inappropriate behaviour in Germany as well as understand the concepts of open-mindedness and 'culture clash'.

*Prerequisites: GERL301B1*

<b>ENGL0099 Intermediate English</b>	<b>3 Cr Hr (3,0)</b>	<b>3</b>
<b>ECTS</b>		
<p>Students will focus on English at an intermediate level through the receptive skills of reading and listening and the productive skills of writing and speaking. <b>Intermediate English</b> is aimed at students who have successfully passed <b>Elementary English</b> or achieved a grade of between 61-80 on the English Placement Test. This course is zero credit hours. Attendance: Students are required to attend regularly according to the regulations of GJU and should provide the instructor with official excuses in case they are absent for a long time. Participation and homework: Students are required to participate in the group discussion in class. Interaction is necessary as well as oral presentations will be given to measure how fluent students are and to improve their skill of speaking. Medium of communication: GJU email, face to face (on campus) and during office hours. Teaching method: Explaining, discussing and doing the exercises given to students.</p>		
<i>Prerequisites: ENGL0098</i>		

<b>ENE534 Low Carbon Buildings</b>	<b>3 Cr Hr (3,0)</b>	<b>5</b>
<b>ECTS</b>		
<p>Low carbon buildings; methods for balancing architectural and human requirements; relationship between building design and: thermal comfort inside the building, lighting performance, heating, cooling and lighting loads; psychrometric chart to analyze climate and human comfort; the effects of common passive solar strategies on building design; different thermal comfort models; determine the thermal and lighting performance of a building using manual methods and software; appropriate passive solar and low energy design strategies; assess solar access at a site using manual methods; energy assessment tools for building simulation; energy efficiency techniques in the residential sector.</p>		
<i>Prerequisites: BSC001</i>		

<b>MILS100 Military Science</b>	<b>3 Cr Hr (3,0)</b>	<b>2</b>
<b>ECTS</b>		
<p>History of the Jordanian Arab Army. United Nations Peace Keeping Forces. Preparation of the nation for defense and liberation. History of the Hashemite Kingdom of Jordan and its development.</p>		
<i>Prerequisite:-</i>		

<b>NE101 National Education</b>	<b>3 Cr Hr (3,0)</b>	<b>3</b>
<b>ECTS</b>		
<p>In a context of striving towards democracy like the one Jordan enjoys today, the meaning and practice of active and responsible citizenship becomes more crucial. It is often argued that democracy requires “democrats” to flourish, and become well established. Democrats are those women and men who recognize pluralism, inclusion, positive engagement, and participation as the main values that govern their interaction with the state as citizens and with each other as diverse people of different interests. In this course you will be able to understand your rights and responsibilities as Jordanian citizen expand your knowledge about the frameworks, and processes that regulates citizen-state relationships as well as the basic necessary skills for you to practice your citizenship rights in a civic manner.</p>		
<i>Prerequisites:-</i>		

<b>PHYS103 Physics I</b>	<b>3 Cr Hr (3,0)</b>	<b>5</b>
<b>ECTS</b>		
<p>Physics 103 is concerned with mechanics, the study of motion. Mechanics, in turn, consists of two major areas; kinematics and dynamics. Mechanics is basic to the understanding all the other areas of physics. Only three simple laws (Newton's laws of motion) and two fundamental conservation principles (the conservation of energy and the conservation of momentum) are needed to describe almost all the motion that we observe in our everyday world. The purpose of Physics 103 is to gain some understanding of these basic laws and principles and to learn how to apply them to physical happenings that occur in our daily life and work. The basic method of study will be to define the concepts, discuss and demonstrate the principles and laws, and to test and refine understanding by problem solving.</p>		
<i>Prerequisites: -</i>		

**PHYS104 Physics II** **3 Cr Hr (3,0)** **5**

**ECTS**

To provide you with theoretical knowledge about Electricity & Magnetism. Many courses to come during your study will depend directly or indirectly on this course. They include that you: • develop a good understanding of a few important concepts in physics • learn to apply these concepts to different situations • gain the ability to reason qualitatively and quantitatively about physics.

*Prerequisites: PHYS103*

**MGT418 Quality Management** **3 Cr Hr (3,0)**

**4.5 ECTS**

Total Quality Management (TQM) helps the students to learn to view quality from a variety of functional perspectives, gain a better understanding of the problems associated with improving quality, also quality tools utilized in service and international/environments. This module focuses on the essence, principles, and practices of total quality management (TQM). Some of the ideas and topics that are covered are: process improvement; process orientation; service quality; human resources; customer satisfaction programs; quality function deployment; process control and capability; role of inspection; economics of quality; productivity measurement; learning and organizational performance measures; and teachings of Deming, Juran, and Crosby.

