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CHEMICAL ENGINEERING

Chemical Engineers play a vital role in industrial development and economic prosperity in the Kingdom of Saudi Arabia due to the vast contribution of the chemical and petrochemical industries in the overall Saudi economy. The recent expansions in materials and processed minerals of non-petroleum origin (e.g. phosphates, uranium, iron ...etc.) provide new working grounds for chemical engineers. Other major working areas for chemical engineers are in water desalination (the Kingdom has the largest productivity of desalinated water worldwide), industrial waste treatment, military industries, extractive metallurgy (iron, gold, aluminum), building materials, fertilizers and industrial cleaners. Also, Chemical Engineering encompasses biochemical engineering, which involves the pharmaceutical and food industries and biotechnology. The work of chemical engineers extends from the design and planning of new industrial projects to the operation, control and development of existing industries.

THE DEPARTMENT

1. Overview

The Chemical Engineering Department was established in 1394 H (1974 G) in the College of Engineering at King Saud University. The department currently has 29 faculty members: 14 Full Professors, 5 Associate Professors, 9 Assistant Professors and 3 Lecturers. Also, there are 6 Teaching and Research Assistants, and 4 Technicians. The department has very well equipped laboratories. Some of these laboratories enable the students to visualize the various chemical processes and how they are interrelated. Besides the student’s laboratories, the department contains faculty laboratories in which they conduct their own research. Also, the department has advanced computation facilities either through direct contact with university and college computers or the departmental personal computers facilities. The departmental computation laboratories are equipped with a number of design, simulation, and control packages that are used by the students to enhance the understanding of the various chemical processes.

For the sake of excellency and continuous improvement, the department is seeking the ABET accreditation. For this reason and because the university started the preparatory year on the academic year 2007/2008, the department underwent massive reevaluation of its bachelor and master programs. Reflection of this modification is manifested in the program plans.
To meet the market requirements, the department managed to establish a master program in polymer science and engineering. To advocate research and development, the department managed to establish SABIC chair for Polymer research and ACWA chair for Water and Power research.

For more information, please contact:

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King Saud University  
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Kingdom of Saudi Arabia  
Tel:  +966-1-467-6850  
Fax:  +966-1-467-8770  
Email: chair_ch@ksu.du.sa

URL:http://www.ksu.edu.sa/sites/Colleges/Engineering/ChemicalEngineering/Pages/tempo.aspx

2. Vision  
The department of chemical engineering aims at contributing to the nation’s development and improving the welfare of the society, through preparing professional chemical engineers and conducting applied research.

3. Mission  
The department strives to providing rigorous and dynamic education to students in chemical engineering field, serving local communities, contributing to the progress of the chemical engineering profession and leading in innovative applied research

4. Objectives  
The following objectives has been set up by the department in support of our mission:

Objective 1: Educate the students in the fundamental principles of science and chemical engineering, and provide them with modern experimental and computational skills.
Objective 2: Help the students to develop the ability to use chemical engineering education to tackle problems of practical importance to society while taking into consideration ethical, safety, economical and environmental factors.

Objective 3: Provide students, through broad education, with necessary skills required for effective communication, teamwork and to be productive and ethically conscience members of the professional community and society.

Objective 4: Provide the students with industrial training to facilitate their integration into professional life.
BACHELOR PROGRAM

Introduction

The B.S. program aims at preparing the students and providing engineers that can satisfy the needs of the industrial and public sectors and also to contribute to the national industrial development in the Kingdom. Therefore, the department is keen to include in its program, besides the basic chemical engineering subjects, courses that cover the most important industries (such as petrochemical industries and water desalination) in the Kingdom. The B.S. program is a five-year program divided into 10 semesters i.e. two semesters per academic year. Starting from the 2008/2009 academic year, the department will launch the new B.S. program.

