



**PART [C]: SPECIALIZED PROGRAMS**

**(9) PETROCHEMICAL PROCESS SYSTEMS  
ENGINEERING Program (PPS)**

برنامج هندسة منظومات العمليات البتروكيمياوية



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## BYLAWS 2023 Bachelor of Science Degree Credit Hours System



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### (9) Petrochemical Process Systems Engineering Program (PPS)

برنامج هندسة منظومات العمليات البتروكيماوية

#### VISION رؤية البرنامج

To produce high caliber engineers with knowledge, expertise, and the strong foundation of social and professional ethics to benefit the society; support the industrial and then socio-economic development and Advanced Research in petrochemical engineering and related disciplines.

تخريج مهندسين من ذوي الكفاءات العالية مزودين بالمعارف والخبرات وأساس متين من الأخلاق الاجتماعية و المهنية قادرين على خدمة المجتمع ودعم التنمية الصناعية و الاجتماعية و الاقتصادية ودفع عجلة البحث في مجال هندسة البتروكيماويات والتخصصات ذات الصلة

#### MISSION رسالة البرنامج

The program is committed to provide graduates with a distinguished scientific level in all disciplines of engineering related to petrochemicals, and who have the ability to meet the field challenges through distinguished scientific research with the use of the latest computational engineering Methods that include machine learning and data science application to serve society and the environment.

يلتزم البرنامج بإمداد سوق العمل بخريجين ذوي مستوى علمي متميز في جميع تخصصات الهندسة المتعلقة بالبتروكيماويات، ولديهم القدرة على مواجهة تحديات المجال من خلال البحث العلمي المتميز مع الاستعانة بأحدث الأساليب الحاسوبية الهندسية التي تشمل التعلم الآلي و علوم البيانات وذلك بهدف خدمة المجتمع والبيئة.

#### GRADUATE ATTRIBUTES مواصفات الخريج

- يخرج البرنامج مهندسين ذوي خلفية قوية في تخصص البتروكيماويات، ذو معرفة متعمقة في مجال الصناعات البتروكيماوية.
- يتميز خريج البرنامج بقدرته على استخدام أحدث الأساليب العلمية في مجال الذكاء الاصطناعي والتعلم الآلي لحل المشكلات الهندسية في تخصص الهندسة الكيميائية و هندسة البتروكيماويات.
- خريج البرنامج قادر على المنافسة في سوق العمل المحلي و الاقليمي و الدولي و ذو قدرات عالية على الفهم و الإستيعاب و التعلم الذاتي و الابتكار و الخلق و الإبداع و لديه مهارات اتصال .
- يمتلك الخريج المهارات العملية و المهنية اللازمة للتوظيف في مجال البتروكيماويات و المجالات ذات الصلة و قادر على استكمال الدراسات العليا في مجال التخصص.
- يتميز الخريج أيضا بالمهارات والأخلاق المهنية اللازمة للعمل ضمن فريق و التفاعل الصحيح في البيئة المهنية. هذا بالإضافة إلى امتلاكه للمهارات الفكرية المطلوبة لتخطيط وتصميم و تحليل و تنفيذ وإدارة المشاريع الصناعية البتروكيماوية .



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### PROGRAM BENCHMARK مرجعية البرنامج

- The program engineers have a strong background in petrochemical, with in-depth knowledge in petrochemical industries.
- The graduate of the program is distinguished by his ability to use the latest scientific methods in the field of artificial intelligence and machine learning to solve engineering problems in the field of Chemical Engineering and Petrochemical Engineering.
- The program graduate is able to compete in the local, regional and international market, has high abilities in understanding, assimilation, self-learning, innovation, creation and creativity. He also has communication skills.
- The graduate students possess practical and professional skills required for employment in petrochemicals fields and related fields, besides being able to complete the postgraduate studies in their specialization field.
- The graduate is also distinguished by his skills and professional ethics required to work within a team and interact correctly in a professional environment. This is in addition to possessing the intellectual skills required to plan, design, analyze, implement, and manage petrochemical industrial projects.

- يبنى البرنامج المعايير القومية الاكاديمية المرجعية (اصدار 2018) والمعدة من الهيئة القومية لضمان جودة التعليم والاعتماد وذلك للجدارات الخاصة بخريج كليات الهندسة على المستوى (A) ، وكذلك للجدارات الخاصة بخريج برامج الهندسة الكيميائية على المستوى (B).
- وكذلك يبنى البرنامج بعض المعايير الأخرى الأكثر تخصصاً على المستوى (C)، وذلك نظراً لطبيعة البرنامج.

NARS 2018	LEVEL A	LEVEL B	LEVEL C	LEVEL D
	Totally Adopted	Totally Adopted	See Below	NA

Level C Sub-Specialty Competencies:

**The Petrochemical Process Systems Engineering (PPS) graduate must be able to:**

- C1. Construct and develop systems and processes in the Petrochemical industries according to its regulatory framework.
- C2. Examine system components or/and direct modification of equipment/products to ensure conformance with engineering design, performance specifications, or environmental regulations.
- C3. Demonstrate & evaluate several methods applied to break down Petrochemical industries, and develop everyday products like plastic, rubber, and synthetic fibres.
- C4. Develop, design, evaluate, install, operate, or maintain equipment, systems, or processes in petrochemicals field to meet technical & economical requirements.
- C5. Apply computing science and machine learning techniques necessary to analyze, design and optimize chemical and petrochemical engineering systems and processes.



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**SPECIALIZED COURSES CONTENTS توصيف المقررات**

Code	Name	Credit Hours	Category	Pre-requisite
PPSS280	Engineering Seminar	1	DR	30 CR.HRS. + AA APPROVAL
PPSS281	Industrial Training-1	1	FR	60 CR.HRS. + AA APPROVAL
PPSS381	Industrial Training-2	2	DR	PPSS281 + AA APPROVAL
PPSS481	Graduation Project-1	1	FR	110 CR.HRS. + SOPHOMORE
PPSS482	Graduation Project-2	3	DR	PPSS481 + AA APPROVAL
<b>Total</b>		<b>2+6</b>		

**COURSES CONTENTS توصيف المقررات**

Code	Name/Content	Credit Hours	Contact Hours							Total
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	
<b>Faculty Requirements</b>										
PPSS280	Engineering Seminar Pre-requisites: 30 CR.HRS. + AA APPROVAL Talks and presentations are invited from industrial establishments relevant to the program. The guest speaker should discuss the organization, management, and recent technologies implemented in his/her industrial establishment. Students exercise writing brief technical reports on the guest presentation and deliver their own presentation about the topic. The course is graded as Pass/Fail grade-system.	1	1							1
Textbook	CRC Fundamentals of Petroleum and Petrochemical Engineering (Chemical Industries), edition, 2020. Press; 1st									
PPSS281	Industrial Training-1 Pre-requisites: 60 CR.HRS. + AA APPROVAL Training on industrial establishments relevant to the program. Training lasts for total of 90 hours, during a minimum period of three weeks. The program training advisor schedules at least one follow up visit to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The	1	0	0						1



