Section 8

Petroleum and Petrochemical Engineering Program (PPC)

Based on Credit Hours System (CHS)

September 2013

1. INTRODUCTION

The oil and gas industry has been flourishing in the Middle East in the last decade. The Egyptian universities have contributed in the supply of the manpower requirements on the local, Arab region, and worldwide levels. In many cases, graduates from the petroleum engineering department had to assume responsibilities in refining and petrochemical plants while many chemical engineers have been assigned jobs in the prospecting and oil field operations. This situation called for the formation of a hybrid engineer combining the qualifications of both disciplines. This is particularly important in the case of Egypt where the proven reserves of natural gas are in continual increase, thus necessitating the expansion of the industry both on the export size where new projects are being implemented for natural gas exportation either in pipelines or in the form of LNG. On the other hand, the expansion of the industry for producing higher added value petrochemicals is mandatory for the growth of Egyptian economics. In that respect, the Faculty of Engineering of Cairo University has established a new bachelor program based on the credit hours system (CHS) in Petroleum and Petrochemical Engineering, a new discipline that integrates knowledge and skills required for both upstream and downstream industries of oil and gas. The graduates will major in either upstream (PPE-P) or downstream (PPE-C) industries of oil and gas and in the same time acquire the background of the other.

2. PROGRAM MISSION

The purpose of this program is to supply the market with graduate engineers specialized in all engineering disciplines related to petroleum and petrochemicals engineering covering both upstream and downstream aspects of the industry. The graduates would have comprehensive knowledge of the entire petroleum industry with special emphasis on sized experience in oil and gas operations. Graduating senior students will have to choose either upstream or downstream courses. Both include specialized core and elective courses. On the upstream side the geological aspects, oil and gas exploration, drilling and production in addition to evaluation and maintenance of oil and gas reservoirs will be covered. On the downstream side special emphasis is devoted to oil and gas processing and petrochemicals.

Upstream elective courses will address aspects related to drilling, well logging, enhanced oil recovery etc… The downstream elective courses will address detailed knowledge of all aspects of oil and gas processing, refining, and petrochemical processing operations such as desulphurization, dehydration, cracking, reforming, isomerization, polymerization, etc.

Engineers majoring in either branch will also have sufficient background knowledge of basic engineering sciences, economics, safety and environmental engineering in addition to project execution and management. This dual specialization shall improve fieldwork flexibilities in career development.

3. EDUCATIONAL OBJECTIVES

One of the main goals of the Faculty of Engineering, Cairo University is to respond to the dynamics of changes in the industrial environment particularly contributing to the formation of engineers with inter-disciplinary backgrounds. The petroleum sector is one such area where emphasis has to be put on this inter-disciplinary aspect. The proposed program has four main educational objectives. These can be summarized as follows:

The program aims to:

1. Provide a study opportunity which enables the students to acquire in-depth knowledge and understanding of both the up-stream and down-stream aspects of the petroleum (oil, gas, and petrochemicals) industry.
2. Develop the appropriate intellectual skills required to enable graduates to plan, design, analyze, execute and manage industrial petroleum projects.
3. Provide students with the practical and professional skills necessary for employment in the field of petroleum and petrochemicals engineering and related fields or for further advanced research studies where petroleum engineering knowledge and other skills are applied.
4. Develop general and transferable skills necessary for understanding of the human relations in industry and impart professional attitudes and ethics enabling the graduates to work in multi-disciplinary teams and interact properly in the professional environment.

4. PROGRAM LEARNING OUTCOMES

4.1 Knowledge and Understanding

The graduates of PPC program will be able to:

(K1) Explain the basic concepts, theories and laws of mathematics and sciences
(K2) Recognize the basics of information and communication technology (ICT)
(K3) Classify the characteristics of engineering materials related to the discipline
(K4) Recognize the principles of design including elements design, process and/or a system related to specific disciplines
(K5) Identify methodologies of solving engineering problems, data collection and interpretation
(K6) Recognize quality assurance systems, codes of practice and standards, health and safety requirements and environmental issues
(K7) Describe business and management principles relevant to engineering
(K8) Classify current engineering technologies as related to disciplines
(K9) Discuss topics related to humanitarian interests and moral issues
(K10) Demonstrate knowledge of technical language and report writing techniques
(K11) Outline and confirm the importance of professional ethics and socio-economical impacts of engineering solutions on society and environment
(K12) Discuss contemporary engineering topics
(K13) Define fundamental, basic characteristics and features of organic and inorganic reactions and their applications in Chemical Process Industries, including

petroleum refining, natural gas processing, fertilizers, ceramics, electrochemical processes, etc…

(K14) Characterize different states of matter and interfaces
(K15) Perform conventional chemical analysis and characterization of common engineering materials
(K16) Identify the principles of chemical engineering, including chemical reaction equilibrium and thermodynamics, mass and energy balance, transport processes, separation processes, mechanical unit operations and process control
(K20) Use the general principles of design techniques specific to particular processes including reactor and vessel design
(K21) Assess the environmental impact of various industries, waste minimization and treatment
(K22) Identify the exploration methods of oil & gas reservoirs
(K23) Summarize oil drilling, completion and work-over operations
(K24) Apply formation, evaluation, well logging, well test analysis, modeling & simulation
(K25) Explain natural gas and oil and gas reservoir operations
(K26) Define the properties of reservoir rock and fluid in oil and gas bearing formation
(K27) Direct and monitor oil and gas drilling operations
(K28) Conduct feasibility assessment studies for developing new oil and gas fields

4.2 Intellectual Skills

The graduates of PPC program will be able to:

(I1) Integrate processing steps into a sequence and apply analysis technique such as energy and mass balance
(I2) Summarize and select the appropriate techniques relevant to different industries
(I3) Collect data, draw simplified equipment flow sheets, charts and curves and interpret data derived from laboratory observation
(I4) Synthesize new processes or products through utilization and effective management of available resources
(I5) Evaluate and appraise designs, processes (operations), equipment and machinery , and propose improvements
(I6) Use the principles of engineering science in developing solutions to practical petroleum engineering problems
(I7) Design case studies in exploration, drilling, production, oil and gas reservoirs.
(I8) Identify maps
(I9) Analyze well logs and testing
(I10) Design of well drilling operations
(I11) Select the best method to be used in enhanced oil recovery methods (EOR)

4.3 Practical and Professional Skills

The graduates of PPC program will be able to:

(P1) Perform complete mass and energy balances for chemical engineering plants
(P2) Apply the principles of chemical equilibrium and process thermodynamics to systems with chemical reactions
(P3) Conduct troubleshooting in chemical engineering plants
(P4) Use chemical engineering IT tools and programming in design

(P5) Determine the characteristics and performance of measurement and control systems
(P6) Employ principles and concepts of transport phenomena in problem solving
(P7) Carry out specialized engineering design in petroleum exploration and drilling, production and reservoir engineering projects
(P8) Design maps
(P9) Analyze well logs and testing
(P10) Employ traditional and recent advances technologies in petroleum engineering branches
(P11) Use basic workshop equipment and machinery safely
(P12) Manage well drilling operations
(P13) Operate and maintain mechanical equipment and machinery, apparatus in oil and gas fields
(P14) Apply different methods to enhance oil recovery (EOR)

4.4 General and Transferable Skills

The graduates of PPC program will be able to:
(T1) Collaborate effectively within multidisciplinary team.
(T2) Work in stressful environment and within constraints.
(T3) Communicate effectively.
(T4) Demonstrate efficient IT capabilities.
(T5) Lead and motivate individuals.
(T6) Effectively manage tasks, time and resources.
(T7) Search for information and engage life-long self learning discipline.
(T8) Acquire entrepreneurial skills.
(T9) Refer to relevant literatures.

5. MARKET NEEDS ASSESSMENT

Considering the lack of engineers with appropriate inter-disciplinary background to cover the market needs of the petroleum and petrochemical industries, the Faculty of Engineering, Cairo University has endeavored to cover the market requirements by initiating the new program with curricula fitting the specific need of this industry.

The market needs for such graduates will be monitored to plan the number of students that will graduate from the program on a yearly basis. It is estimated that at least 70 students would be enrolled annually

6. PROGRAM DESCRIPTION

The program offers instructions in numerous topics concerning petroleum and petrochemical engineering. At the end of these courses, participants are expected to gain the knowledge of; design and study of petroleum operations; exploration, drilling, production and reservoir engineering of oil and gas as well as petrochemical processing, design and performance of chemical rectors, etc.

The program offers a Bachelor Degree in Petroleum and Petrochemical Engineering and enables the student to concentrate on either the Petroleum Engineering track (PPC-P) or the Petrochemical Engineering track (PPC-C). The Bachelor Degree of the PPC program and its two internal tracks consists of a total of 180 credit hours offered over a period of 10 main semesters, the Fall and Spring semesters per academic year. The students are expected to complete the degree requirements in 10 main semesters. High caliber students may finish in 9 main semesters.

6.1 Curriculum Overview

The curriculum of the PPC program consists of 180 credits spread over 73 courses covering topics in Humanities and Social Sciences (HSS), Basic Sciences (BS), Engineering Sciences (ES), and Applied Engineering Sciences (AS) as required by the Supreme Council of Universities (SCU).