The new B.S. program requires the student to study a total 160 credit units, of which 28 units are preparatory year, 12 units are university requirement, 56 units are college requirements and 64 units are required by the department. The department requirement is divided into 43 units as core courses, 8 units as foundation courses and 9 units of electives. Finally 4 units are devoted to a design project in which the student designs a complete factory, or simulates an industrial process or conducts a complete laboratory experiment. This design project is intended to polish the students knowledge of chemical engineering. During his course of study, the chemical engineering student studies laboratory courses which are embedded within the relevant courses in addition to completing a sixty days summer training requirement. During the training program, the students acquire the practical knowledge and the experience for his future employment. The program plan shown in the next page illustrates the temporal distribution of the course requirements in Chemical Engineering. The program plan starts from the 3rd level because the students spent the first year in the preparatory program.
## Bsc Program Plan

### 3rd Level

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 101</td>
<td>General Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 103</td>
<td>General Physics (1)</td>
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</tr>
<tr>
<td>MATH 106</td>
<td>Integral Calculus</td>
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</tr>
<tr>
<td>MATH 107</td>
<td>Algebra &amp; Analytical Geometry</td>
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</tr>
<tr>
<td>ENGL 1XX</td>
<td>Technical writing</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
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</table>

### 4th Level

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<tbody>
<tr>
<td>PHYS 104</td>
<td>General Physics (2)</td>
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</tr>
<tr>
<td>MATH 203</td>
<td>Calculus for Engineering Students</td>
<td>3</td>
</tr>
<tr>
<td>GE 104</td>
<td>Basics of Engineering Drawing</td>
<td>3</td>
</tr>
<tr>
<td>GE 105</td>
<td>Introduction to Engineering Design</td>
<td>2</td>
</tr>
<tr>
<td>ENGL 000</td>
<td>Communications Skills for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>IC 101</td>
<td>Introduction to Islamic Culture</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td><strong>17</strong></td>
</tr>
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</table>

### 5th Level

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<tr>
<td>IC 102</td>
<td>Islam and Society</td>
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<tr>
<td>ARAB 101</td>
<td>Language Skills</td>
<td>2</td>
</tr>
<tr>
<td>MATH 204</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>GE 201</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 244</td>
<td>Organic Chemistry (1)</td>
<td>2</td>
</tr>
<tr>
<td>CHE 201</td>
<td>Chemical Engineering Principles (1)</td>
<td>3</td>
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<td><strong>Total</strong></td>
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### 6th Level

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<tbody>
<tr>
<td>GE209</td>
<td>Computer Programming</td>
<td>3</td>
</tr>
<tr>
<td>ARAB 103</td>
<td>Expository Writing</td>
<td>2</td>
</tr>
<tr>
<td>IC 103</td>
<td>The Islamic Economic System</td>
<td>2</td>
</tr>
<tr>
<td>CHE 202</td>
<td>Chemical Engineering Principles</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 230</td>
<td>Physical Chemistry Principles</td>
<td>3</td>
</tr>
<tr>
<td>STAT 324</td>
<td>Engineering Probability and Statistics</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 245</td>
<td>Organic Chemistry (2)</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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### 7th Level

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<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 254</td>
<td>Numerical Methods</td>
<td>3</td>
</tr>
<tr>
<td>CHE 205</td>
<td>Chemical Engineering Thermodynamics (1)</td>
<td>2</td>
</tr>
<tr>
<td>CHE 312</td>
<td>Momentum Transport Operations</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 350</td>
<td>Instrumental Analysis</td>
<td>4</td>
</tr>
<tr>
<td>IC 104</td>
<td>Fundamentals of the Islamic Political System</td>
<td>2</td>
</tr>
<tr>
<td>GE 302</td>
<td>Industry &amp; Environment</td>
<td>2</td>
</tr>
<tr>
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### 8th Level

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<th>Credit Hours</th>
</tr>
</thead>
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<td>CHE 206</td>
<td>Chemical Engineering Thermodynamics (2)</td>
<td>2</td>
</tr>
<tr>
<td>CHE 309</td>
<td>Unit Operations</td>
<td>3</td>
</tr>
<tr>
<td>CHE 313</td>
<td>Heat Transfer Operations</td>
<td>3</td>
</tr>
<tr>
<td>CHE 331</td>
<td>Fundamentals of Materials Science</td>
<td>3</td>
</tr>
<tr>
<td>CHE 401</td>
<td>Modelling and Simulations of Chemical Processes</td>
<td>2</td>
</tr>
<tr>
<td>CHE 314</td>
<td>Mass Transfer operations</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>