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Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
	student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. The course is graded as Pass/Fail grade-s/system.									
PPSS381	Industrial Training-2 Pre-requisites: PPSS281 + AA Approval Training on industrial establishments relevant to the program. Training lasts for total of 180 hours, during a minimum period of six weeks. The program training advisor schedules at least two follow-up visits to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. The course is graded as Pass/Fail grade-s/system.	2	0	0						0
PPSS481	Graduation Project-1 Pre-requisites: 110 credits + SOPHOMCRE Students – in groups (or individually in some programs) - undertake a final project as part of the program. In GP1, students provide a clear identification of a real-life problem that represents an actual need for the industry or the community and reflects the mission and strategic objective of CUF. Students are expected to survey the related literature, collect, and interpret market data, and proposed an approach for the solution, using the engineering knowledge and skills acquired. The course is graded as Pass/Fail based upon a report/oral presentation stating the expected cost and required material, tools, and facilities as well as a timed list of deliverables.	1	0	0	2					3
PPSS482	Graduation Project-2 Pre-requisites: PPSS481 + AA Approval Graduation Project-2 is the second phase of the graduation project. The aim is to develop innovative solutions to problems encountered during the implementation process thus fulfilling the deliverables stated in Graduation Project-1. A dissertation on the project is submitted taking into consideration technical, economic, social, and environmental requirements while analyzing the major results and presenting direct conclusions.	3	1	2		3				6



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**PROGRAM REQUIREMENTS** متطلبات البرنامج

Category		No. of courses	Course Credit Hour	Total Credit Hours
Discipline Requirements (DR)	core/ compulsory	15	3	45
		9	2	18
	1	1	1	
	Elective	0	0	0
<b>Total DR courses</b>		<b>25</b>		<b>64</b>
Program Requirement (PR)	core/ compulsory	9	3	27
		1	4	4
	Elective	5	3	15
<b>Total PR courses</b>		<b>15</b>		<b>46</b>
<b>Total Elective courses (DR &amp; PR)</b>		<b>6</b>		<b>19</b>

▪ **Discipline Requirements (DR) core/compulsory courses list**

Code	Name	Credit Hours	Pre-requisite
CHES101	Organic Chemistry-1	2	CHES001
CHES102	Chemical Engineering Fundamentals	3	CHES001
CHES103	Material Science for Petrochemical Engineers	2	
PES201	Introduction to Petroleum Industry	3	
CHES202	Physical Chemistry-1	2	CHES001
CHES201	Fluid Mechanics	3	
PES202	General Geology	3	
INTS201	Electrical Engineering	3	PHYS002
MTHS104	Differential Equations	3	MTHS003
CHES205	Computer Applications in Petrochemical Engineering	2	INTS005
CHES206	Organic Chemistry-2	3	CHES101
CHES204	Thermodynamics and Combustion	3	CHES202
CHES203	Physical Chemistry-2	3	CHES202
CHES301	Unit Operations	3	CHES201
MDPS301	Stress Analysis and Vessel Design	2	EMCS002



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Code	Name	Credit Hours	Pre-requisite
CHES303	Cryogenic Processes	2	CHES204
CHES304	Heat Transfer and Applications	3	CHES201
CHES306	Process Control	3	
CHES405	Mass Transfer	3	CHES201 + CHES203 + CHES304
CHES403	Process and Plant Design	3	
CHES406	Economics of Oil and Gas Production	2	GENS120
CHES407	Separation Processes	2	CHES405
PPSS280	Engineering Seminar	1	30 CR.HRS. + AA APPROVAL
PPSS381	Industrial Training-2	2	PPSS281 + AA APPROVAL
PPSS482	Graduation Project-2	3	PPSS481 + AA APPROVAL
<b>Total</b>	<b>25</b>	<b>64</b>	

▪ **Program Requirements (PR) core/compulsory courses list**

Code	Name	Credit Hours	Pre-requisite
PES301	Reservoir Engineering	3	PES201
CHES302	Introduction to Machine Learning	3	CHES205 + MTHS204
CHES305	Chemical Reactor Design	3	CHES204 + CHES203 + CHES102
CHES307	Application of Machine Learning in Chemical Engineering	3	CHES302
PES401	Petroleum Production Engineering	3	PES301
CHES401	Advanced Chemical Engineering Equipment Design	3	CHES304 + CHES301
CHES402	Petrochemicals from Oil and Gas	3	CHES206
CHES404	Petroleum Refining Engineering	3	CHES206
METS401	Electrochemistry and Corrosion	3	
<b>Total</b>	<b>Including the elective courses</b>	<b>46</b>	



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▪ **Program Requirements (PR) elective courses list**

Code	Name	Credit Hours	Pre-requisite
<b>ELECTIVE- E2<sup>(1)</sup></b>			
CHES210	Data Science in Chemical Engineering	4	CHES105 + MTHS204
CHES211	Optimization in Chemical Engineering	4	CHES105 + MTHS104
<b>ELECTIVE- E2<sup>(2)</sup></b>			
CHES220	Professional Ethics and Contracting	3	
CHES221	Entrepreneurship for Chemical Engineering	3	
CHES222	Circular Economy	3	GENS120
<b>ELECTIVE- E4<sup>(3)</sup></b>			
CHES310	Environmental Laws and Ethics	3	GENS110
CHES311	Environmental Pollution and Climate Change	3	GENS110
CHES312	Safety and Risk Assessment	3	GENS110
CHES313	Water Treatment for Oil & Gas Operations	3	
<b>ELECTIVE- E5<sup>(4)</sup></b>			
CHES410	Advanced Reactor Design	3	CHES305
CHES411	Catalysis	3	CHES305
CHES412	Polymer Science and Technology	3	CHES101 + CHES204
CHES413	Petroleum Standards	3	PES201
CHES414	Industrial Measurements and Control Applications	3	CHES306
CHES415	Advanced Separation Processes	3	CHES407
CHES416	Advanced Statistics for Petrochemical Industries	3	MTHS204
CHES417	Advances in Petrochemical Engineering	3	CHES301

**Remarks:**

- (1) Student selects one course from group E-2 equivalent to 4 credits
- (2) Student selects one course from group E-3 equivalent to 3 credits
- (3) Student selects at least two (2) courses from group E-4 equivalent to 6 credits
- (4) Student selects at least two (2) courses from group E-5 equivalent to 6 credits





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**Proposed Study Plan - 8 semesters - Including Freshman Level**