6.1.1 Humanities and Social Sciences Courses

- English Language
- Communication and Presentation Skills
- Technical Writing
- Humanities and Engineering
- Fundamentals of Management
- Selections of Life-long Skills
- Accounting
- Economics
- Risk Management and Environment
- Introduction to Computers
- Marketing
- Ethics and Legislation
- Project Planning, Implementation and Economics

6.1.2 Basic Sciences Courses

- Physics
- Chemistry
- Organic Chemistry
- Engineering Graphics
- Manufacturing Engineering
- Stress Analysis and Mechanical Design
- Material Science
- Mathematics
- Probability and Statistics
- Mechanics

6.1.3 Engineering Sciences Courses

- Basic Engineering Design
- Civil Engineering
- Chemical Engineering Fundamentals
- Physical Chemistry

- Electrical Engineering
- General Geology
- Heat Transfer and Applications
- Introduction to Petroleum Industry
- Computer Applications in Petrochemical Engineering
- Mass Transfer and Separation Processes
- Process and Plant Design
- Cryogenic Processes
- Thermodynamics and Combustion
- Petroleum Exploration Engineering
- Instrumentation and Process Control
- Fluid Mechanics

6.1.4 Applied Engineering Sciences Courses

- Drilling Engineering I , II
- Natural Gas Engineering I
- Petroleum Field Operations
- Petroleum Production Engineering I
- Petroleum Refining Engineering
- Reservoir Engineering I, II
- Unit Operations
- Reservoir Rock and Fluid Properties
- Elective Courses I, II, III (PPC-C track)
- Petrochemicals from Oil and Gas (PPC-C track)
- Graduation Project I, II (PPC-C track)
- Reactor and Vessel design (PPC-C track)
- Advances in Cryogenics (PPC-C track)
- Petroleum refining Engineering (PPC-C track)
- Electrochemistry and Corrosion (PPC-C track)
- Oil and gas production Economics (PPC-C track)
- Project Planning, implementation and Economics (PPC-C track)
- Elective Courses I, II, III (PPC-P track)
- Well Completion and Workover (PPC-P track)
- Petroleum Production Engineering II (PPC-P track)
- Natural Gas engineering II (PPC-P track)
- Well logging (PPC-P track)
- Oil Well Drilling III (PPC-P track)
- Petroleum Legislations and Economics (PPC-P track)
- Water Flooding (PPC-P track)
- Enhanced Oil Recover (PPC-P track)
- Graduation Project I, II (PPC-P track)

6.2 University Requirements

The main purpose of a university education is not only to prepare students for successful careers but also to provide them with the knowledge and skills to develop a rational, well-rounded and successful personal identity. Moreover, Cairo University

helps students to gain an appreciative understanding of the natural and cultural environments in which they live and their roles in the society and community services.

The university requirements of the CHS bachelor programs consist of 24 credits (13.3% of total 180 credits), which are satisfied by completing twelve (12) courses:

1. Nine (9) compulsory courses equivalent to 18 credits (10.0%), as listed in Table 1a
2. Three (3) elective courses equivalent to 6 credits (13.3%), as listed in Table 1b

Table 1a Compulsory Courses of University Requirements (18 credits, 10.0% of total 180 credits)

	Code	Course Title	Credits
1	GENN001	Humanities and Engineering	2
2	GENN002	English Language	2
3	GENN004	Computers for Engineers	2
4	GENN101	Technical Writing	2
5	GENN102	Fundamentals of Management	2
6	GENN201	Communication and Presentation Skills	2
7	GENN204	Accounting	2
8	GENN210	Risk Management and Environment	2
9	GENN221	Economics	2

Table 1b Elective Courses of University Requirements (6 credits, 3.3% of total 180 credits)

	Code	Course Title	Credits	Group
1	GENN301	Ethics and Legislation(1)	2	E-1(1)
2	GENN310	Advanced Risk Management	2	
3	GENN311	Technical Writing in Arabic	2	
4	GENN321	Foreign Language	2	
5	GENN326	Marketing	2	
6	GENN327	Selections of Life-long Skills	2	
7	GENN331	Business Communication	2	
8	GENN332	Service Management	2	

Remarks:

(1) Student selects at least three (3) courses equivalent to 6 credits

6.3 College Requirements

College requirements provide students with the knowledge and skills that are essential to develop a successful engineer. A college core that is common to all credit hours programs is implemented. This unified college core contains two categories of courses. The first category of college core courses includes courses of basic knowledge essential to all engineering graduates such as Mathematics, Physics, Mechanics, Graphics and Design, Manufacturing, and Chemistry. The second category includes courses that all students are required to undertake in order to develop certain intended learning outcomes common to all engineering graduates, such as Seminar, Industrial Training, and Graduation Project courses.

The college requirements of the CHS bachelor programs consist of 45 credits (25.0% of total 180 credits), which are satisfied by completing nineteen (19) compulsory courses, as listed in Table 2.

Table 2 Compulsory Courses of College Requirements (45 credits, 25.0% of total 180 credits)

	Code	Course Title	Credits
1	CHEN001	Chemistry	3
2	GENN003	Basic Engineering Design	2
3	MDPN001	Engineering Graphics	3
4	MDPN002	Fundamentals of Manufacturing Engineering	3
5	MECN001	Mechanics-1	2
6	MECN002	Mechanics-2	2
7	MTHN001	Introduction to Linear Algebra and Analytic Geometry	3
8	MTHN002	Calculus I	3
9	MTHN003	Calculus II	3
10	MTHN102	Multivariable Calculus and Linear Algebra	3
11	MTHN203	Probability and Statistics	3
12	PHYN001	Mechanics, Oscillations, Waves and Thermodynamics	3
13	PHYN002	Electricity and Magnetism	3
14	PPCN280	Seminar-1	1
15	PPCN281	Industrial Training-1	1
16	PPCN380	Seminar-2	1
17	PPCN381	Industrial Training-2	2
18	PPCN480	Graduation Project-1	1
19	PPCN481	Graduation Project-2	3

6.4 Discipline Requirements

The PPC program is a new bachelor program based on the credit hours system under the umbrella of both Petroleum and Chemical Engineering Departments. The discipline "Engineering core" requirements consist of 57 credits (31.7% of total 180 credits), which are satisfied by completing twenty-two (22) courses, as listed in Table 3. These courses are designed to provide the student with the core petroleum and petrochemical engineering application. All the discipline core courses are compulsory.

Table 3 Compulsory Courses of Discipline Requirements: Petroleum and Chemical Engineering (57 credits, 31.7% of total 180 credits)

	Code	Course Title	Credits
1	CHEN101	Physical Chemistry-1	2
2	CHEN102	Organic Chemistry-1	2
3	CHEN103	Chemical Engineering Fundamentals	3
4	CHEN104	Physical Chemistry-2	3
5	CHEN105	Thermodynamics and Combustion	3
6	CHEN106	Computer Applications in Petrochemical Engineering	2
7	CHEN201	Organic Chemistry-2	2
8	CHEN202	Fluid Mechanics	3
9	CHEN204	Cryogenic Processes	2
10	CHEN301	Mass Transfer and Separation Processes-1	2
11	CHEN302	Instrumentation and Process Control	3
12	CHEN304	Unit Operations	3
13	CHEN305	Heat Transfer and Applications	3
14	CHEN306	Process and Plant Design	2
15	CHEN307	Mass Transfer and Separation Processes-2	2
16	CVEN125	Civil Engineering	3
17	INTN201	Electrical Engineering	3
18	MDPN201	Stress Analysis and Mechanical Design	3
19	METN132	Materials Science	3
20	PEN101	Introduction to Petroleum Industry	3
21	PEN102	General Geology	3
22	PEN305	Petroleum Geology	2

6.5 Major Requirements

The program offers a major specialty in Petroleum and Petrochemical Engineering which requires the successful completion of at least 54 credits (30.0% of total 180 credits), which are divided as follows.

a. PPC-C track requirements:
   a1. Fifteen (15) compulsory courses equivalent to 41 credits (22.8%), as listed in Table 4a, of which seven (7) courses equivalent to 19 credits (10.6%) are common with track PPC-P.
   a2. Five (5) elective courses equivalent to 13 credits (7.2%), as listed in Table 5a.

b. PPC-P track requirements:
   b1. Seventeen (17) compulsory courses equivalent to 45 credits (25.0%), as listed in Table 4b, of which seven (7) courses equivalent to 19 credits (10.6%) are common with track PPC-C.
   b2. Three (3) elective courses equivalent to 9 credits (5.0%), as listed in Table 5b.

Table 4a Compulsory Courses of Major Requirements: Petrochemical Engineering Track PPC-C (41 credits, 22.8% of total 180 credits)

	Code	Course Title	Credits
1	CHEN401	Petroleum Refining Engineering	3
2	CHEN402	Petrochemicals from Oil and Gas	3
3	CHEN403	Chemical Reactor and Vessel Design	3
4	CHEN404	Advances in Cryogenics	2
5	CHEN407	Advanced Chemical Engineering Design	3
6	CHEN408	Economics of Oil and Gas Production	2
7	GENN401	Project Planning, Implementation and Economics	3
8	METN401	Electrochemistry and Corrosion	3
9	PEN201	Drilling Engineering-1(1)	3
10	PEN202	Reservoir Rock and Fluid Properties(1)	3
11	PEN203	Drilling Engineering-2(1)	2
12	PEN204	Natural Gas Engineering-1(1)	3
13	PEN302	Reservoir Engineering-1(1)	3
14	PEN303	Petroleum Production Engineering-1(1)	3
15	PEN306	Petroleum Field Operations(1)	2

Remarks:

(1) Courses common with track PPC-P

Table 4b Compulsory Courses of Major Requirements: Petroleum Engineering Track PPC-P (45 credits, 25.0% of total 180 credits)

	Code	Course Title	Credits
1	PEN201	Drilling Engineering-1(1)	3
2	PEN202	Reservoir Rock and Fluid Properties(1)	3
3	PEN203	Drilling Engineering-2(1)	2
4	PEN204	Natural Gas Engineering-1(1)	3
5	PEN301	Petroleum Exploration Engineering (1)	2
6	PEN302	Reservoir Engineering-1(1)	3