### 9th Level

<table>
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<th>Course</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>CHE 315</td>
<td>Chemical reaction Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CHE 406</td>
<td>Separation Processes</td>
<td>4</td>
</tr>
<tr>
<td>CHE 000</td>
<td>Elective (1)</td>
<td>3</td>
</tr>
<tr>
<td>GE 401</td>
<td>Engineering Economy</td>
<td>2</td>
</tr>
<tr>
<td>CHE 498</td>
<td>Graduation Projects (1)</td>
<td>2</td>
</tr>
<tr>
<td>GE 402</td>
<td>Engineering Management</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>16</strong></td>
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### 10th Level

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<tr>
<th>Course #</th>
<th>Course</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>CHE 412</td>
<td>Computer Aided Chemical Process Design</td>
<td>3</td>
</tr>
<tr>
<td>CHE 414</td>
<td>Process Control</td>
<td>3</td>
</tr>
<tr>
<td>CHE 421</td>
<td>Economics of Chemical Processes</td>
<td>3</td>
</tr>
<tr>
<td>CHE 000</td>
<td>Elective (2)</td>
<td>3</td>
</tr>
<tr>
<td>CHE 000</td>
<td>Elective (3)</td>
<td>3</td>
</tr>
<tr>
<td>CHE 499</td>
<td>Graduation Projects (2)</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>
BSc Course Description

CHE 201: Chemical Engineering Principles – I, 3(3,1,0)
Origin and role of Chemical Engineering, Engineering Calculations Processes and process variables Material balances in single unit & multiple units for non-reactive and reactive processes including combustion reactions).
Pre-requisite: CHEM 101,

CHE 202: Chemical Engineering Principles - II, 2(2,1,0)
Energy and energy balance and thermodynamic principles. Balances on non-reactive processes Balances on reactive processes including fuels and combustion).
Pre-requisite: CHE 201, CO-requisite: CHEM 302,

CHE 302: Computerized Material and Energy Balances, 2(2,1,0)
Computer solution of simultaneous linear and nonlinear algebraic equations. Simultaneous material and energy balances in process flow sheets. Degree of freedom analysis. Sequential and Simultaneous solution with complete and partial solutions.
Pre-requisite: CHE 202, EE 209,

CHE 304: Thermodynamics for Petroleum Engineering, 2(2,1,0)
Pre-requisite: CHEM 302

CHE 307: Chemical Engineering Thermodynamics I, 2(2,1,0)
Pre-requisite: CHE 201, CHEM 230

CHE 308: Chemical Engineering Thermodynamics II, 2(2,1,0)
Thermodynamics properties of fluids. Thermodynamics properties of homogenous mixtures Phase equilibrium. Chemical reaction equilibrium.
Pre-requisite: CHE 307

**CHE 309: Unit Operations, 3(3,1,0)**
Pre-requisite: CHE 312

**CHE 312: Momentum Transport Operations, 3(3,1,0)**
Co-requisite: GE 210

**CHE 313: Energy Transport Operations, 3(3,1,0)**
Pre-requisite: CHE 202, CHE 312

**CHE 314: Mass Transport Operations, 3(3,1,0)**
Pre-requisite: CHE 202, CHE 312

**CHE 316: Separation Processes I, 3(3,1,0)**
Membrane based separation processes including Reverse osmosis, Gas permeation, Dialysis operations. Evaporation and design of evaporators.
Drying operations including Equations for various types of dryers an Drying equipment.
Pre-requisite: CHE 313, CHE 314

**CHE 321: Computer Aided Chemical Process Design, 3(3,1,0)**
Pre-requisite: CHE 302

**CHE 323: Instrumentation and Process Control, 3(3,1,0)**
Apply fundamental laws (momentum, heat and mass transfer, reaction engineering, …) to develop dynamic models for simple chemical systems. Examine the dynamics of simple chemical systems. Understand the process control structure. Design the classical PID control for single-input-single-output systems. Analyze the performance and stability of the controlled systems.
Pre-requisite: ---