S	Code	Name	Credit Hours	Contact Hours								
				Lec	Tut (2)	App Tut	Lab	Stud	Off Tut	OffHr	Total	
SEMESTER 1	PHYS001	Mechanical Properties of Matter and Thermodynamics	3	2		2	1					5
	MTHS002	Calculus I	3	2	2							4
	EMCS001	Engineering Mechanics – Dynamics	3	1	2		1					4
	CHES001	Chemistry for Engineers	2	1	2							3
	INTS001	Engineering Graphics	3	2				3				5
	INTS005	Information Technology	2	1			3					4
	GENS004	Proficiency and Capacity Building	1	1								1
	GENS001	Critical and Creative Thinking	2	2								2
		<b>Sub-Total</b>	<b>19</b>	<b>13</b>	<b>6</b>	<b>2</b>	<b>4</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>28</b>

S	Code	Name	Credit Hours	Contact Hours								
				Lec	Tut (2)	App. Tut	Lab	Stud	Off Tut	Off. Hrs	Total	
SEMESTER 2	MTHS003	Calculus 2	3	2	2							4
	EMCS002	Engineering Mechanics - Statics	2	1	2							3
	PHYS002	Electricity and Magnetism	3	2		2	1					5
	E-A (GENS005)	Elective E-A (Writing and Presentation Skills)	2	2								2
	GENS002	Societal Issues	2	2								2
	CHES101	Organic Chemistry-1	2	1			3					4
	CHES102	Chemical Engineering Fundamentals	3	2		2						4
	CHES103	Material Science for Petrochemical Engineers	2	1		3						4
		<b>Sub-Total</b>	<b>19</b>	<b>13</b>	<b>4</b>	<b>7</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>28</b>



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S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App Tut	Lab	Stud	Off Tut	OffHr	Total
SEMESTER 3	MTHS102	Linear Algebra and Multivariable Integrals	3	2	2						4
	PES201	Introduction to Petroleum Industry	3	2		1	2				5
	E-A (GENS110)	Elective E-A (Fundamental of Management, Risk and Environment)	2	2							2
	CHES202	Physical Chemistry 1	2	1		3					4
	CHES201	Fluid Mechanics	3	2	2						4
	PES202	General Geology	3	2	2						4
	INTS201	Electrical Engineering	3	2	2						4
		<b>Sub-Total</b>	<b>19</b>	<b>13</b>	<b>8</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>27</b>

S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App. Tut	Lab	Stud	Off Tut	Off. Hrs	Total
SEMESTER 4	MTHS104	Differential Equations	3	2	2						4
	CHES205	Computer Applications in Petrochemical Engineering	2	1			3				4
	CHES206	Organic Chemistry-2	3	2			3				5
	CHES204	Thermodynamics and Combustion	3	2			2				4
	CHES203	Physical Chemistry - 2	3	2	2	1					5
	MTHS204	Advanced Probability and Statistics	3	2	2						4
	E1	University Elective	2	2							2
		<b>Sub-Total</b>	<b>19</b>	<b>13</b>	<b>4</b>	<b>2</b>	<b>9</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>28</b>



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S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App Tut	Lab	Stud	Off Tut	Off. Hrs	Total
SEMESTER 5	E3	Elective-E1	3	2	2						4
	CHES301	Unit Operations	3	2		3					5
	PES301	Reservoir Engineering	3	2	2						4
	CHES302	Introduction to Machine Learning	3	2		1	2				5
	PPSS280	Engineering Seminar	1	1							1
	MDPS301	Stress Analysis and Vessel Design	2	1		3					4
	E2	Elective E2	4	2	1		2				5
		<b>Sub-Total</b>	<b>19</b>	<b>12</b>	<b>5</b>	<b>7</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>28</b>

S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App. Tut	Lab	Stud	Off Tut	Off. Hrs	Total
SEMESTER 6	CHES303	Cryogenic Processes	2	1		3					4
	E-A (GENS120)	Elective E-A (Fund. of Economics and Accounting)	2	2							2
	CHES304	Heat Transfer and Applications	3	2		3					5
	CHES305	Chemical Reactor Design	3	2	2						4
	CHES307	Application of Machine Learning in Chemical Engineering	3	2		1	2				5
	CHES306	Process Control	3	2	2						4
	E4	Elective - E3	3	2	2						4
		<b>Sub-Total</b>	<b>19</b>	<b>13</b>	<b>6</b>	<b>7</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>28</b>



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S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App Tut	Lab	Stud	Off Tut	OffHr	Total
SEMESTER 7	PES401	Petroleum Production Engineering	3	2	2						4
	CHES401	Advanced Chemical Engineering Equipment Design	3	2	2						4
	CHES402	Petrochemicals from Oil and Gas	3	2		2					4
	CHES404	Petroleum Refining Engineering	3	2		1	2				5
	CHES405	Mass Transfer	3	2		3					5
	CHES403	Process and Plant Design	3	2	2						4
	PPSS481	Graduation Project - 1	1		2						2
		<b>Sub-Total</b>	<b>19</b>	<b>12</b>	<b>8</b>	<b>4</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>28</b>

S	Code	Name	Credit Hours	Contact Hours							
				Lec	Tut (2)	App. Tut	Lab	Stud	Off Tut	Off. Hrs	Total
SEMESTER 8	E4	Elective - E4	3	2	2						4
	E5	Elective - E5	3	2	2						4
	E5	Elective - E6	3	2	2						4
	METS401	Electrochemistry and Corrosion	3	2	2						4
	CHES406	Economics of Oil and Gas Production	2	2							2
	CHES407	Separation Processes	2	1	3						4
	PPSS482	Graduation Project - 2	3	1	2	3					6
			<b>Sub-Total</b>	<b>19</b>	<b>12</b>	<b>10</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>



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Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
<b>Discipline Requirement</b>										
CHES101	Organic Chemistry-1	2	1			3				4
	Pre-requisites:(Chemistry for Engineers) CHES001									
	Types of Organic compounds, Valency, Isomerism, Saturated and unsaturated hydrocarbons, halogen derivatives of paraffins, alcohols and polyalcohols, organo-sulphur compounds, fatty acids and their derivatives, aldehydes and ketones, Amines, destructive distillation of coal, Aromatic compounds, Structure of benzene.									
Textbook	David R Klein, Organic Chemistry, 3rd edition, Wiley 2017									
CHES102	Chemical Engineering Fundamentals	3	2		2					4
	Pre-requisites: (Chemistry for Engineers) CHES001									
	Block flow diagrams, process flow diagrams, stream information, equipment information, batch versus continuous processes, the input/output structure of the process, recycle and bypass structures, units and dimensions, process variables, material balances for reactive and non-reactive processes, energy balances for reactive and non-reactive processes.									
Textbook	Richard M. Felder, Ronald W. Rousseau, Lisa G. Bullard, Elementary Principles of Chemical Processes, 4th Edition, Wiley, 2018									
PES201	Introduction to Petroleum Industry	3	2		1	2				5
	Pre-requisites:									
	Overview of Oil and Gas Resources, International petroleum organizations, Origin of Petroleum, Introduction to Petroleum Geology and Oil Traps. Introduction to Petroleum Refining and the different Petroleum Products. Overview of the Petrochemicals Industry.									
References	<ul style="list-style-type: none"> <li>• Speight, J. G., An Introduction to Petroleum Technology, Economics, and Politics, Wiley-Scrivener, 2011.</li> <li>• Treese, S.A., Pujadó, P.R., Jones, D.S.J., 2015. Handbook of Petroleum Processing, Second. ed. Springer International Publishing, Switzerland.</li> </ul>									



