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## **Department of Chemical Engineering**

The department of Chemical Engineering offers the following programs:

### **1. Graduate Diplomas**

#### **1.1 Professional Diploma in Pollution Protection and Environmental Engineering**

The student must complete 24 credit hours.

Compulsory courses: The student must pass the following five courses with a total of 15 credit hours (07 18 641, 07 18 642, 07 18 652, 07 18 653, 07 18 654).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as “Diploma courses”

#### **1.2 Professional Diploma in Petroleum Refining and Petrochemicals**

The student must complete 24 credit hours.

Compulsory courses: The student must pass the following five courses with a total of 15 credit hours (07 18 641, 07 18 642, 07 18 661, 07 18 681, 07 18 682).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as “Diploma courses”

#### **1.3 Specialized Diploma in Chemical Engineering**

The student must complete 30 credit hours.

Compulsory courses: The student must pass the following six courses with a total of 15 credit hours (07 18 611, 07 18 648, 07 18 651, 07 18 661, 07 18 681, 07 18 682).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as “Diploma courses”

### **2. Master Degrees**

#### **2.1 Master of Engineering in Chemical Engineering**

The student must pass 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.



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Compulsory courses: The student must pass six courses with a sum of 18 credit hours with course numbers (07 18 711, 07 18 712, 07 18 725, 07 18 731, 07 18 741, 07 18 751).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as “Master courses”. The student is allowed to choose 2 courses from another major.

## **2.2 Master of Science in Chemical Engineering**

The student must pass 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.

Compulsory courses: The student must pass four courses with a sum of 12 credit hours with course numbers (07 18 711, 07 18 712, 07 18 731, 07 18 741).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as “Master courses”. The student is allowed to choose 2 courses from another major.

## **3. Doctor of Philosophy- Ph.D. Degree**

### **3.1 Doctor of Philosophy in Chemical Engineering**

The student must pass 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.

Compulsory courses: The student must pass four courses with a sum of 9 credit hours with course numbers (07 18 811, 07 18 821, 07 18 831, 07 18 834).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as “Master courses” or any other level.

The student is allowed to choose 3 courses from another major.

### **List of Diploma, Master and Ph.D. courses**

No.	Course Code	Course name	Credit Hours	Exam Duration	Pre-requisites
1	07 18 611	Transport Phenomena (A)	3	3	
2	07 18 621	Alternative Energy Sources	3	3	
3	07 18 641	Air Pollution (Types and Sources)	3	3	
4	07 18 648	Water Pollution (Types and Sources)	3	3	
5	07 18 651	Applied Microbiology	3	3	
6	07 18 652	Analysis of Water and	3	3	



		Industrial Liquid Wastes			
7	07 18 653	Solid Wastes and its Treatment	3	3	
8	07 18 654	Environmental Engineering	3	3	
9	07 18 661	Corrosion and Equipment Protection	3	3	
10	07 18 671	Extrusion of Plastics (A)	3	3	
11	07 18 672	Polymer Composite Processing	3	3	
12	07 18 673	Fiber Formation Engineering	3	3	
13	07 18 681	Petroleum Refining Engineering	3	3	
14	07 18 682	Petrochemicals Technology	3	3	
15	07 18 711	Advanced Separation Techniques	3	3	
16	07 18 712	Advanced Mass Transfer	3	3	
17	07 18 724	Fuel	3	3	
18	07 18 725	Advanced Heat Transfer (A)	3	3	
19	07 18 731	Advanced Chemical Reaction Engineering	3	3	
20	07 18 741	Advanced Thermodynamics of Chemical Reactions	3	3	
21	07 18 751	Treatment of Industrial Liquid Wastes	3	3	
22	07 18 752	Solid Wastes and its Treatment	3	3	
23	07 18 753	Design of Waste Treatment Units	3	3	
24	07 18 754	Application of Biotechnology in Pollution Control	3	3	
25	07 18 755	Bio-chemical Engineering	3	3	
26	07 18 761	Advanced Study in Electrochemical Processes	3	3	
27	07 18 771	Polymer Additives	3	3	
28	07 18 772	Monomers Production Engineering	3	3	
29	07 18 774	Advanced Material Science	3	3	
30	07 18 775	Science and Engineering of Polymers	3	3	
31	07 18 781	Fertilizers	3	3	



Faculty of Engineering  
Alexandria University

Graduate Studies  
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Amended 2013