	Code	Course Title	Credits
7	PEN303	Petroleum Production Engineering-1(1)	3
8	PEN304	Reservoir Engineering-2(1)	2
9	PEN306	Petroleum Field Operations(1)	2
10	PEN401	Well Completion and Workover	3
11	PEN402	Petroleum Production Engineering-2	3
12	PEN403	Natural Gas Engineering-2	3
13	PEN404	Well Logging	3
14	PEN405	Petroleum Legislations and Economics	3
15	PEN410	Oil Well Drilling-3	3
16	PEN411	Water Flooding	2
17	PEN413	Enhanced Oil Recovery	2

Remarks:

(1) Courses common with track PPC-C

Table 5a Elective Courses of Major Requirements: Petrochemical Engineering Track PPC-C (13 credits, 7.2% of total 180 credits)

	Code	Course Title	Credits	Group
1	CHEN405	Advanced Separation Processes	3	E-2C(1)
2	CHEN406	Advanced Statistics for Petrochemical Industries	3	
3	CHEN409	Petroleum Standards	3	
4	CHEN410	Advances in Petrochemical Engineering	3	
5	CHEN411	Catalytic Reactor Design	3	
6	CHEN412	Advances in Polymer Engineering	3	
1	CHEN303	Industrial Measurements and Control Applications	2	E-3C(2)
2	CHEN308	Polymer Science and Technology	2	
3	CHEN310	Water Treatment for Oil & Gas Operations	2	
4	PEN301	Petroleum Exploration Engineering (3)	2	
5	PEN304	Reservoir Engineering-2(3)	2	

Remarks:

(1) Student selects at least three (3) courses from group E-2C equivalent to 9 credits

(2) Student selects at least two (2) courses from group E-3C equivalent to 4 credits

(3) Courses common with track PPC-P

Table 5b Elective Courses of Major Requirements: Petroleum Engineering Track PPC-P (9 credits, 5.0% of total 180 credits)

	Code	Course Title	Credits	Group
1	PEN406	Natural Gas Liquefaction and GTL	3	E-2P(1)
2	PEN407	Subsurface Mapping	3	
3	PEN408	Gas Pipeline and Domestic Networks	3	
4	PEN409	Well Stimulation	3	
5	PEN412	Simulation and Modeling for PE	3	E-2P(1)
6	PEN414	Directional, Horizontal and Multi-lateral Drilling	3	
7	PEN415	Data Mining	3	
8	PEN416	Advanced Topics in Petroleum Engineering	3	
9	PEN417	Deep Water Technology	3	
10	PEN418	Seismic Stratigraphy	3	
11	PEN419	Formation Evaluation and Reservoir Characterization	3	
12	PEN420	Horizontal Well Technology	3	

Remarks:

(1) Student selects at least three (3) courses from group E-2P equivalent to 9 credits

6.6 Conformity to SCU Requirements

The classification and categorization of the courses offered by the Petroleum and Petrochemical Engineering program follow the guidelines provided by the Supreme Council of Universities (SCU), as shown in Tables 6a and 6b. The classification is based on the "Sample Study Plan and Course Sequence" described in Section 7. The categorization is given for the following five student levels according to the regulations of the credit hours system of education at the Faculty of Engineering, Cairo University:

- **Freshman**: a student who completed less than 36 credits
- **Sophomore**: a student who completed more than 35 credits but less than 72 credits
- **Junior**: a student who completed more than 71 credits but less than 108 credits
- **Senior-1**: a student who completed more than 107 credits but less than 144 credits
- **Senior-2**: a student who completed more than 143 credits

The Petrochemical Engineering track (PPC-C) consists of 73 courses: 67 compulsory courses (165 credits) and 6 elective courses (15 credits). The Petroleum Engineering track (PPC-P) consists of 73 courses: 67 compulsory courses (165 credits) and 6 elective courses (15 credits). The total 180 credits of the PPC program are distributed between lectures (LEC) and tutorials (TUT), where a tutorial is classified as a problem solving session (PSS) and/or a practical work/laboratory session (PLS). The one credit of a tutorial corresponds to 2-3 hours to provide sufficient practical training for the students. Thus, the total contact hours of learning are about 300 hrs.

Table 6a Conformity to Supreme Council Criterion: Track PPC-C

Category	Freshman	Sophomore	Junior	Senior-1	Senior-2	Total Credits	%
Humanities and Social Sciences	6	6	7	5	0	24	13.3
Basic Sciences	22	8	13	0	3	46	25.6
Engineering Sciences	8	20	8	16	9	61	33.9
Applied Engineering Sciences	0	2	9	15	23	49	27.2
Total	36	36	37	36	35	180	100
University Requirements	6	6	8	4	0	24	13.3
College Requirements	30	3	5	3	4	45	25.0
Discipline Requirements	0	27	13	17	0	57	31.7
Major Requirements	0	0	11	12	31	54	30.0
Total	36	36	37	36	35	180	100

Table 6b Conformity to Supreme Council Criterion: Track PPC-P

Category	Freshman	Sophomore	Junior	Senior-1	Senior-2	Total Credits	%
Humanities and Social Sciences	6	6	7	5	0	24	13.3
Basic Sciences	22	8	13	0	0	43	23.9
Engineering Sciences	8	20	8	16	6	58	32.2
Applied Engineering Sciences	0	2	9	15	29	55	30.6
Total	36	36	37	36	35	180	100
University Requirements	6	6	8	4	0	24	13.3
College Requirements	30	3	5	3	4	45	25.0
Discipline Requirements	0	27	13	17	0	57	31.7
Major Requirements	0	0	11	12	31	54	30.0
Total	36	36	37	36	35	180	100

7. SAMPLE STUDY PLAN and COURSE SEQUENCE

A sample study plan for the PPC program is presented as one recommended sequence to complete the graduation requirements over 10 main semesters, the Fall and Spring semesters per academic year. Since the program is based on the credit hours system of education, the student does not have to take the courses during the semester indicated in the study plan as long as the course prerequisites are satisfied. The PPC curriculum encourages students to interact with the industrial sector and government agencies by offering two industrial training courses in at least two summer sessions. Also, the students will be trained on teamwork and be exposed to large engineering projects during their practical training and graduation projects.

Freshman Year Course Schedule

	Semester-1: Fall		Semester-2: Spring	
	Course Code	CR	Course Code	CR
1.	MECN001	2	MECN002	2(1)
2.	MTHN002	3	MTHN003	3(2)
3.	PHYN001	3	PHYN002	3
4.	MTHN001	3	CHEN001	3
5.	MDPN001 OR MDPN002	3 OR 3	MDPN002 OR MDPN001	3 OR 3
6.	GENN001 OR GENN002	2 OR 2	GENN002 OR GENN001	2 OR 2
7.	GENN004 OR GENN003	2 OR 2	GENN003 OR GENN004	2 OR 2
Semester Credit Hrs		18		18

Remarks:

(1) Course MECN002 has a prerequisite course MECN001

(2) Course MTHN003 has a prerequisite course MTHN002

PPC Program Study Plan: Track PPC-C

	Semester-3: Fall		Semester-4: Spring		Semester-5: Fall		Semester-6: Spring	
	Course Code	CR	Course Code	CR	Course Code	CR	Course Code	CR
1.	PEN102	3	CVEN125	3	MDPN201	3	MTHN203	3
2.	CHEN106	2	MTHN102	3	INTN201	3	GENN221	2
3.	METN132	3	CHEN104	3	PEN201	3	GENN210	2
4.	CHEN102	2	GENN102	2	PEN202	3	PEN203	2
5.	CHEN101	2	CHEN105	3	CHEN201	2	PEN204	3
6.	CHEN103	3	PEN101	3	CHEN202	3	CHEN204	2
7.	GENN101	2	GENN201	2	PPCN280	1	GENN204	2
8.	----------	------	----------	------	----------	------	GENN3XX(1)	2
9.	----------	------	----------	------	----------	------	PPCN281(0)	1
Semester Credit Hrs		17		19		18		18+1(0)

	Semester-7: Fall		Semester-8: Spring		Semester-9: Fall		Semester-10: Spring	
	Course Code	CR	Course Code	CR	Course Code	CR	Course Code	CR
1.	CHEN301	2	CHEN306	2	CHEN401	3	METN401	3
2.	CHEN304	3	PEN303	3	CHEN402	3	CHEN407	3
3.	CHEN302	3	XXXN3XX(3)	2	CHEN403	3	CHEN408	2
4.	XXXN3XX(3)	2	PEN305	2	CHEN404	2	PPCN481	3
5.	PEN302	3	CHEN305	3	GENN401	3	CHEN4XX(2)	3
6.	GENN3XX(1)	2	PEN306	2	PPCN480	1	CHEN4XX(2)	3
7.	GENN3XX(1)	2	CHEN307	2	CHEN4XX(2)	3	----------	------
8.	----------	------	PPCN380	1	----------	-----	----------	------
9.	----------	------	PPCN381(0)	2	----------	-----	----------	------
Semester Credit Hrs		17		17+2(0)		18		17

Remarks:

(0) Industrial training courses to be completed in the summer sessions

(1) General elective course (group E-1, 2 credits per course): GENN301, GENN310, GENN311, GENN321, GENN326, GENN327, GENN331, GENN332

(2) Major elective course (group E-2C, 3 credits per course): CHEN405, CHEN406, CHEN409, CHEN410, CHEN411, CHEN412

(3) Major elective course (group E-3C, 2 credits per course): CHEN303, CHEN308, CHEN310, PEN301, PEN304