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Code	Name/Content	Credit Hours	Contact Hours							
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
CHES103	Material Science for Petrochemical Engineers	2	1		3					4
	Pre-requisites: Introduction on nature and properties of materials – Crystal structures – Plan and vector indices – Solids imperfections – Diffusion in solids – Mechanical properties of polymers – Mechanical properties of composites – Phase diagrams.									
Textbook	William D.Callister , Jr. & David G Rethwisch, Fundamentals of Materials Science and Engineering, WILEY , 9th edition 2019									
CHES202	Physical Chemistry-1	2	1		3					4
	Pre-requisites: (Chemistry for Engineers) CHES001 Thermodynamic systems and boundaries - forms of energy - extensive and intensive properties - properties of pure substances -basic laws of thermodynamics (conservation of mass – first, second and third laws of thermodynamics) and their applications for closed and open systems- Thermochemistry- thermodynamic analysis of systems (turbines, pumps, compressors, heat exchangers, ....) - isentropic efficiencies of turbines, nozzles, compressors, and pumps.									
References	<ul style="list-style-type: none"> <li>• Cengel Y., Fundamentals of Thermal-fluid Science, 5th. Ed., 2016 ,</li> <li>• Dahm K., Visco D., Fundamentals of Chemical Engineering Thermodynamics, 2nd. Ed., 2014.</li> <li>• Kayansayan N., Thermodynamics Principles &amp; Applications, 2nd. Ed., 2013</li> </ul>									
CHES201	Fluid Mechanics	3	2	2						4
	Pre-requisites: Fluid properties, pressure variation in a fluid and pressure measuring devices, Static forces applied on a submerged surface, basic definitions of fluid kinematics, continuity equation for steady and unsteady flow, Bernoulli's equation and its modifications, NPSH and cavitation, Flow measurements, Viscous flow in pipes, Different piping systems									
References	<ul style="list-style-type: none"> <li>• Munson, Young and Okiishi, Fundamentals of Fluid Mechanics 8th edition, 2016 ISBN: 978-1-119-08070-1</li> <li>• D. Elger, B. Leuret, C. Crowe, J. Roberson, Engineering Fluid Mechanics, 11th Edition, John Wiley &amp; Sons Inc., 2016</li> </ul>									



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			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
PES202	General Geology	3	2	2						4
	Pre-requisites: Introduction - Environment of Deposition - Deltaic, marine and Peripheral seas - Origin and classification of sedimentary rocks - Weathering - Residual deposits and soils - Fragmental sediments - History of stratigraphy - Stratigraphy nomenclature - Unconformity - Correlation - Concepts of stratigraphy studies - Samples collection - Stratigraphy of Egypt - Stratigraphic maps – Study of important microfossils.									
Textbook	Tarbuck, E. J. and Lutgens, F. K., Earth An Introduction to Physical Geology, Pearson, 2016.									
INTS201	Electrical Engineering	3	2	2						4
	Pre-requisites: (Electricity and Magnetism) PHYS002 Introduction; Electric circuit theory; Direct current circuits; Single Phase alternating current Circuits; Three Phase alternating current Circuits; Transformers; Direct current machines; Alternating current machines: constructing types and main characteristics. Three Phase Induction Motors.									
Textbook	Electrical and Electronic Principles and Technology, JOHN BIRD, Second edition 2003, Newness.									
MTHS104	Differential Equations	3	2	2						4
	Pre-requisites: (Calculus 2) MTHS003 First-order differential equations, separable, exact, linear, homogeneous and Bernoulli equations; modeling with first order differential equations; higher-order differential equations; method of undetermined coefficients; variation of parameters; modeling with higher order differential equations; series solutions; Laplace transform; properties and applications, shifting theorems, convolution theorem; solutions of differential equations using Laplace transform; Fourier series; Fourier transform.									
References	<ul style="list-style-type: none"> <li>• "A First Course in Differential Equations with Modeling Applications" 11th Edition 2017, by Dennis G. Zill</li> <li>• "Fundamentals of Differential Equations", 9th Edition, 2017, by R. Nagle , Edward Saff , Arthur Snider.</li> <li>• "Advanced Engineering Mathematics", John Wiley &amp; Sons, Inc., 10th Edition, 2011, by Erwin Kreyszig.</li> </ul>									



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			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
CHES205	Computer Applications in Petrochemical Engineering	2	1			3				4
	Pre-requisites: (Information Technology) INTS005									
	Introduction to programming using Excel and PYTHON. Solving problems related to petrochemical engineering using Excel and PYTHON.									
References	<ul style="list-style-type: none"> <li>• Computer Applications in Chemical Engineering, by Asha Immanuel Raju Chaduvula, .LAP LAMBERT Academic Publishing, 2018</li> <li>• Heys, J.J., Chemical and Biomedical Engineering Calculations Using Python, Wiley, 2017.</li> <li>• Josef Billo, Excel f Scientists and Engineers: Numerical Methods, 2006</li> </ul>									
CHES206	Organic Chemistry-2	3	2			3				5
	Pre-requisites: (Organic Chemistry-1) CHES101									
	Aromatic compounds, rules of orientation in the aromatic ring, methods of preparation of aromatic compounds, reactions of the aromatic nucleus: oxidation, hydrogenation, sulphonation, nitration and halogenation, preparation and reactions of aromatic amines, phenols, alcohols aldehydes and ketones, aromatic acids and their derivatives.									
References	<ul style="list-style-type: none"> <li>• David R. Klein, Organic Chemistry, 3rd edition Wiley, 2017.</li> <li>• Charlotte W. Pratt . Kathleen Corrly, Essential biochemistry 5th edition, Wiley 2021</li> </ul>									
CHES204	Thermodynamics and Combustion	3	2			2				4
	Pre-requisites: (Physical Chemistry-1) CHES202									
	Chemical reaction equilibrium - factors affecting the position of equilibrium of reversible chemical reactions - thermodynamics of ideal and non-ideal gas mixtures - fundamental equations governing thermodynamics ( Maxwell equation , equations of state) - principles and application of fugacity and activity coefficients - principles of combustion, thermodynamic cycles (Carnot, Rankin, Diesel, Otto) - types of internal combustion engines - gas turbines - introduction to refrigeration.									
References	<ul style="list-style-type: none"> <li>• Cengel Y., Fundamentals of Thermal-fluid Science, 5th. Ed., 2016,</li> <li>• Dahm K., Visco D., Fundamentals of Chemical Engineering Thermodynamics, 2nd. Ed., 2014.</li> <li>• Kayansayan N., Thermodynamics Principles &amp; Applications, 2nd. Ed., 2013</li> </ul>									