*Prerequisites: BSC001*

**ENGL1001 Upper-Intermediate English** **3 Cr Hr (3,0)** **3**

**ECTS**

Education is the ability to listen to almost anything without losing your temper or your self-confidence." Robert Frost (1874 - 1963) **Upper-Intermediate English** is aimed at students who have achieved a passing grade in **Intermediate English** or a grade between 81 and above on the English Placement Test. **Upper-Intermediate English** is equal to three credit hours. Students will focus on English at an upper intermediate level. Students will analyze and produce essays with an emphasis on argumentation and persuasion working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Class activities include interactive lectures, small group and class discussions, informal debates, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using basic literary terms and concepts. Note: The process of argumentation enables us to clarify and develop our own responses to important issues, and a significant part of that process involves dialogue with both those who share our opinions and those who do not. In order to participate responsibly and effectively in meaningful dialogue, we must maintain an attitude characterized by openness, responsibility, rationality, and respect for all participants. Upon finishing this level, all students are eligible to receive an English language proficiency letter indicating their level according to the Common European Framework Reference for Languages (CEFR) varying between B1 and B2 according to the grade they get upon finishing this level.

*Prerequisites: ENGL0099*

**CEE515 Water and wastewater Treatment engineering** **3 Cr Hr (3,0)** **5**

**ECTS**

The needs for water quality and how to achieve it by drinking water treatment; wastewater treatment; other water-quality control strategies (principles and theory).

*Prerequisites: BSC001*

**CEE516 Water and wastewater Treatment engineering Lab** **1 Cr Hr (0,3)** **2**

**ECTS**

Water and Wastewater analysis: acidity; alkalinity; chloride; hardness; Ammonia; dissolved oxygen;

biochemical oxygen demand; chemical oxygen demand; coliform bacteria; solids determination; coagulation; and softening.

*Prerequisites: BSC001*

## IV. Dual Study University Requirements Courses:

### **DS101 Dual Study Practical I**

**3 CH (3,0), 3 ECTS**

Student and the company/organization agree on a training plan for the 12-week practical phase. The student will be given a general orientation to the company/organization and be assigned to one or more departments in the company. He/She and will contribute to the completion of routine tasks. In addition to guidance from the company/organization, the student will be supervised and evaluated by a university instructor. Supervision can be performed via a combination of field visits, virtual meetings, and direct communication with the student and/or his supervisor in the company/organization. The regular aim for the academic supervisor is to visit the student once during the practical phase. During the training, the student will learn about the various responsibilities of professionals in his/her field and interact with employees. He/she will learn the basic processes and services inside the company/organization. The student will also perform supervised work and apply their basic professional knowledge in their work activities. Students will learn about the importance of professionalism, organization, effective communication, and ethics in the work environment. They will construct a general awareness of the culture of the company and develop a good understanding of the company's position in its targeted market. Students will get the opportunity to start building their professional network.

*Prerequisites: -*

### **DS201 Dual Study Practical II**

**3 CH (3,0), 3 ECTS**

Student and the company/organization agree on a training plan for the 12-week practical phase. The student will be assigned to one or more departments in the company and will contribute to the completion of their routine tasks. In addition to guidance from the company/organization, the student will be supervised and evaluated by a university instructor. Supervision can be performed via a combination of field visits, virtual meetings, and direct communication with the student and/or his supervisor in the company/organization. The regular aim for the academic supervisor is to visit the student once during the practical phase. During the training, the student will learn to become aware of the main responsibilities of professionals in his/her field. He/she will become familiar with processes and services inside the company/organization. The student will also perform work with limited supervision and apply their scientific knowledge in their work activities. Students will learn and practice professionalism, organization, effective communication, and ethics in the work environment. They will construct a sound awareness of the culture of the company and develop a very good understanding of the company's position in its targeted market. Students will get the opportunity to expand their professional network. They will also work on a project assignment related to the work of his/her company. The project is then evaluated at the end of the training period.

*Prerequisites: DS101*

### **DS301 Dual Study Practical III**

**0 CH (0,0), 6 ECTS**

Student and the company/organization agree on a training plan for the 12-week practical phase. The student will be assigned to one or more departments in the company and will contribute to the completion of their routine tasks. During the training, the student will learn to become fully aware of the main responsibilities of professionals in his/her field. He/she will become familiar with processes, projects, and services inside the company/organization. The student will also perform work with limited or no supervision and apply their scientific knowledge in their work activities. Students will learn and practice professionalism, organization,

effective communication, and ethics in the work environment. They will construct a strong awareness of the culture of the company and develop an excellent understanding of the company's position in its targeted market. Students will get the opportunity to expand their professional network.

*Prerequisites: DS201*

## **V.Module Description**

## Bachelor

<b>Module Title</b>		<b>Module Code</b>
Process safety and Hazardous Waste Management		PCE5104-DS

<b>Compulsory Module</b>	X	<b>Year of Study</b>	3	<b>Semester Hours</b>	3
<b>Elective Module</b>		<b>Spring Semester</b>		<b>Workload</b>	150
<b>Optional Module</b>		<b>Winter Semester</b>		<b>ECTS</b>	5
<b>Pre-university</b>		<b>Summer Semester</b>	X	<b>Remedial</b>	
		<b>Pre-Programm</b>			

### Examination

#### Portfolio:

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

### Responsible Lecturer(s)

Prof. Dr. Munib Saket

<b>Course</b>	<b>Mode of Delivery</b>	<b>Contact Time</b>	<b>Self-Study</b>
Process safety and Hazardous Waste 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.
- Preparation 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, 2<sup>nd</sup> 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, 1<sup>st</sup> 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