PPC Program Study Plan: Track PPC-P

	Semester-3: Fall		Semester-4: Spring		Semester-5: Fall		Semester-6: Spring	
	Course Code	CR	Course Code	CR	Course Code	CR	Course Code	CR
1.	PEN102	3	CVEN125	3	MDPN201	3	MTHN203	3
2.	CHEN106	2	MTHN102	3	INTN201	3	GENN221	2
3.	METN132	3	CHEN104	3	PEN201	3	GENN210	2
4.	CHEN102	2	GENN102	2	PEN202	3	PEN203	2
5.	CHEN101	2	CHEN105	3	CHEN201	2	PEN204	3
6.	CHEN103	3	PEN101	3	CHEN202	3	CHEN204	2
7.	GENN101	2	GENN201	2	PPCN280	1	GENN204	2
8.	----------	------	----------	------	----------	------	GENN3XX(1)	2
9.	----------	------	----------	------	----------	------	PPCN281(0)	1
Semester Credit Hrs		17		19		18		18+1(0)

	Semester-7: Fall		Semester-8: Spring		Semester-9: Fall		Semester-10: Spring	
	Course Code	CR	Course Code	CR	Course Code	CR	Course Code	CR
1.	CHEN301	2	CHEN306	2	PEN402	3	PEN401	3
2.	CHEN304	3	PEN303	3	PEN403	3	PEN411	3
3.	CHEN302	3	PEN304	2	PEN404	2	PEN413	2
4.	PEN301	2	PEN305	2	PEN405	3	PPCN481	3
5.	PEN302	3	CHEN305	3	PEN410	3	PEN4XX(2)	3
6.	GENN3XX(1)	2	PEN306	2	PPCN480	1	PEN4XX(2)	3
7.	GENN3XX(1)	2	CHEN307	2	PEN4XX(2)	3	----------	------
8.	----------	------	PPCN380	1	----------	------	----------	------
9.	----------	------	PPCN381(0)	2	----------	------	----------	------
Semester Credit Hrs		17		17+2(0)		18		17

Remarks:
(0) Industrial training courses to be completed in the summer sessions
(1) General elective course (group E-1, 2 credits per course): GENN301, GENN310, GENN311, GENN321, GENN326, GENN327, GENN331, GENN332
(2) Major elective course (group E-2P, 3 credits per course): PEN406, PEN407, PEN408, PEN409, PEN412, PEN414, PEN415, PEN416, PEN417, PEN418, PEN419, PEN420

8. COURSE CONTENTS

8.1 University-Core Courses

GENN001	**Humanities and Engineering** **Compulsory, Credits: 2 (2+0+0)**

	Prerequisite(s): none History of Technology: Engineering and technology in a cultural, social, and historical context. Development of technology as a key to history of civilization in a comparative perspective - Exploring Humanities: Modes of thought found within humanities and social sciences. Humanities for Engineers: Humanities themes of increased complexity - Different work methodologies - Critical analysis of information & choice of argumentation - Work methodologies and pedagogical interest.
GENN002	**English Language** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): none** Writing clear topic sentences, well-developed supporting sentences, and concluding sentences. Editing paragraphs for punctuation & writing errors. Extracting meaning of words from reading texts. Making logical inferences from texts. Discussing opinions and thoughts about daily life topics. Planning, implementing and delivering group presentations. Skimming through and scanning text for details. Developing critical thinking skills.
GENN004	**Computers for Engineers** **Compulsory, Credits: 2 (1+0+2)** **Prerequisite(s): none** Developing basic concepts of algorithmic thinking to solve problems of relevance in engineering practice and implementing these algorithms using high-level computer language. Using data types, input/output commands, loops, control structures, functions, arrays, and other programming language constructs in a computer program. Evaluating and interpreting the results of programming work.
GENN101	**Technical Writing** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): GENN002 + 28 credits** Discovering and outlining ideas. Organizing outlines. Ways To begin the three parts of technical writing. Writing abstracts, summaries, and conclusions of long reports. The thesis statement. Forms: letters, memos, reports, scientific articles, job description, CV, references and footnotes. Selection of key words, titles, and subtitles. Editing, revising and proof-reading techniques. Electronic word processing and technical writing, vocabulary building, and basic types and patterns of argument.
GENN102	**Fundamentals of Management** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): 28 credits** Introduction to management, Historical view and evolution of concepts. Basic Managerial Functions: Planning, Strategies, Objectives, MBO; Organizing, Departmentation, Job Description; Elements of Human Resource Management: Staffing, Directing, Controlling. Total Quality Management, Continuous Improvement. Engineering Applications.
GENN201	**Communication and Presentation Skills** **Compulsory, Credits: 2 (1+1+0)**

	Prerequisite(s): GENN101 Analyzing the audience. Selecting presentation topics and objectives. Recognizing different types of speeches and presentations. Overcoming nervousness and developing confidence while addressing an audience. Researching and generating information for informative presentations. Chucking presentation content. Designing effective visual aids. Using explicit and effective transitions throughout a presentation. Creating benefit statements for persuasive presentations. Using persuasive devices such as pathos and logos in speeches. Planning and delivering informative, persuasive, entertaining and inspiring presentations. Handling question and answer sessions effectively.
GENN204	**Accounting** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): 42 credits** Basic accounting concepts: Accounting terms and assumptions. Accounting Methodology: balance sheet, income statement, cash flow statement. Income Determination: Cash Effects, Basis of Accounting. Accounting ratio – measuring the performance – cost concepts – cost accumulation – cost allocation – cost/volume/profit analysis – budgets – forecasting. Cost Accounting.
GENN210	**Risk Management and Environment** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): GENN102** Risk Management: Introduction. Risk Definition. Basic Axioms Behind Risk Management. Systemic Approach to Handling Risk . Principle of Risk Management: Identification of Risks. Preliminary Risk Analysis (PRA). Risk Assessment. Risk Evaluation. Risk Control. Hierarchies of Control. Monitoring and Reviewing. Documentation. Study of a practical problem in which the student applies Basic Risk Management Environment: Environmental Systems: Local, Regional and Global. Influence of Air Pollutants on the, Environment, Water Pollutants, Industrial Waste, Hazardous Wastes, Management of Pollutant Releases, Pollution Prevention, Recycling of Waste Materials, Waste Treatment Technologies, Ultimate Disposal of Wastes, Water Treatment Technologies. Control of Air Pollution, Contaminated Land and Its Reclamation, Principals and Uses of the Environmental Risk Assessment, Environmental Risk Assessment Methodology, Environmental Impact Assessment Environmental Health Risk Assessment. National and International regulations**.**

GEN N221	**Economics** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): 42 credits** Economics as a Discipline: Economics as a Social Science, Micro-economics and Macroeconomics, Theories in Economics, Barriers to Clear Thinking in Economics. The Economic Problem: Scarcity, Resources and Production, Production Possibility Boundaries, Choices and Opportunity Costs, Resource Use (Fundamental Choices). Demand and Supply: The Mechanics of a Market. Demand and Supply, Consumers Behavior (Demand, Individual Demand and Market Demand), Properties of Demand Curves, Demand versus Quantity Demanded, Producers Behavior: Supply, Individual Supply and Market Supply, Properties of Supply Curves, Supply versus Quantity Supplied, Equilibrium of Demand and Supply, Adjustment in Market Equilibrium. Supply and Demand Analysis: Economic Analysis, Demand Shifts: Substitutes and Complements, Demand Shifts: Superior and Inferior Goods, Price Ceilings, Price Floor, Excise Taxes. Price Elasticity of Demand: Price Sensitivity, Price Elasticity of Demand, Measuring Price Elasticity of Demand with the Arc Formula, Price Elasticity of Demand and Slope, Price Elasticity of Demand and Total Revenue, Determinants of Price elasticity of Demand, Other Elasticities. Perfect Competition and Monopoly Production and Input Use: Production, Production Functions, Short-Run Functions, Long-Run Production, Choices of Inputs. Economic Costs: Economic Costs, Short-Run Costs, Short-Run Cost Curves, Long-Run Costs and Long-Run Cost Curves. Profits, Interests, and Rent. Interest Rates, Time Value of Money. Feasibility Studies. Project Economic Analysis. Depreciation. Factor Markets: Perfect and Imperfect Competition.
GENN301	**Ethics and Legislation** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): 80 credits** Engineering profession: Ethical issues in engineering practice. Conflicts between business demands and professional ideals. Social and ethical Responsibilities of Technologists. Codes of professional ethics. Case studies. Value Crisis in contemporary society. Nature of values: Psychological values, Societal values, Aesthetic values, Moral and ethical values. Work ethics and professional ethics. The legal rule: Mandatory and complementary. Sources of Law. Formal sources: Statutory Law, Custom, the Principles of natural Law and rules of justice. Informal sources: Jurisprudence, Doctrine. Application of Law. Holders of right; Natural persons, Juristic persons. Theory of Obligation; definition, forms. Sources of Obligations. The contract; Parties, Formation, Validity, Effect, and compensation of Damage. Introduction to Engineering Contracts. Contracting Contract.