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			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
CHES203	Physical Chemistry-2 Pre-requisites: (Physical Chemistry-1) CHES202 Factors affecting the rate of chemical reactions - basic rate equation - concepts related to chemical reactions kinetics (half – life of the reaction) - Arrhenius relation and the effect of temperature on the reaction constant – practical determination of different physical properties (specific gravity, surface tension, distribution coefficient, ..... ) – practical determination of the rate and order of some chemical reactions - phase rule, one component systems, ideal binary liquid vapour equilibrium and properties of liquids (vapour pressure, viscosity, and surface tension).	3	2		2	1				5
Textbook	Atkins' PHYSICAL CHEMISTRY. By Peter Atkins, Julio de Paula and James Keeler 11th Edition. (2018). Oxford University Press.									
CHES301	Unit Operations Pre-requisites: (Fluid Mechanics) CHES201 Particulate solids properties, Solid storage and transportation, Flow through porous media, Fluidization, Flow of fluid past immersed bodies, Oil – gas separation, Centrifugation and cyclone design.	3	2		3					5
Textbook	McCabe J. and Smith W, "Unit Operations of Chemical Engineering" – 5th ed. – McGrawHill, 2005									
MDPS301	Stress Analysis and Vessel Design Pre-requisites: (Engineering Mechanics - Statics) EMCS002 Equilibrium of bodies under external loads and Free Body Diagrams, Section properties, Axial thermal stresses, Internal reactions due to bending, shearing force and bending moment diagrams, Bending stresses in beams, Torsional stresses and power transmission, combined stresses and Mohr's Circle, Stresses in cylindrical and spherical vessels, Fundamentals of strength of materials, tension testing, hardness and impact tests. Vessel Design: Design of Cylindrical and Spherical Vessels under Internal Pressure – Design of Heads and Closures – Design of Process Vessels and Pipes under External Pressure – Design of Tall Vessels – Design of Support for Process Vessels.	2	1		3					4
Textbook	Hibbeler, R. C., Mechanics of Materials, Pearson Prentice Hall, 10th edition, Pearson, 2017.									



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			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
CHES303	Cryogenic Processes Pre-requisites: (Thermodynamics and Combustion) CHES204 Basic definitions related to cryogenics, review first and second law of thermodynamics, Carnot refrigeration cycles, Distinguish between heat pumps and refrigeration cycles, Ideal and actual vapor compression cycles, Cascade and Multi-stages Vapor-Compression Systems, Practical applications of cryogenics.	2	1		3					4
Textbook	Michael J. Moran, Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 9th ed., John Wiley & Sons, Inc., 2018									
CHES304	Heat Transfer and Applications Pre-requisites: (Fluid Mechanics) CHES201 Modes of heat Transfer. Thermal conduction, natural and forced convection, Thermal radiation. Design and checking the suitability of heat exchangers.	3	2		3					5
Textbook	Yunus Cengel, Heat Transfer. Practical Approach, 2 <sup>nd</sup> Ed., McGraw Hill, 2002.									
CHES306	Process Control Pre-requisites: Laplace Transform- Modeling of simple systems-Linearization of nonlinear systems-Response of simple systems to external disturbances- Control Configurations-Control Modes-Block diagram algebra and reduction methods-Stability analysis of linear closed loop control systems- Design and tuning of control loops.	3	2	2						4
Textbook	George Stephanopoulos, Chemical Process Control: An Introduction to Theory and Practice, Prentice-Hall, 1984.									
CHES405	Mass Transfer Pre-requisites: (Fluid Mechanics) CHES201, (Physical Chemistry-2) CHES203 and (Heat Transfer and Applications) CHES304 Introduction to mass transfer based on Fick's law for molecular, convective and eddy diffusion. Calculation of mass transfer coefficient from correlations. Mass transfer between two phases. Design single and multi-stage contact.	3	2		3					5
References	<ul style="list-style-type: none"> <li>Treybal, R. E., Mass-transfer operations, 3<sup>rd</sup> Ed., McGraw-Hill, 1980</li> <li>Geankoplis Ch., Transport Process and Unit Operations, 3<sup>rd</sup> Ed., Prentice-Hall, 1993.</li> <li>Coluson and Richerdson, Chemical Engineering vol, vol II , vol III.</li> <li>McCabe and Smith, Unit operations for Chemical Engineering,</li> <li>Sherwood, Mass Transfer,</li> <li>Perry 's, Chemical Engineering,</li> <li>Mass Transfer: Theory and Applications, Narayanan, 1 st edition, 2014</li> </ul>									



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			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	Total
CHES403	Process and Plant Design Pre-requisites: Different types of flow sheets, Site selection criteria, Chemical plant layout criteria and different layout methods, Project time management and Gantt chart. Material balance, Species allocation, Reaction path Synthesis, Heat Exchanger Networking and Safety.	3	2	2						4
Textbook	Richard Turton, Richard C. Bailie, Wallace B. Whiting, Joseph A. Shaeiwitz, Analysis, Synthesis, and Design of Chemical Processes, 4 <sup>th</sup> Ed., Prentice Hall International Series, 2016.									
CHES407	Separation Processes Pre-requisites: (Mass Transfer) CHES405 Absorption and stripping. Distillation operation. Single stage for binary and multi-component distillation. Different methods for calculation number of stages in multi-stage binary distillation column. Operating conditions affecting and separation of difficult mixtures in distillation. Design of internals of plate and packed columns. Solvent extraction and its applications in petroleum industry, design and calculation of liquid extraction battery. Humidification and dehumidification operations. Computer simulation to solve different separation problems.	2	1	3						4
References	<ul style="list-style-type: none"> <li>Treybal, R. E., Mass-transfer operations, 3<sup>rd</sup> Ed., McGraw-Hill, 1980</li> <li>Geankoplis Ch., Transport Process and Unit Operations, 3<sup>rd</sup> Ed., Prentice-Hall, 1993.</li> <li>Coluson and Richerdson, Chemical Engineering vol, vol II, vol III.</li> <li>McCabe and Smith, Unit operations for Chemical Engineering,</li> <li>Sherwood, Mass Transfer,</li> <li>Perry's, Chemical Engineering,</li> <li>Mass Transfer: Theory and Applications, Narayanan, 1<sup>st</sup> edition, 2014</li> </ul>									