32	07 18 782	Gases Production Technology	3	3	
33	07 18 792	Modeling and Simulation	3	3	
34	07 18 793	Simulation (Case Studies)	3	3	07 18 792
35	07 18 794	Numerical Methods in Chemical Engineering	3	3	
36	07 18 811	Transport Phenomena (B)	3	3	
37	07 18 821	Advanced Heat Transfer (B)	3	3	
38	07 18 822	Combustion and Tubular Furnaces Design	3	3	
39	07 18 823	Advanced Material Science	3	3	
40	07 18 824	Chemical Engineering Fluid Dynamics	3	3	
41	07 18 825	Fluidization Engineering	3	3	
42	07 18 831	Reactor Design	3	3	
43	07 18 832	Optimization Methods	3	3	
44	07 18 833	Catalysis	3	3	07 18 731 07 18 712
45	07 18 834	Applied Mathematics for Chemical Engineers	3	3	
46	07 18 835	Rheology	3	3	
47	07 18 871	Extrusion of Plastics (B)	3	3	
48	07 18 891	Mathematical Models and Polymer-Reactors Design and its Control	3	3	
49	07 18 601	Diploma Project in Pollution Protection and Environmental Engineering	3	Presentation	
50	07 18 602	Diploma Project in Petroleum Refining and Petrochemicals	3	Presentation	
51	07 18 603	Project for Specialized Diploma in Chemical Engineering	3	Presentation	
52	07 18 701	Scientific Report for the Master of Engineering in Chemical Engineering	3	Defense	
53	07 18 705	Thesis for the Master of Science in Chemical Engineering.	8	Defense	
54	07 18 801	Dissertation for the Doctor of Philosophy in Chemical	24	Defense	



		Engineering.			
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**Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)**

**07 18 611 Transport Phenomena (A)**

Viscosity and momentum transfer, effect of temperature and pressure on viscosity, velocity distribution in laminar flow, falling film flow, annular flow, creep flow round a sphere, continuity equation, flow of incompressible fluids.

**07 18 621 Alternative Energy Sources**

Solar energy, H<sub>2</sub> energy, energy from agricultural wastes, geothermal energy, wind energy, hydro-energy.

**07 18 641 Air Pollution (Types and Sources)**

Air pollutants (particulates and gases), characteristics of suspended and carried particulates, density, particle volume, ways of dust suspension and carry over, gaseous pollutants and its sources (SO<sub>2</sub>, SO<sub>3</sub>, H<sub>2</sub>S, CL<sub>2</sub>, CO, N<sub>2</sub> oxides) allowable limits of concentration of gaseous pollutants, effect of air pollutants on environment (mankind, animals and plants).

**07 18 648 Water Pollution (Types And Sources)**

Effect of industrial wastes on water pollution, effect of pollutants on municipal and industrial feed waters and on the aquatic life, organics and its effect on dissolved oxygen, aerobic reactions, biochemical oxygen demand and its calculations, chlorination processes, self-cleaning of water ways and rivers, relation between BOD and COD, removal of bacteria by water treatment, fungus control in water, underground water pollution.

**07 18 651 Applied Microbiology**

Micro-organisms (types, classes, effect on life), bacteria, enzymes and yeasts (methods of multiplication, nutrition need, its biology), preparation of bacteria and fungus and its identification, sterilization, fermentation industry.

**07 18 652 Analysis of Water and Industrial Liquid Wastes**

Acidity and alkalinity, required and residual chlorine, different metals, chlorides, cyanides, color, fluorides, fats, hardness, iodides, different N<sub>2</sub> compounds, BOD and COD, DO, pH, phosphates, TDS and TVS, silica, phenol, sulfates, sulfides, odor and taste.



**07 18 653 Solid Waste and its Treatment**

Sources of different solid wastes, treatment and disposal of municipal solid wastes, industrial solid wastes and its treatment before landfill, biological oxidation, stabilization.

**07 18 654 Environmental Engineering**

What's environment. Pollution sources soil, water and air. Natural sources. Industrial sources. Agriculture. Environment protection. Pollution prevention and waste recovery. Chemical and physical units used in treatment. Design of equipment.

**07 18 661 Corrosion and Equipment Protection**

Basics of corrosion, electrochemical nature of corrosion, Tafel extrapolation of passivity, polarization, design consideration to combat corrosion, cathodic and anodic protection, protection by coatings.

**07 18 671 Extrusion of Plastics (A)**

The extruder and its components, flow equations, single extruders, velocity distribution in flow channels, equations representing melt extrusion, isothermal operation, efficient operation.

**07 18 672 Polymer Composite Processing**

Size reduction. Crushing. Mixing (simple – plane – dispersed – vigorous) plastic mixer. Solid- dry- melt mixing. Molds. Pellets. Composite variables.

**07 18 673 Fiber Formation Engineering**

Crystallization under tension, heat treatment, internal structure of fibers, engineering problems, spinning from melts and solutions, analysis of spinning operation variables.

**07 18 681 Petroleum Refining Engineering**

Atmospheric distillation, vacuum distillation, treatment of distillates, raising the octane number, desulphurization, isomerization, thermal and catalytic cracking, coking, uses of different distillates.