GENN310	**Advanced Risk Management** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN210 + MTHN203** Review of the Basic Risk Axioms and Concepts. Evolution of Risk Concepts and Terminology. Financial and Industrial Risk: Comparison and Contrast. Probabilistic Nature of Risk.. System Decomposition. Legal and Regulatory Risks. Tools for Risk Assessment: Probability and Consequences: Event Tree, Fault Tree, FMECA, FEMEA, MOSAR (The French Approach), Simulation, Optimization and Operations Research. HACCP: principles and applications. HAZOP.Qualitative and Quantitative Risk Assessments (QRA). Quantitative Risk Assessment: Qualitative Aspects of System Analysis (Quantification of Basic Events. Confidence Interval. Quantitative Aspects of System Analysis. System Quantification for Dependent Events. Human Reliability. Uncertainty Quantification). Operational Risk. Reporting Risk Operations. Sectoral Risk Management. Specific Risk Topics: Risk Specific to Confined Spaces. The Special Case of BLEVE and Explosive Mixtures. Social and Psychological Risk. Social Risk Management and Social Protection. Disaster Risk Management and Vulnerability Reduction. Can Risk be a Management Style?
GENN311	**Technical Writing in Arabic** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN101 + 80 credits** Review of the Basics of Arabic Grammar and Mechanics. Writing Effective Sentences and Paragraphs Using Arabic Language. Discovering and Outlining Ideas. Writing Abstracts, Summaries, and Conclusions of Long Reports. The thesis Statement. Writing Technical Forms Using Arabic Language: Letters, Memos, Reports, Scientific Articles, Job Description, CV. Writing References and Footnotes. Selection of Key Words, Titles and Subtitles. Editing, Revising and Proofreading Techniques. Electronic Word Processing and Technical Writing. Integrating Graphs, Tables and Charts in Technical Documents. Vocabulary Building. Basic Types and Patterns of Argument: Terminology, Building Sub-Arguments of Fact and Policy. مراجعة أسس القواعد النحوية و ميكانيكيات اللغة العربية - الأخطاء الشائعة فى استخدامات اللغة العربية - كتابة جمل وفقرات صحيحة وفعالة باستخدام اللغة العربية - خلق الأفكار (التفاكر) - كتابة مقدمات، ملخصات و خاتمات التقارير - كتابة الأبحاث - أشكال الكتابة باللغة العربية: الرسائل، المذكرات، التقارير، المقالات العلمية، الوصف الوظيفي، كتابة السيرة الذاتية وتوثيق المراجع - اختيار الكلمات المفتاحية و كذلك العناوين الرئيسية والفرعية - التعرف على تقنيات التحرير و المراجعة و القراءة الاحترافية - إمكانية معالجة النصوص والكتابة الإليكترونية - الرسوم و الجداول و المخططات البيانية في الوثائق الفنية - بناء حصيلة لغوية من الكلمات والمفردات - تعلم الانماط و الأساليب الأساسية والمبدئية للنقاش من حيث المنهجية والبناء.
GENN321	**Foreign Language** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN201** Emphasizing the development of student's communicative skills to speak, listen, read and write in languages other than Arabic and English, such as

	French, German, Spanish, Italian, Japanese, Chinese, etc, and to study cultural characteristics of such foreign languages from historical, geographical, literature, economic, and social viewpoints. Topics include, but not limited to, the basics of language grammar and mechanics, writing effective sentences and paragraphs, vocabulary building, writing technical engineering documents and writing technical forms: letters, memos, reports, scientific articles, job description, resumes and curriculum vitas.
GENN326	**Marketing** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN102 + 80 credits** Introduction. The Field of Sales; Strategic Sales Force Management. The Personal Selling Process and Sales Force Organization. Profiling and Recruiting Salespeople; Selecting and Hiring Applicants, Developing the Sales Program, Sales Force Motivation, Sales Force Compensation, Expenses and Transportation; Leadership of a Sales Force, Forecasting Sales and Developing Budgets; Sales Territories, Analysis of Sales Volume, Marketing Cost & Profitability Analysis, Performance Evaluation; Ethical and Legal Responsibilities tender writing.
GENN327	**Selections of Life-Long Skills** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN201** Communicating Clearly - Managing Time and Resources - Making Decisions - Delegating Successfully - Motivating People - Managing Teams - Negotiating Successfully - Minimizing Stress - Getting Organized - Managing Changes - Interviewing People - Managing Your Career - Balancing Work and Life - Thinking Creativity and Innovation - Influencing People – Systems Thinking – Interpersonal Management Skills – Entrepreneurial Skills.
GENN331	**Business Communication** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN201** Skills for effective communication in the workplace; constructing and delivering persuasive business presentations; theoretical and experiential knowledge of argumentation and debate for informal and formal presentations; style, layout, and convention of business writing; writing business proposals, progress reports, and feasibility reports; common areas of miscommunication.
GENN332	**Service Management** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN102 + 80 credits** Role of services in the economy, The nature of services, Service quality, Service Strategy, Developing new services, The role of technology in supporting service delivery, Design of services, Capacity planning and managing queues, Quantitative methods for service management.

8.2 College-Core Courses

CHEN001	**Chemistry** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): none** Gases; Applications to gaseous law; Mass balance and heat balance in combustion processes of fuels; Solutions & separation techniques; Applications to electrochemistry; Corrosion; Water treatment; Building materials; Environmental Engineering; Selected chemical industries: fertilizers, dyes, polymers, sugar, petro-chemicals, semi-conductors, oil and fats, industrial systems; Chemical Vapor deposition.
GENN003	**Basic Engineering Design** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): none** Introduction to Design: Problem description and Introduction to Internet communication - Project Management: Project Management Application, Problem Solving Techniques: Problem Definition, Design Constraints - Creative Thinking and Problem Solving: Introduction to critical and creative thinking, nature of design problems - Brainstorming seminar, list of possible and impossible solutions and generating Ideas - Creative Thinking and Decision making: Product life cycles , Selection of idea (s), Final decision matrix, Justify decision - The Design Matrix: Context, purpose and requirements of engineering design - Analyze selected solution/preliminary design - Automated Design & the Positive Attitudes for Creativity - Systematic generation and evaluation of ideas.
MDPN001	**Engineering Graphics** **Compulsory, Credits: 3 (1+0+5)** **Prerequisite(s): none** Techniques and skills of engineering drawing, normal and auxiliary projections. Solid geometry. Intersections between planes and solids. Development, sectioning. Drawing and joining of steel frames. Assembly drawing of some mechanical parts.
MDPN002	**Fundamentals of Manufacturing Engineering** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): none** Engineering Materials - Elements of Manufacturing Processes, material flow, energy flow and information flow - Forming in the liquid state, Casting and molding processes - Forming in the solid state, metal forming, forming of plastics and powder metallurgy - Material Joining processes, welding, soldering and brazing, riveting, joining by mechanical elements, assembly processes - Material removal processes, metal cutting and finishing processes - Computer applications in manufacturing - Term mini-project.
MECN001	**Mechanics-1 (Statics)** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): none** Statics of particles, forces in three-dimensions, vector algebra; equivalent systems of forces, resultant of a group of forces, moments of forces,

	moment of a couple, reduction of a system of forces, wrench; equilibrium of rigid bodies in two dimensions, reactions at supports and connections for a 2D structure, 2D trusses, equilibrium of rigid bodies in three dimensions, reactions at supports and connections for a three dimensional structure; centroids and centers of gravity, center of gravity of 2D bodies, centroids of areas and lines, first moments of areas and lines, composite plates and wires; moments of inertia, moments of inertia of areas, second moment, or moment of inertia of an area, polar moment of inertia, radius of gyration of an area, parallel-axis theorem, moments of inertia of composite areas, product of inertia, principal axes and principal moments of inertia, moments of inertia of masses, moment of inertia of a mass, parallel axis theorem, moments of inertia of thin plates, moments of inertia of composite bodies, mass product of inertia, principal axes and principal moments of inertia.
MECN002	**Mechanics-2 (Dynamics)** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): MECN001** Kinematics of particles: rectilinear motion of particles, position, velocity and acceleration, uniform rectilinear motion, uniformly accelerated rectilinear motion, curvilinear motion, derivatives of vector functions, rectangular components of velocity and acceleration, relative motion, tangential and normal components of acceleration, motion of a particle in a circular path, velocity and acceleration of a particle in polar coordinates. Kinetics of particles: Newton's second law, linear momentum of a particle, equations of motion with applications in Cartesian coordinates, tangential and normal directions, polar coordinates, free vibrations of particles, simple harmonic motion; energy & momentum methods, work of a force, kinetic energy of a particle, principle of work and energy, applications, power and efficiency, potential energy, conservation of energy, principle of impulse and momentum, impulsive motion, impact, direct central impact and coefficient of restitution, oblique central impact.
MTHN001	**Introduction to Linear Algebra and Analytic Geometry** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): none** Matrix algebra, determinants, inverse of a matrix, row equivalence, elementary matrices, solutions of linear systems of equations; parabola, ellipse and hyperbola, eccentricity and conic sections; quadratic equations; solid geometry, line, plane, quadratic surfaces.
MTHN002	**Calculus I** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): none** Functions, graphing of functions, combining functions, trigonometric functions; limits and continuity; differentiation; inverse functions; exponential and logarithmic functions; inverse trigonometric functions; hyperbolic and inverse hyperbolic functions; indeterminate forms and L'Hopital's rule; Taylor and Maclaurin expansions.