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			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	
<b>Program Requirement</b>										
<b>Program Courses (Compulsory)</b>										
PES301	Reservoir Engineering	3	2	2						4
	Pre-requisites: (Introduction to Petroleum Industry) PES201									
	Reservoir classification & energy - Calculation of oil and gas in place - Estimation of oil and gas reserves - Under saturated reservoirs - Gas Cap reservoirs with water drive. Water flooding and gas injection.									
Textbook	Ahmed, T., Reservoir Engineering Handbook, Fourth Edition, Elsevier, 2010.									
CHES302	Introduction to Machine Learning	3	2	1	2					5
	Pre-requisites: (Computer Applications in Petrochemical Engineering) CHES105 and (Advanced Probability and Statistics) MTHS204									
	Introduction to expert systems and knowledge engineering – knowledge representation – abduction - expert system building - knowledge engineering - Machine Learning – application fields that need intelligence (learning-planning-robotics- decision support systems - intelligent agents – semantic web.									
References	<ul style="list-style-type: none"> <li>• Pattern-Recognition-and-Machine-Learning by Christopher Bishop, 2006.</li> <li>• A First Course in Machine Learning by Simon Rogers, Mark Girolami, 2017.</li> <li>• Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, 2015.</li> </ul>									
CHES305	Chemical Reactor Design	3	2	2						4
	Pre-requisites: (Thermodynamics and Combustion) CHES204 and (Physical Chemistry-2) CHES203 and (Chemical Engineering Fundamentals) CHES 102									
	Reactor Design: Collection and analysis of Rate Data – Multiple reactions - Isothermal and non-isothermal (Adiabatic and non-adiabatic reactors) homogeneous reactors. Study the catalysis and its effect on the rate of reaction									
References	<ul style="list-style-type: none"> <li>• H. Scott Fogler, Elements of Chemical Reaction Engineering, 5th Edition, Prentice Hall International Series in the Physical and Chemical Engineering Sciences, Prentice Hall, 2016.</li> <li>• Lloyd E. Brownell and Edwin H. Young, Process Equipment Design: Vessel Design, 1<sup>st</sup> Ed. Wiley, 1959.</li> </ul>									



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CHES307	Application of Machine Learning in Chemical Engineering	3	2		1	2				5
	Pre-requisites: (Introduction to Machine Learning) CHES302									
	Applying machine learning tools to different areas of science and industry with practical example applications. Integrating machine learning methods with conventional modeling methods to reach higher accuracy and interpretability. Applications may include: regression analysis, process control, thermodynamic parameters estimation, real-time optimization, drug discovery, fault detection and preventive maintenance and other up to date applications.									
References	<ul style="list-style-type: none"> <li>• Thomas E. Quantrille, Y. A. Liu (2012) Artificial Intelligence in Chemical Engineering, Elsevier. Aceves-Fernandez, M. A. , (Ed.). (2018).</li> <li>• Artificial Intelligence - Emerging Trends and Applications, Chapter 20 - Application of AI in Chemical Engineering, IntechOpen. <a href="https://doi.org/10.5772/intechopen.71805">https://doi.org/10.5772/intechopen.71805</a> Cartwright, H., (2020).</li> <li>• Machine Learning in Chemistry: The Impact of Artificial Intelligence, The Royal Society of Chemistry. <a href="http://dx.doi.org/10.1039/9781839160233">http://dx.doi.org/10.1039/9781839160233</a></li> </ul>									
PES401	Petroleum Production Engineering	3	2	2						4
	Pre-requisites: (Reservoir Engineering) PES301									
	Reservoir performance - Radial flow around wells - Productivity index - Inflow Performance Relationships - Naturally flowing wells - Vertical lift performance - Multiphase flow in wells- Choke performance.									
References	<ul style="list-style-type: none"> <li>• Guo, B., Liu, X. and Tan, X., Petroleum Production Engineering- Gulf Professional Publishing, 2017.</li> <li>• Wind, T. E. W., Principles of oil well production, 2nd Edition, McGraw-Hill, 1964.</li> </ul>									
CHES401	Advanced Chemical Engineering Equipment Design	3	2	2						4
	Pre-requisites: (Heat Transfer and Applications) CHES304 and (Unit Operations) CHES301									
	Design of industrial filters – Design of solid – gas separators – Design of sedimentation tanks – Flow of non-Newtonian fluids – Design of mixers - Design of Evaporators – Design of tube still heaters – Design of Boilers and Condensers –Design of mixers.									
Textbook	McCabe J. and Smith W, "Unit Operations of Chemical Engineering" – 5th ed. – McGrawHill, 2005.									



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CHES402	Petrochemicals from Oil and Gas	3	2			2				4
Pre-requisites: (Organic Chemistry-2) CHES206										
Unit Operations in synthesis, Natural and synthetic fibers, fermentation, Saccharide and Carbohydrates, dyes, Synthesis of some important compounds: olefins, phenyl chloride, fertilizers, and Thermoplastics.										
References	<ul style="list-style-type: none"> <li>• P. H. GROGGINS, Unit Processes in Organic Synthesis, Student Edition, McGRAW. HILL KOGAKUSHA, LTD., 5th Ed., 2008</li> <li>• Sami Matar, Chemistry of Petrochemical Processes, Gulf Publishing Company, 1994</li> </ul>									
CHES404	Petroleum Refining Engineering	3	2		1	2				5
Pre-requisites: (Organic Chemistry-2) CHES206										
Crude oil fractionation, Details of design of Atmospheric and Vacuum distillation Columns, Basic petroleum fractions from AD/AV complex, Refinery Gases, Gasoline Specifications & use in Internal Combustion Engines, ignition quality of gasoline, Pre-ignition and Detonation, Mechanism of Detonation, Naphtha Specification and uses, Aviation Turbine Fuel, Kerosene specifications, Gas Oil and Diesel Fuel, Fuel oil and Asphalt specifications & uses, Wax distillates production, Manufacture of lubricating oils, Theory of friction and Lubrication, Manufacture of grease, Complex refinery schemes for processing of Natural Gas and crude oil, dehydration, desulphurization, Cracking & reforming Operations.										
References	<ul style="list-style-type: none"> <li>• Kaiser, M.J., Klerk, A. de, Gary, J.H., Handwerk, G.E., 2019. Petroleum Refining: Technology, Economics, and Markets, Sixth. ed. CRC Press.</li> <li>• Treese, S.A., Pujadó, P.R., Jones, D.S.J., 2015. Handbook of Petroleum Processing, Second. ed. Springer International Publishing, Switzerland.</li> </ul>									
METS401	Electrochemistry and Corrosion	3	2	2						4
Pre-requisites:										
Electrochemical cells – Cell potential and pole potential – Nernst equation – Measurement of cell potential – Solubility product – pH value – Equilibrium constant – Ionic conduction – Transfer number – Kinetics of electrochemical reactions – Polarization – Design and economics of electrochemical cells – Industrial applications (Caustic soda cells – Aluminum cells – electroplating – batteries and fuel cells) – Corrosion (Mechanism – Types – Measurements – Corrosion protection)										
References	<ul style="list-style-type: none"> <li>• Electrochemistry, second edition, Philip H. Rieger, Springer 1994.</li> <li>• Industrial Electrochemistry, second edition, Derek Pletcher and Frank C. Walsh, 1990.</li> <li>• Jackowska, Krystyna and Krysiński, Paweł, Applied Electrochemistry, De Gruyter, 2020</li> </ul>									