**07 18 682 Petrochemicals Technology**

Reactions of H<sub>2</sub> and CO, oxidation of olefins, chlorination of paraffins, nitration of paraffins, manufacture of olefins, hydration of olefins, oxidation of olefins, chlorine and bromine compounds, diolefins, aromatics and naphthenes.

**07 18 711 Advanced Separation Techniques**



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Adsorption, ion exchange, freeze drying, fractional distillation, gas diffusion, dialysis and electro dialysis.

**07 18 712 Advanced Mass Transfer**

Finite stages contactors, maximum allowable vapor velocity in distillation towers, factors affecting plate efficiency, design details of different trays, packed trays, liquid distribution, pressure drop and flooding.

**07 18 724 Fuel**

Coal, combustion calculations, composition of flue gases, incomplete combustion and efficiency of boilers, heating value, testing of liquid fuels (viscosity, flash point, volatility, octane and cetane numbers, diesel index, residual carbon), fuel pollutants (S), gas fuels (natural gas, LPG, blast furnace gases, coke oven gases, water gas).

**07 18 725 Advanced Heat Transfer (A)**

Design of different types of heat exchangers, condensers and boilers. Heat transfer in furnaces and its design.

**07 18 731 Advanced Chemical Reaction Engineering**

Non-ideal flow (residence time distribution, mixing model( mixing of fluids, reactor design for heterogeneous systems, non-catalytic reactions of fluids with solid surfaces, reaction rate for constant volume spheres and that of decreasing volume, controlling step, design applications.

**07 18 741 Advanced Thermodynamics of chemical Reactions**

Thermodynamic properties of real fluids, fugacity and activity, steam power stations, Rankin cycle reheated, chemical equilibrium, thermal effects, air cooling cycles.

**07 18 751 Treatment of Industrial Liquid Wastes**

Systems of collecting liquid wastes, biological characteristics of raw waters and industrial liquid wastes (bacteria, fungi, BOD) primary methods of treatment (sedimentation, bio-filtration, bio-aeration, stabilization ponds, aerobic and anaerobic digestion). Advanced treatment techniques (removal of suspended matter, nitrification and denitrification, removal of dissolved matter) reuse of waters and its problems, treatment of raw waters, mixing and flocculation, water softening.

**07 18 752 Solid Waste and its Treatment**

Sources of different solid wastes, treatment and disposal of municipal solid wastes, industrial solid wastes and its treatment before landfill, biological oxidation, stabilization.

**07 18 753 Design of Waste Treatment Units**



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Settling units, mixing units, filtration units, centrifugal separation units, absorption towers, scrubbing towers, bio-filters, bag filters, de-nitrification units, precipitation units of heavy metals.

**07 18 754 Application of Biotechnology in Pollution Control**

Analysis of industrial liquid wastes, BOD and COD and its determination, characteristics of some industrial liquid wastes, tertiary treatment, types and activity of micro-organisms used in industrial liquid wastes, methane bacteria and treatment of agricultural wastes, use of micro-organisms acting on sulfur and phosphorus in pollution control, aeration and oxidation methods, bio-energy and biogas.

**07 18 755 Biochemical Engineering**

Fermentation of amino acids. Biocatalysis. Production to plant cell. Treatment of liquids. Biosafety. Biological processes and health care. Bioreactors. Biotensing. Technologies of processes.

**07 18 761 Advanced Study in Electrochemical Processes**

Role of mass transfer for and kinetics in electrochemical processes. Design and operation of electrochemical reactors. Time of electrochemical methods for industrial wastewaters. Energy conversion using electrochemical.

**07 18 771 Polymer Additives**

Stabilizers, anti-oxidants, coloring, anti-flame additives, anti-bio-deterioration materials, greases, separating materials, releasing agents, crystallization aids, plasticizers, coloring.

**07 18 772 Monomers Production Engineering**

Raw materials. production of double bond monomers and productions of condensation monomers.

**07 18 775 Science and Engineering of Polymers**

Molecular weights and molecule weight distribution. Mechanical and thermodynamic properties. Internal structure. Thermal structure. Thermodynamics of polymers. Transport phenomena in polymers. Wheatgrass for: lipid feed. Composite materials.

**07 18 781 Fertilizers**

Nitrogen and Phosphorus fertilizers (ammonium nitrate, urea, ammonium phosphates, tri-poly-phosphates, super-phosphates), compound fertilizers.

**07 18 782 Gases Production Technology**

Petroleum gases. Natural gas. Drying gases. Prevention of hydrates. Removal of hydrogen sulfide. Removal of sulfur oxides. Production of gas separation process.





**07 18 792 Modeling and Simulation**

Mathematical models for mass, energy and momentum balances in the different chemical processes, simulation of different industrial units and deviation of the used models.