MTHN003	**Calculus II** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN002** Anti-derivatives; indefinite integrals; techniques of integration; definite integrals, applications of definite integrals; functions of several variables; partial derivatives, applications for partial derivatives.
MTHN102	**Multivariable Calculus and Linear Algebra** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN001 + MTHN003** Double integrals, double integrals in polar coordinates; triple integrals, triple integrals in spherical and cylindrical coordinates; applications of double and triple integrals; line and surface integrals; vector analysis, gradient of a scalar function, divergence of a vector, curl of a vector, divergence and Stokes' theorems, vector identities; LU-factorization; vector spaces; inner product spaces; eigenvalues and eigenvectors; diagonalization of matrices; functions of matrices.
MTHN203	**Probability and Statistics** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN102** Probability axioms; probability laws; conditional probability; random variables; discrete and continuous distributions; joint distribution; computer simulation; sampling; measures of location and variability; parameter estimation, testing of hypothesis.
PHYN001	**Mechanics, Oscillations, Waves and Thermodynamics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): none** Physics and measurements; elastic properties of solids; universal gravitation and motion of planets; fluid mechanics (statics and dynamics); oscillatory motion; wave motion, sound waves; thermo-dynamics, temperature, heat and the first law of thermodynamics, the kinetic theory of gases, heat engines, entropy and the second law of thermodynamics. Laboratory experiments on course topics.
PHYN002	**Electricity and Magnetism** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): none** Electric field; Gauss' law; electrostatic potential; capacitance and dielectrics; current and resistance; direct current circuits; magnetic fields, sources of magnetic field; Faraday's law; Maxwell's equations; inductances; magnetic properties of matter. Laboratory experiments on the course topics.
PPCN280	**Seminar-1** **Compulsory, Credits: 1 (1+0+0)** **Prerequisite(s): 72 credits + 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.*
PPCN380	**Seminar-2** **Compulsory, Credits: 1 (1+0+0)** **Prerequisite(s): PPCN280 + GENN201** Students will be required to present seminars on a subject assigned to (or chosen by) them about the latest technology relevant to the program. The grade depends on organization, quality, and content of both the presentation and the report prepared by the student. *The course is graded as Pass/Fail grade-system.*
PPCN281	**Industrial Training-1** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): 72 credits + AA Approval** Training on industrial establishments relevant to the program. Training lasts for total of 90 hours, during a period about 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 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-system.*
PPCN381	**Industrial Training-2** **Compulsory, Credits: 2 (0+0+6)** **Prerequisite(s): PPCN281 + 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-system.*
PPCN480	**Graduation Project-1** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): 130 credits + AA Approval** Students undertake a major project as part of the program. The aim of the project is to provide the students, who work in groups, with an opportunity to implement appropriate concepts and techniques to a particular design. Students are required to select and research the expected project to be designed and implemented in the following course Graduation Project-2. The student should give an oral presentation to be approved. *The course is graded as Pass/Fail grade-system.*

PPCN481	**Graduation Project-2** **Compulsory, Credits: 3 (1+0+6)** **Prerequisite(s): PPCN480 + AA Approval** All students undertake a major project as part of the program. The aim of the project is to provide the students, who work in groups, with an opportunity to implement the appropriate concepts and techniques to a particular design. A dissertation on the project is submitted on which the student is examined orally.

8.3 Discipline Courses

CHEN101	**Physical Chemistry-1** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): CHEN001** Real gases, compressibility factor, Dalton's law, Amagat's law, Virial equations, Cubic equations of state, Generalized correlations for Gases and liquids, chemical kinetics, effect of temperature, pressure, and concentration, half life period.
CHEN102	**Organic Chemistry-1** **Compulsory, Credits: 2 (1+0+3)** **Prerequisite(s): CHEN001** Types of Organic compounds, Valency, Isomerism, Saturated and unsaturated hydrocarbons , petroleum and natural gas, distillation and refining of various fractions and cracking, reforming, 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.
CHEN103	**Chemical Engineering Fundamentals** **Compulsory, Credits: 3 (2+0+3)** **Prerequisite(s): CHEN001** Block flow diagrams, process flow diagrams, process topology, 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, energy balances, computer aided balance calculations.
CHEN104	**Physical Chemistry-2** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): CHEN101** Phase rule, one component systems, ideal binary liquid vapour equilibrium, properties of liquids (vapour pressure, viscosity, and surface tension), first law of thermodynamics, enthalpy, second law and third law of thermodynamics, entropy, free energy, thermodynamic analysis, mixing, dilution, equilibria in chemical reactions, law of mass action.

CHEN105	**Thermodynamics and Combustion** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): CHEN101** Thermodynamic laws revisited, principles of combustion, thermodynamic cycles (Carnot, Rankin, Diesel, Otto), types of internal combustion engines, gas turbines, introduction to refrigeration.
CHEN106	**Computer Applications in Petrochemical Engineering** **Compulsory, Credits: 2 (1+0+2)** **Prerequisite(s): GENN004** Computer Simulation - Programming of simple petrochemical engineering applications using Excel and MATLAB - Emphasis on the solution of differential equations
CHEN201	**Organic Chemistry-2** **Compulsory, Credits: 2(1+0+3)** **Prerequisite(s): CHEN102** 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.
CHEN202	**Fluid Mechanics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MECN002** Fluid properties, hydrostatics, fluid motion, continuity equation, Bernouli's equation, pressure losses, Poiseuille-Hagen equation, Darcy equation, types of pumps. Non-Newtonian fluids, thixotropy, compressible fluid dynamics, compressible fluid measurements, critical velocities, power required for gas conveyance, stagnation temperatures, types of compressors, turbo-expanders.
CHEN204	**Cryogenic Processes** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): CHEN105** Enthalpy-composition diagrams, binary mixtures, cooling to extremely low temperatures, Joule-Thompson effect, liquefaction of gases, low temperature storage, cold storage, special applications.
CHEN301	**Mass Transfer and Separation Processes-1** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): CHEN104 + CHEN202** Diffusion and inter-phase transfer, staged and differential contacting schemes, gas absorption, liquid extraction, distillation, membrane processes, adsorption, hydrodynamics of staged and differential contact equipment.
CHEN302	**Instrumentation and Process Control** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): 90 credits** Basic principles of instrumentation - Dynamics of simple systems - Control loop components - Transient response of simple systems -

	Control configurations - Control modes - Control valves - Stability of control systems - Controller tuning - Introduction to PLC.
CHEN304	**Unit Operations** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): CHEN202** Particle characteristics, sedimentation and decantation, filtration, centrifugation, separation of droplets from gases, emulsification and coalescence, gas-solid separation.
CHEN305	**Heat Transfer and Applications** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): CHEN202** Thermal conduction, steady and unsteady state heat transfer, insulating materials, natural and forced convection, boiling and condensation, design of heat exchangers, radiation, black bodies, gas and flame radiation, design of tube still heaters
CHEN306	**Process and Plant Design** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): 120 credits** Development of the project, site location, site preparation and structures, master plot plans, equipment layout, piping layout and routing. Analysis, synthesis, systems approach, separation task sequencing, task integration, species allocation, safety considerations, piping and instrumentation diagrams, synthesis and optimization of chemical processes.
CHEN307	**Mass Transfer and Separation Processes 2** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): CHEN301** Separation processes, models of mass transfer, absorption and desorption, tray and packed towers, crystallization.
CVEN125	**Civil Engineering** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MECN001** Buildings: types of buildings, items within a building, types of foundations, building materials with emphasis on concrete and testing, insulation against heat moisture, noise and pollution, Principles of fire protection, tender document. Surveying: Principles & applications of surveying sciences with emphasis on plane surveying, Popular techniques and engineering uses of distance, angles and height difference measurements. Applications of mapping, earthwork computations, setting out engineering structures, Integrated digital surveying and mapping using total station, Internet resources. Structures: Types of structures, loads, supports, reactions, internal forces, analysis of beams, frames, trusses. Beams subjected to moving loads.

INTN201	**Electrical Engineering** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PHYN002** Introduction; Electric circuit theory; Direct current circuits; Single Phase alternating current; Transformers; Direct current machines; Alternating current machines: constructing types and main characteristics.
MDPN201	**Stress Analysis and Mechanical Design** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN002 + MECN001** 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 circle, Stresses in cylindrical and spherical vessels, Fundamentals of strength of materials, tension testing, hardness and impact tests. Fundamentals of machine Design, Factore of Safety, Design procedure of selected machine elements
METN132	**Materials Science** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN002 + PHYN001** Nature and properties of materials: Crystal structures and lattices, crystal imperfections, slip and dislocations, plastic deformation, phase diagrams, binary phase equilibrium characteristics of alloy solidification and structure of metals and alloys, Iron carbon diagram, various types of bonds, Hot and cold working of metals, recovery, recrystalization and grain growth. Metallography: Study of microstructure.
PEN101	**Introduction to Petroleum Industry** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): CHEN102** Overview of Oil and Gas Resources, International petroleum organizations, Origin of Petroleum, Basic Review of Petroleum Geology, The Geologic Column, Petroleum Traps, Migration and Accumulation, Basic Functions and Components of Rig, Drilling Fluid Functions, Types and Compositions Fundamental Drilling Operations. Completion Types, Completion Equipment, Definitions of Reserves, Reservoir Drive Mechanisms, Primary Recovery, Petroleum Fractionation, Different Petroleum Products, Petroleum Oilfield Safety.
PEN102	**General Geology** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): none** 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

PEN305	**Petroleum Geology** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): PEN101 + PEN102** Occurrence of petroleum - Primary and secondary porosity - Classification of traps; Structural, Stratigraphic and combination traps - Salt domes - Subsurface mapping - Origin of petroleum - Migration and accumulation of petroleum - Petroleum province - Ground water geology - Oil fields in Egypt.