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CHES406	Economics of Oil and Gas Production	2	2							2
Pre-requisites: (Fundamentals of Economics and Accounting) GENS120										
Techno Economic feasibility study of petrochemical plants – Project financing – Preparation of tender documents of petrochemical plants – Technical and commercial evaluation of offers.										
References	<ul style="list-style-type: none"> <li>• Marshall, D., McManus, W., Viele, D., 2013. Accounting: What the Numbers Mean. 12th Edition, McGraw-Hill/Irwin</li> <li>• Egyptian Petroleum ministry official releases</li> </ul>									
<b>Program Courses (Electives)</b>										
<b>Elective Group E-2</b>										
CHES210	Data Science in Chemical Engineering	4	2	1		2				5
Pre-requisites: (Computer Applications in Petrochemical Engineering) CHES105 and (Advanced Probability and Statistics) MTHS204										
Introduction to Data Science – Data Wrangling – Data Reduction – Data Analysis – Data Visualization – Statistical Testing Basics and Sample Comparison Tests – Applications and case studies in Chemical Engineering. Labs and tutorials will be taught in PYTHON.										
References	<ul style="list-style-type: none"> <li>• George, N., 2021. Practical Data Science with Python: Learn tools and techniques from hands-on examples to extract insights from data.</li> <li>• Beck, D.A.C., Carothers, J.M., Subramanian, V.R. and Pfaendtner, J. (2016), Data science: Accelerating innovation and discovery in chemical engineering. AIChE J., 62: 1402-1416.</li> </ul>									
CHES211	Optimization in Chemical Engineering	4	2	1		2				5
Pre-requisites: (Computer Applications in Petrochemical Engineering) CHES105, (Differential Equations) MTHS104										
Basic concepts of optimization, unconstrained single variable optimization, unconstrained multivariable optimization, linear programming, non-linear programming, constrained optimization.										
References	<ul style="list-style-type: none"> <li>• Beers, Kenneth J. Numerical Methods for Chemical Engineering: Applications in MATLAB®. Cambridge University Press, 2006.</li> <li>• Engineering Optimization: Methods and Applications - A. Ravindran, K. M. Ragsdell, G. V. Reklaitis, 2nd Edition, Wiley India, 2006 Press, W. H. Numerical Recipes 3rd Edition: The Art of Scientific Computing. Cambridge University Press, 2007.</li> <li>• Engineering Optimization: Theory and Practice - S. S. Rao, 4th Edition, John Wiley &amp; Sons, Inc, 2009</li> </ul>									



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<b>Elective Group E-3</b>										
CHES220	Professional Ethics and Contracting	3	2	2						4
	Pre-requisites: Morals and ethics - The importance of ethics in science and engineering - The role of codes of ethics - Professional responsibilities of engineers - Basics of ethical analyses and decision making - Ethical leadership in engineering and society - Conflicts of interests - Engineers in organizations - Ethics in the workplace - Fairness (personal and social) - Planning and making contracts - Negotiating skills - Structuring contracts - Price and Payment - Risk and delivery -2 weeks industrial seminar									
References	<ul style="list-style-type: none"> <li>• ICHEME, 2013. The Red Book, Lump Sum Contract, 5th Edition.</li> <li>• ICHEME, 2021. Code of Professional Conduct.</li> <li>• ICHEME, 2021. Disciplinary Regulations.</li> </ul>									
CHES221	Entrepreneurship for Chemical Engineering	3	2	2						4
	Pre-requisites: Business model canvas, value proposition canvas, design thinking, minimal viable product, competition analysis, customer segmentation, pricing and cost management, shareholder agreement, financial management, pitch deck, Different sources of funding, funding lifecycle, lean methodology.									
References	<ul style="list-style-type: none"> <li>• Entrepreneurship, successfully launching new ventures, six edition, Bruce, R. Barringer Oklahoma State University, R. Duane Ireland Texas A &amp; M University.</li> <li>• Disciplined Entrepreneurship – 24 Steps to a Successful Startup, published by John Wiley &amp; Sons Inc; Illustrated, 30/08/2013.</li> <li>• Beyond Entrepreneurship 2.0, Published by Random House Business Books, 2020/12/0, JIM COLLINS, BILL LAZIER.</li> </ul>									
CHES222	Circular Economy	3	2	2						4
	Pre-requisites: (Fundamentals of Economics and Accounting) GENS120 Introduction to the Circular Economy- Circular Systems Engineering- Transition Management- Life Cycle Assessment (LCA)- Case									
Textbook	Circular Economy: From Waste Reduction to Value Creation, Volume 3, by Karen Delchet-Cochet, 2020.									





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<b>Elective Group E-4</b>										
CHES310	Environmental Laws and Ethics	3	2	2						4
	Pre-requisites: (Fundamental of Management, Risk and Environment) GENS110									
	Structural framework of Egypt's legal system and how policies and laws are made and administered - Political and economic realities involved in creating and administering environmental laws - Environmental laws and regulations - Economic, political, societal and environmental effects of existing environmental laws - Environmental philosophies on value and right action (anthropocentrism, animal welfare, biocentrism, ecocentrism) - Putting environmental ethics into practice (reduce, reuse, recycle, food ethics, living simply, ecoterrorism) - Ethics of climate change-2 weeks industrial seminar									
References	<ul style="list-style-type: none"> <li>• Egyptian Ministry of Environment, Law 4/1994 for the Protection of the Environment Amended by Law 9/2009 and Law 105/2015 and its Executive Regulations.</li> <li>• Environmental Protection Agency Laws</li> </ul>									
CHES311	Environmental Pollution and Climate Change	3	2	2						4
	Pre-requisites: (Fundamental of Management, Risk and Environment) GENS110									
	Types of pollution – Transport of pollutants – Industrial wastes and its characteristics – Industrial waste treatment – Pollutants properties – Environmental auditing – Pollution reduction – Pre-treatment processes – Design of primary treatment and precipitators – Design of biological treatment – Air pollution and mathematical models – Formulation and integration of air pollutants control methods. Definition of climate change and its causes - Prediction of climate change and its possible effects - Adaptation to climate change and ways to cope with energy problems.									
References	<ul style="list-style-type: none"> <li>• Spellman, F. R., The science of environmental pollution, Fourth Edition, CRC Press, 2021.</li> <li>• Metcalf &amp; Eddy, Inc., George Tchobanoglous, H. Stensel, Ryujiro Tsuchihashi and Franklin Burton, Wastewater Engineering: Treatment and Resource Recovery, Fifth Edition, McGraw-Hill, 2014.</li> </ul>									