**07 18 793 Simulation (Case Studies)**

Application of the computer programs in the simulation of the different industrial units, selection of the optimum operating conditions, some economic studies.

**07 18 794 Numerical Methods in Chemical Engineering**

Fundamentals of computational mathematics; discretization & roundoff errors. Euler, Taylor, Runge-Kutta, extrapolation and linear multistep methods. Analysis of stability & convergence. Error estimation and automatic step control. Boundary and Eigenvalue problems. Fundamentals of the finite difference method and related discretization errors. Stability, consistency & convergence.

**07 18 811 Transport Phenomena (B)**

Overall mass, momentum, and mechanical energy balances for isothermal systems, friction loss, stable and transient flow, effect of temperature and pressure on thermal conductivity of gases and liquids, thermal conductivity of solids, thermal conductivity in the presence of outside heat source, heat transfer for viscous medium, heat transfer in fins, natural and forced convection currents.

**07 18 821 Advanced Heat Transfer (B)**

Design of different types of heat exchangers, condensers and boilers. Heat transfer in furnaces and its design.

**07 18 822 Combustion and Tubular Furnaces Design**

Heating value, approximate and ultimate balances in combustion (mass and energy), use of combustion charts, chimney losses, pollution control.

**07 18 823 Advanced Material Science**

Crystalline structure of metals, phase diagrams, copper and nickel alloys, rubbers, ceramics, glasses, composites, fiber-reinforced materials, cement, concrete, wood and asphalt.

**07 18 824 Chemical Engineering Fluid Dynamics**

Applications of fluid dynamics to chemical engineering systems. Theory and practice of laminar and turbulent flow of Newtonian and non-Newtonian fluids in conduits and other



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equipment. Multi-phase flow. Introduction to the dynamics of suspended particles, drops, bubbles, foams, and froth. Selected topics relevant to chemical and other engineering disciplines.

**07 18 825 Fluidization Engineering**

Fundamentals of fluidization, two-phase flow theory and powder characteristics, structure and property of the emulsion phase and bubbles, mass and heat-transfer in fluidized beds with and without chemical reaction.

**07 18 831 Reactor Design**

Single ideal reactors and its design, multiple reactors systems, autocatalytic reactions, effect of temperature and pressure.

**07 18 832 Optimization Methods**

Search methods for single and multiple combinations, linear programming, restricted and unrestricted optimization, case studies.

**07 18 833 Catalysis**

Contact catalysis, adsorptive catalysis, contact catalysts, selectivity, catalysis equations, diffusion controlled reactions, design of catalytic reactors.

**07 18 834 Applied Mathematics for Chemical Engineers**

This unit of study consists of two main strands: statistical analysis of data and numerical (computer based) methods for solution of equation sets. By the end of the statistical analysis strand, students should be proficient in applying the basic principles of statistical analysis, and appreciate how they can be applied to a variety of engineering applications. The following statistical tools are studied: normal distribution, the test statistic  $z$ , confidence intervals for the population mean,  $t$ -distribution, hypothesis testing, data fitting, uncertainty analysis, propagation of random errors and analysis of variance. The numerical methods strand will see students become proficient in: solution of single and multivariable algebraic equations; solution of nonlinear differential equations; use of Excel and Matlab for data manipulation and equation solving; use of commercial flow sheeting software (Hysys) for solving engineering problems.

**07 18 855 Rheology**

Elastic rheology, rheological models, viscous rheology, dynamic loading, reduction and loss factors, transport factor, flow systems and the effect of molecular weights **and its** distribution, primary viscosity and its minimum value, 2-dimensional flow in spiral extruders, combined extrusion.

**07 18 871 Extrusion of Plastics (B)**



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Processing. Momentum transport equation. Plasticization. Aspect ratio. Types and nature of outlet dies. Polymers in extrusion. Trade names and symbols. Properties of proceeding speciation.

**07 18 891 Mathematical Models and Polymer-Reactors Design and its control**

Steady state model. Differentiation model. O-Z transformation. Reactors. Traditional classification of reactors. Continuous and non-continuous reactors for addition reactions in different types of reactors. Heat transfer in reactors. Constituency of homogenous reactors. Control of single phase reactors. Heterogeneous reactions in different reactors. Reactions stability in multiphase systems. Condensation reactions in different reactors.

**07 18 601 Diploma Project in Pollution Prevention and Environmental Engineering**

**07 18 602 Diploma Project in Petroleum Refining and Petrochemicals**

**07 18 603 Project for Specialized Diploma in Chemical Engineering**

**07 18 701 Scientific Report for the Master of Engineering in Chemical Engineering**

**07 18 705 Thesis for the Master of Science in Chemical Engineering**

**07 18 801 Dissertation for the Doctor of Philosophy in Chemical Engineering.**