8.4 Major Courses: Track PPC-C

CHEN401	**Petroleum Refining Engineering** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PEN306** 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 (uses & production of Linear Alkyl Benzene LAB), 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.
CHEN402	**Petrochemicals from Oil and Gas** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): CHEN304** Unit Operations in synthesis, Natural and synthetic fibers, fermentation, Saccharide and Carbohydrates, dyes, Synthesis of some important compounds: olefins, phenyl chloride, fertilizers and Thermoplastics.
CHEN403	**Chemical Reactor and Vessel Design** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): CHEN104 + CHEN105** **Reactor Design**: Theory of chemical reactions, rate equations, parallel and consecutive reactions, homogeneous isothermal reactors, adiabatic and programmed reactions, un-catalyzed heterogeneous reactions, heterogeneous catalysis, various types of industrial catalytic reactors. **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

CHEN404	**Advances in Cryogenics** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): CHEN204** Advanced topics in cryogenics – cryogenic equipment – Liquefaction of natural gas – Liquefaction equipment – Practical applications
CHEN407	**Advanced Chemical Engineering Equipment Design** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): CHEN304 + CHEN305** Design of Evaporators; Design of tube still heaters; Design of Boilesrs and Condensers; Design of filters; Design of solid; Gas separators.
CHEN408	**Economics of Oil and Gas Production** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): GENN221** Technoeconomic feasibility study of petrolechemical plants – Project financing – Preparation of tender documents of petrochemical plants – Technical and commercial evaluation of offers.
GENN401	**Project Planning, Instrumentation and Economics** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): 108 credits** Conceptual idea, techno-economical feasibility study, project financing, basic and detailed engineering, preparation of the tender documents, techno-commercial evaluation of offers, contract award and penalties, execution schedule, supervision of civil, electrical erection, commissioning and start. Equipment costs, plant total capital cost, operating costs, types of interest, cash flow, depreciation, profitability measurements.
METN401	**Electrochemistry and Corrosion** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): 108 credits** Potential, Nernst equation, equilibrium constant, ionic conduction, transfer numbers, electrochemical reactions, polarization, applications, fuel cells, corrosion mechanisms, measurement and protection.
PEN201	**Drilling Engineering-1** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PEN101 + PEN102** Formation Pressure – Fracture pressure – Basics of drilling equipment History of oil wells drilling – Rotary drilling – Rig components – Hoisting system – Drillstring design – Circulating system – Rig hydraulics – Drilling bits – well control – drilling fluids – solids control equipment. Threads and couplings – Casing design – Oil well cementing operations and equipment – Completion – Drilling fluids.
PEN202	**Reservoir Rock and Fluid Properties** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): CHEN104** Petroleum reservoir fluids- Hydrocarbon phase behavior: single and two phase systems – Bubble point and dew point curves – Retrograde

	phenomenon – Reservoir fluids characteristics – Gas in solution – Flash and differential gas liberation- The Properties of reservoir fluids.
PEN203	**Drilling Engineering-2** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): PEN201** Special Equipment and Operations; Introduction. Top Drive. Offshore Technology. Innovations and advances in Drilling Equipment and Instrumentation. Coiled Tubing Units; Special Operations: Fishing, Coring, Underbalanced Drilling. Deep Gas Well Drilling. BOP and Well Control; Management of Drilling Operations: Planning, the Drilling Prognosis, Reporting Drilling Operations, Contracts, Drilling Organizations and Tasks.
PEN204	**Natural Gas Engineering-1** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): PEN201** Physical properties of gases and condensates – Gas reservoir performance- Flow equations – Well deliverability- Transient Testing- Piping system performance- Flow in gas wells- Flow in pipelines- Gas compression- Gas condensate production- Recovery estimate- Gas reserves- Field operations problems- Gas flow measuring.
PEN302	**Reservoir Engineering-1** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): PEN202** 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.
PEN303	**Petroleum Production Engineering-1** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PEN203** Reservoir performance - Radial flow around wells - Productivity index - Inflow Performance Relationships - Naturally flowing wells - Vertical lift performance - Multiphase flow in wells- Choke performance.
PEN306	**Petroleum Field Operations** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): CHEN304** Oil and gas gathering systems – Crude oil characteristics- water in oil emulsion- Separation of oil and gas - Types of separators - Internal construction - Multistage separation - Separator capacity -Sizing and selection - Oil treatment facilities - Emulsion treatment - Desalting units - Crude stabilization - Measurements and transportation of crude oil- Classification and Fractionation of crudes.
CHEN405	**Advanced Separation Operations** **Elective (group E-2C), Credits: 3 (2+2+1)** **Prerequisite(s): CHEN307** Ultrafiltration – Microfiltration – Reverse osmosis – ion exchange separation – Chromatographic separation – Membrane separation techniques

CHEN406	**Advanced Statistics for Petrochemical Industries** **Elective (group E-2C), Credits: 3 (2+2+1)** **Prerequisite(s): MTHN203** Sampling – Testing of Hypotheses – Non parametric tests – Analysis of variance – Application to quality control – Reliability analysis
CHEN409	**Petroleum Standards** **Elective (group E-2C), Credits: 3 (2+2+1)** **Prerequisite(s): PEN101 + PEN306** Standards of crudes and refined products for different oil applications
CHEN410	**Advances in Petrochemical Engineering** **Elective (group E-2C), Credits: 3 (2+2+21)** **Prerequisite(s): CHEN304** Selected topics in Petrochemical Engineering
CHEN411	**Catalytic Reactor Design** **Elective (group E-2C), Credits: 3 (2+2+1)** **Prerequisite(s): CHEN403** 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.
CHEN412	**Advances in Polymer Engineering** **Elective (group E-2C), Credits: 3 (2+2+1)** **Prequisite(s): CHEN308 + CHEN403** Kinetics of step growth polymerization (linear, non-linear, stoichiometric, non- stoichiometric); kinetic and statistical approaches- Kinetics of chain growth polymerization (homogeneous, emulsion,….etc) - Kinetics of copolymerization - Polymerization reactors - Control of polymerization reactors
CHEN303	**Industrial Measurements and Control Applications** **Elective (group E-3C), Credits: 2 (1+2+1)** **Prequisite(s): CHEN302** Mechanical and electrical transducers- measurements of: pressure, liquid and gas flow, liquid level, temperature, specific gravity, and viscosity- Analytical instrumentation- Indicating and recording equipment- Signal transmission- Control Systems for multivariable processes - Advanced control systems - PLC
CHEN308	**Polymer Science and Technology** **Elective (group E-3C), Credits: 2 (1+2+1)** **Prequisite(s): CHEN102 + CHEN105** Introduction on polymers - Elucidation of the structure of polymers - Polymers classifications- Polymerization mechanisms- Polymer molecular weight- Thermodynamics of polymerization- Polymerization processes

CHEN310	**Water Treatment for Oil & Gas Operations** **Elective (group E-3C), Credits: 2 (1+2+1)** **Prequisite(s): 104 credits** 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
PEN301	**Petroleum Exploration Engineering** **Elective (group E-3C), Credits: 2 (1+3+0)** **Prerequisite(s): PEN102** Surface geologic structures - Application of photo geology - Seismic methods - Electric methods - Radioactive methods (fundamentals measurements and data analysis) -Gravity methods - Magnetic methods - Geochemical methods - Remote sensing - risk and decision analysis in petroleum exploration - Planning of exploration survey and special concepts of ground water exploration.
PEN304	**Reservoir Engineering-2** **Elective (group E-3C), Credits: 2 (1+2+1)** **Prerequisite(s): PEN302** Principles of fluid flow through porous medium - Principles of numerical methods for petroleum reservoir flow equations - multiphase flow problems-Well testing: Build-Up and Draw Down well test analysis - Formation damage and skin factor - Well interference testing.

8.5 Major Courses: Track PPC-P

PEN201	**Drilling Engineering-1** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PEN101 + PEN102** Formation Pressure – Fracture pressure – Basics of drilling equipment History of oil wells drilling – Rotary drilling – Rig components – Hoisting system – Drillstring design – Circulating system – Rig hydraulics – Drilling bits – well control – drilling fluids – solids control equipment. Threads and couplings – Casing design – Oil well cementing operations and equipment – Completion – Drilling fluids.
PEN202	**Reservoir Rock and Fluid Properties** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): CHEN104** Petroleum reservoir fluids- Hydrocarbon phase behavior: single and two phase systems – Bubble point and dew point curves – Retrograde phenomenon – Reservoir fluids characteristics – Gas in solution – Flash and differential gas liberation- The Properties of reservoir fluids.

PEN203	**Drilling Engineering-2** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): PEN201** Special Equipment and Operations; Introduction. Top Drive. Offshore Technology. Innovations and advances in Drilling Equipment and Instrumentation. Coiled Tubing Units; Special Operations: Fishing, Coring, Underbalanced Drilling. Deep Gas Well Drilling. BOP and Well Control; Management of Drilling Operations: Planning, the Drilling Prognosis, Reporting Drilling Operations, Contracts, Drilling Organizations and Tasks.
PEN204	**Natural Gas Engineering-1** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): PEN201** Physical properties of gases and condensates – Gas reservoir performance- Flow equations – Well deliverability- Transient Testing- Piping system performance- Flow in gas wells- Flow in pipelines- Gas compression- Gas condensate production- Recovery estimate- Gas reserves- Field operations problems- Gas flow measuring.
PEN301	**Petroleum Exploration Engineering** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): PEN102** Surface geologic structures - Application of photo geology - Seismic methods - Electric methods - Radioactive methods (fundamentals measurements and data analysis) -Gravity methods - Magnetic methods - Geochemical methods - Remote sensing - risk and decision analysis in petroleum exploration - Planning of exploration survey and special concepts of ground water exploration.
PEN302	**Reservoir Engineering-1** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): PEN202** 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.
PEN303	**Petroleum Production Engineering-1** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PEN203** Reservoir performance - Radial flow around wells - Productivity index - Inflow Performance Relationships - Naturally flowing wells - Vertical lift performance - Multiphase flow in wells- Choke performance.
PEN304	**Reservoir Engineering-2** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): PEN302** Principles of fluid flow through porous medium - Principles of numerical methods for petroleum reservoir flow equations - multiphase flow problems-Well testing: Build-Up and Draw Down well test analysis - Formation damage and skin factor - Well interference testing.