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Engineering

Code	Name/Content	Credit Hours	Contact Hours							Total
			Lec	Tut (2)	App. Tut	Lab	Stud	Off. Tut	Off. Hrs	
CHES312	Safety and Risk Assessment	3	2	2						4
	Pre-requisites: (Fundamental of Management, Risk and Environment) GENS110									
	Process Safety Fundamentals - Risk management process - Hazard Identification - Qualitative and Quantitative Risk Assessment - Risk Matrix -Tools for Risk Assessment: Probability and Consequences: Event Tree, Fault Tree, FMECA, FMEA, MOSAR - HACCP: principles and applications – HAZOP - Hazard Scenarios, Consequence Analysis and Modelling, Types of Fires and Explosions, Likelihood Analysis. Process Safety in Engineering and Operations: Introduction to Safety - Importance of Process Safety in Operations - Process Safety Performance - Inherently Safer Design, Protective Systems -Plant Layout - case study - 2 weeks industrial seminar									
References	<ul style="list-style-type: none"> <li>• S. K. Biswas, U. Mathur, S. K. Hazra, 2021 Fundamentals of Process Safety Engineering, CRC Press.</li> <li>• Roger L. Brauer, 2016, Safety and Health for Engineers, 3rd Ed., Wiley.</li> </ul>									
CHES313	Water Treatment for Oil & Gas Operations	3	2	2						4
	Pre-requisites:									
	Water chemistry fundamentals - water sampling and analysis - water formed scales - water as a source of corrosion - corrosion control - water treatment microbiology - effects of water salinity - sources of treatable waters in the oil and gas industry (upstream and downstream) -Produced water discharge/disposal and treatment principles- produced water treating equipment - beneficial uses for produced waters - legal issues and regulations - Economics of Water Treatment -Case Study.									
References	<ul style="list-style-type: none"> <li>• Bahadori, A., Essentials of Oil and Gas Utilities: Process Design, Equipment, and Operations, Gulf Professional Publishing, 2016.</li> <li>• Patton, C. C., Applied Water Technology, 2<sup>nd</sup> edition, Campbell Petroleum, 1995.</li> </ul>									
<b>Elective Group E-5</b>										
CHES410	Advanced Reactor Design	3	2	2						4
	(Chemical Reactor Design) CHES305									
	Heterogeneous catalytic reactors - Various types of industrial catalytic reactors - Un-catalyzed heterogeneous reactions - Reactor Design, Catalytic reactors process synthesis - R&D experiences on treatment of kinetic data, Choice of type of reactors - Treatment of kinetic data - Comparison and optimization of reaction system process design - Critical thinking and innovation in R& D experiences - Use of analytical - graphical & numerical mathematics in design.									
Textbook	H. Scott Fogler, Elements of Chemical Reaction Engineering, 5th Edition, Prentice Hall International Series in the Physical and Chemical Engineering Sciences, Prentice Hall, 2016.									



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CHES411	Catalysis (Chemical Reactor Design) CHES305 Definition of a catalyst- Different types of catalysts- Different stages and steps of catalytic reactions. Energy aspect of a catalytic conversion- Preparation of the catalysts- Shaping, thermal treatments- Problems associated with the use of catalysts and their impact on implementation.	3	2	2						4
Textbook	Ross, J. R. H., Heterogeneous Catalysis. Fundamentals and Applications, Elsevier, 2012.									
CHES412	Polymer Science and Technology Prerequisites: (Organic Chemistry-1) CHES101 and (Thermodynamics and Combustion) CHES204 Introduction on polymers - Elucidation of the structure of polymers - Polymers classifications- Polymerization mechanisms- Polymer molecular weight- Polymers melting and crystallization - Thermodynamics of Polymer solutions and Blends.	3	2	2						4
Textbook	Fakirov, S., Fundamentals of Polymer Science for Engineers, Wiley-VCH. 2017.									
CHES413	Petroleum Standards Prerequisites: (Introduction to Petroleum Industry) PES201 Standards of crudes and refined products for different oil applications. Fundamentals of computer process simulation - Oil refinery flow schemes - Oil products- Product specifications (key recoveries, cut/gas points, flow rates) - Simulation of oil refinery units - Case studies.	3	2	2						4
References	<ul style="list-style-type: none"> <li>Kaiser, M.J., Klerk, A. de, Gary, J.H., Handwerk, G.E., 2019. Petroleum Refining: Technology, Economics, and Markets, Sixth. ed. CRC Press.</li> <li>Treese, S.A., Pujadó, P.R., Jones, D.S.J., 2015. Handbook of Petroleum Processing, Second. ed. Springer International Publishing, Switzerland.</li> </ul>									
CHES414	Industrial Measurements and Control Applications Prerequisites: (Process Control) CHES306 Dynamics of first order systems in series-Dynamics of higher order systems- P&ID- Final control elements - Single variable control loops- Feedback systems with large deadtime- Control systems with multiple loops- Adaptive control systems- Multiple input multiple output processes- Interaction and decoupling of control loops - Relative gain arrays and selection of loops - PLC- Instrumentation.	3	2	2						4
Textbook	Jean-Pierre Corriou, Process Control, Theory and Applications, Second Edition, Springer 2017.									



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CHES415	Advanced Separation Processes	3	2	2						4
	Prerequisites: (Separation Processes) CHES407									
	Basics of adsorption, equilibrium isotherm and types of adsorbents– ion exchange separation – Chromatographic separation – Principles and applications of membranes, types, modules and theory and mass transfer through them. Membrane separation techniques, Ultrafiltration – Microfiltration – Reverse osmosis									
References	<ul style="list-style-type: none"> <li>• G. Towler and R. Sinnott, "Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design", 2nd Ed., Elsevier, 2013.</li> <li>• J. D. Seader, Ernest J. Henley, D. Keith Roper, "Separation Process Principles: With Applications Using Process Simulators", 4th Edition, Wiley, 2016</li> </ul>									
CHES416	Advanced Statistics for Petrochemical Industries	3	2	2						4
	Pre-requisites: (Advanced Probability and Statistics) MTHS204									
	Variables and frequency distribution - Probability and Markov chains - Random variables – Sampling – Testing of Hypotheses – Chi square tests – Linear and non-linear regression									
Textbook	B.J. Dretzke "Statistics with Microsoft EXCEL" Ed. Pearson, 4 <sup>th</sup> Edition, 2008									
CHES417	Advances in Petrochemical Engineering	3	2	2						4
	Pre-requisites: (Unit Operations) CHES301									
	Selected topics in Petrochemical Engineering									
Textbook	Advances in Petrochemicals, by Vivek Patel, 2015, ISBN978-953-51-2176-3.									