PEN306	**Petroleum Field Operations** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): CHEN304** Oil and gas gathering systems – Crude oil characteristics- water in oil emulsion- Separation of oil and gas - Types of separators - Internal construction - Multistage separation - Separator capacity -Sizing and selection - Oil treatment facilities - Emulsion treatment - Desalting units - Crude stabilization - Measurements and transportation of crude oil- Classification and Fractionation of crudes.
PEN401	**Well Completion and WorkOver** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): PEN203** Types of Completion, Basic Completion Categories, Open-hole Completion, Uncemented Liner Completions, Perforated Completions, Multizone and Subsea Completion, Completion Selection & Design Criteria, Completion Productivity, Sizing Tubing, Risks of Formation Damage, Sand Fill, Maximizing Well Productivity, Perforation Selection, Completion Fluids, Completion Equipment & Design Practices Down-hole Completion Accessories, Workover Operations.
PEN402	**Petroleum Production Engineering-2** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PEN303** Artificial Lift Methods, Gas lift: Valve design, continuous and intermittent injection - Gas lift valves - Sucker rod pumps - Hydraulic subsurface pumps - Jet pumps - Performance curves of pumps - Electrical submersible pumps - Pump components - Pump selection - Troubleshooting of ESP
PEN403	**Natural Gas Engineering-2** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PEN204** Field processing of natural gas- Design and operation of gas separators - Low temperature separation - Gas Dehydration - Fractionation and Stabilization - Sweetening - Sulphur recovery – LPG production.
PEN404	**Well Logging** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): PEN305** Fundamentals of well logging and log interpretation- Methods of well logging: conventional resistivity methods - Self potential - Laterologs - Micrologs - Radioactive logs - Sonic logs - Density logs - Dipmeter logs- Well logging data interpretation to determine porosity and rock saturation.
PEN405	**Petroleum Legislations and Economics** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): GENN221** Introduction - Supply and demands - Production costs " GNP - Money - Market factors - Petroleum Economics: Present values - Evaluation of

	projects - Depreciation - Depletion Curves - Cost Recovery – Local legislation and Concession agreements - International Organizations: OAPEC & OPEC - Statistics: International and local.
PEN410	**Oil Well Drilling-3** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): PEN203** Well Planning , The drilling prognosis, Drilling costs and AFE, Analysis of cost elements, Rig inspection logistics for large drilling operations, Drilling contracts and insurance for drilling operations, Drilling organizations and key drilling personnel. Reporting drilling operations, Safety for drilling. Applications of computer techniques in drilling. Corrosion problems in drilling
PEN411	**Water Flooding** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PEN304** Review of improved recovery methods - factors to consider in water flooding - Types of hydrocarbon present in the reservoir, Primary drive mechanisms – reservoir geology – original and remaining oil, In-place-stages of depletion – starting conditions, Review of rock and flow properties, Recovery efficiency concepts – unit displacement efficiency – fractional flow equation, Frontal advance equation – problems, Influencing factors on displacement efficiency- effect of initial gas saturation – problems, Vertical sweep efficiency – description of vertical heterogeneity, Calculation of vertical sweep, Aerial sweep efficiency – flood pattern geometries – methods of determining aerial sweep – miscellaneous patterns – influencing factors on aerial sweep, Fluid injectivity – problems, Prediction of water flood performance – prediction methods – Style- Kelton method- Dykstra – Parson Method, Dyes, Caudle % Erickson., Combined effects: a- Higgins-Leighton method, b-Craig, Geffen and Morse method, Empirical prediction methods – mathematical simulation models – problems, Practical aspects of water flooding – philosophy for water flooding – items to consider in water flooding. Water flood performance evaluation – performance improvement – review of injection well tests.
PEN413	**Enhanced Oil Recovery** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): PEN304** Oil displacement - Enhanced oil production methods: Chemical methods (Polymer flooding - Surfactant and alkaline flooding), miscible displacement by gases and carbon dioxide - Thermal methods.
PEN406	**Natural Gas Liquifaction and GTL** **Elective (group E-2P), Credits: 3 (2+2+1)** **Prerequisite(s): PEN204** Thermodynamic properties of Natural Gas, Enthalpy behavior - enthalpy and entropy correlations, Examples calculation using enthalpy and entropy correlations, Refrigeration systems: Compression refrigeration –

	Calculations of simple system, Calculation of Economizer system, Calculation of Chiller load (Qc), Specification of liquid separation temperature, Choice of refrigerant, Properties of common refrigerants, ((P-H) diagram for propane chiller, Effect of temperature on liquefaction cost, Cascade refrigeration, Purity of refrigerants, Mixed refrigerants, Expansion turbine refrigeration, Expander performance, Estimation of expander efficiency, Valve expansion refrigeration, Pressure drop across valve, Liquid condensation across valve, Application of refrigeration for natural gas liquefaction, Case studies and flow scheme for LNG in Egypt, The development of the GTL technology, Definition of GTL processes - The synthesis gas, Methods of producing synthesis gas-Fischer-Tropsch method, Mechanism of Fischer-Tropsch reaction - Kinds of Fischer Tropsch operations, Upgrading Fischer-Tropsch Products. Specifications of the GTL Products, Kinds of GTL technologies. Sasol, GTL Technology Shell, Exxon, Syntroleum, and other GTL technologies, GTL plants, Gas to liquid (GTL) economics- process challenges and Driver of A GTL plant – Factors affecting the GTL economics.-The future of The GTL industry from economic outlook, Potential Impact of the GTL industry- The GTL industry and the Environment, The impact of GTL industry on refiners, The impact of GTL industry on LNG production, The impact of GTL industry on utilization of clean fuels, The GTL projects around the world, The GTL in Arab countries,The possibility of applying GTL technology in Egypt.
PEN407	**Subsurface Mapping** **Elective (group E-2P), Credits: 3 (2+2+1)** **Prerequiste(s): PEN305** Introduction, Subsurface Mapping Rules and Fundamentals of Contouring, Computer Contouring Methods; Indirect (gridded), Direct (triangulation) Subsurface Mapping Methods, Single Surface, Multisurface, Faulted
PEN408	**Gas Pipeline and Domestic Networks** **Elective (group E-2P), Credits: 3 (2+2+1)** **Prerequisite(s): CHEN202 + PEN204** The Gas Piping System, Steady State Flow of Gas through pipes, Pipeline Branching and Networking, Pipeline Components, Design of Pipelines and Networks, Planning and Construction of Pipelines, Instrumentation and Pigging, Leak detection and SCADA system, Risk assessment
PEN409	**Well Stimulation** **Elective (group E-2P), Credits: 3 (2+2+1)** **Prerequisite(s): PEN303** Well Problems, Formation Damage, Acidizing and Matrix Treatments, Hydraulic Fracture, Fracture Fluids, Sand Control
PEN412	**Simulation and Modeling for Petroleum Engineers** **Elective (group E-2P), Credits: 3 (2+2+1)** **Prerequisite(s): PEN304**

	Principles of fluid flow through porous medium - Principles of numerical methods for petroleum reservoir flow equations - Finite differences methods, exact and numerical solutions - Stability, consistency, and convergence - Grid system - single phase flow - multidimensional - multiphase flow problems.
PEN414	**Directional Horizontal and Multilateral Drilling** **Elective (group E-2P), Credits: 3 (2+2+1)** **Prerequisite(s): PEN203** Directional Drilling Systems, Directional Drilling Applications, Surveying methods, Calculation Methods, Horizontal Wells Applications, Candidates for Horizontal Drilling, Screening Criteria, Exploration in Horizontal Wells, Rock Mechanics in Horizontal Sections, Horizontal Drilling Systems, Navigation of Horizontal Wells, Logging in Horizontal Wells, Stimulation in Horizontal Wells, Drilling Fluids Requirements For Horizontal Drilling, Completion of Horizontal Wells.
PEN415	**Data Mining** **Elective (group E-2P), Credits: 3 (2+2+1)** **Prerequisite(s): MTHN203** Introduction , Data Preprocessing , Data Warehouse and online Analytical Processing (OLAP) Technology: An Overview, Data Cube Computation and Data Generalization , Mining Frequent Patterns, Associations and Correlations, Classification and Prediction, Cluster Analysis, Mining Stream, Time-Series and Sequence Data , Graph Mining, Social Network Analysis and Multi-Relational Data Mining.
PEN416	**Advanced Topics in Petroleum Engineering** **Elective (group E-2P), Credits: 3 (2+2+1)** **Prerequisites: PEN302** Selected topics in Petroleum Engineering. Exploration, drilling, production, renewable energy, nuclear energy
PEN417	**Deep Water Technology** **Elective (group E-2P), Credits: 3(2+2+1)** **Prerequisite(s): PEN203** Introduction to Managing the deepwater projects, Deepwater systems, Deepwater Geology, Deepwater drilling rigs, Drilling cementing and Drilling Fluids, Deepwater Drilling Eng & well construction, Deepwater subsea, completion, production, well testing and abandonment, Deepwater well control, Well construction and design exercise, Deepwater risk analysis.

PEN418	**Seismic Stratigraphy** **Elective (group E-2P), Credits: 3 (2+2+1)** **Prerequisite(s): PEN301** Breaking Out Operational Sequences, Introduction to Fault Interpretation, Chronostratigraphy Construction and Interpretation, Sea Level Curves, Accommodation Space, and Cycle Orders, Vail Sequence Theory and Sequence Hierarchy, Carbonate Sequences, Siliciclastic Sequences, Seismic Facies, Paleo-Environmental Analysis, Geohistory Reconstruction, Optimizing Exploration**.**
PEN419	**Formation Evaluation and Reservoir Characterization** **Elective (group E-2P), Credits: 3 (2+2+1)** **Prerequisite(s): PEN303** Current methodologies used in geological description/analysis, formation evaluation (the analysis/interpretation of well log and core data), and the analysis of well performance data (the analysis/ interpretation of production data well test data); specifically, the assessment of field performance data
PEN420	**Horizontal Well Technology** **Elective (group E-2P), Credits: 3 (2+2+1)** **Prerequisite(s): PEN304 + PEN402** Overview of Horizontal Wells, Skin Damage for Horizontal Wells, Effective Wellbore Radius, Productivity of Horizontal Wells, Comparison of Horizontal and Fractures Vertical Wells, Water and Gas Coning in Vertical and Horizontal Wells, Horizontal Wells in Gas Reservoirs, Pressure Drop Through Horizontal Wells, Horizontal Wells in Gas Reservoirs