**CHE 331: Principles of Materials Engineering, 3(3,1,0)**
Pre-requisite: PHY 104

**CHE 401: Computational Techniques, 2(2,1,0)**
Pre-requisite: CHE 302

**CHE 402: Chemical Engineering Laboratory I, 2(0,0,4)**
The instructor can choose any 6-7 experiments out of the following ones: Double Pipe Heat Exchanger, Filtration, Thermal Conductivity, Permeability and Fluidization, Centrifugal Pump Performance, Solid Handling, Flow Through Pipe and Fittings, Heat Transfer By Radiation, Pressure Drop Through Packed Beds, Centrifugal Fan Characteristics

Pre-requisite: CHE 313

**CHE 403: Chemical Engineering Laboratory II, 2(0,0,4)**
The instructor can choose any 6 experiments out of the following: Drying, Distillation, Absorption, Cooling Tower, Chemical reaction order, Extraction, Diffusion coefficient, Ion Exchange

Pre-requisite: CHE 316

**CHE 404: Chemical Reactor Engineering, 3(3,1,0)**

Pre-requisite: CHE 308

**CHE 405: Chemical Engineering Laboratory III, 2(0,0,4)**
Exp1A: Open-loop dynamic of two interacting storage tanks
Exp1B: Open-loop dynamics of temperature sensors
Exp02: Open-loop dynamic of three stirred tanks in series
Exp03: Open-loop response of tank pressure to step disturbances
Exp04: Pressure control of pressurized tank
Exp05: Level automatic PID control with outflow
Exp06: Temperature Control System

Co-requisite: CHE 323
CHE 411: Separation Processes II, 3(3,1,0)
Pre-requisite: CHE 316

CHE 413: Desalination and Water Treatment, 3(3,1,0)
Pre-requisite: CHE 313,

CHE 421: Chemical Plant Economics, 3(3,1,0)
Pre-requisite: CHE 321,

CHE 422: Selected Topics in Chemical Engineering, 2(2,1,0)
Treatment of contemporary selected topics such as: Particulate systems, Energy conversion, Mathematical modeling of chemical engineering systems, Adsorption and Ion exchange, Nuclear fuel processing and reprocessing, Biochemical engineering, polymer processing and treatment, corrosion and its control.
Pre-requisite: 5th level,

CHE 423: Selected Topics in Chemical Engineering, 2(2,1,0)
Treatment of contemporary selected topics such as: Particulate systems, Energy conversion, Mathematical modeling of chemical engineering systems, Adsorption and Ion exchange, Nuclear fuel processing and reprocessing, Biochemical engineering, polymer processing and treatment, corrosion and its control.
Pre-requisite: 5th level,

**CHE 426: Heterogeneous Reactor Engineering, 3(3,1,0)**

Pre-requisite: CHE 404

**CHE 432: Materials Engineering and Corrosion, 3(3,1,0)**
Extractive metallurgy including extraction of metal. Electrochemical Engineering and its applications. Corrosion and corrosion control, Experimental tests including electrode potential and corrosion measurement.

Pre-requisite: CHE 331,

**CHE 441: Petroleum Refining Engineering, 3(3,1,0)**
Refinery feedstocks, crude oil evaluation, and characterization. Types of refineries and basic refinery modules. Overall refinery flow. Principle operations in the refinery. Physical separation processes. Products: Types and specifications. Introduction to environmental regulations and legislations and their effects on refining operations.

Pre-requisite: CHE 411,

**CHE 498: Project-I, 3(0,0,0)**
This course is aimed at providing the students with the opportunity to unified all their previous courses or utilize it into one project by designing chemical process or making experimental project and presenting a formal report.

Pre-requisite: fifth level

**CHE 499: Project-II, 3(0,0,0)**
This course is the second part of final year project (CHE 498)

Pre-requisite: CHE 489
GRADUATE PROGRAMS

1. M.S. Program

The department offers the degree of Masters of Science in Chemical Engineering since 1401/1402 H (1981/1982 G). Since then 50 students have already obtained their M.S. degrees in the department while 8 students currently enrolled in the program.

To cope with the global changes in the chemical engineering education and more importantly to satisfy the local job demand, the department has renovated its classical Master program to include thesis and non-thesis options and added a specialized program as discussed in the following sections.

1.1 Master of Science in Chemical Engineering

Program Objectives
- Forming graduate students in various fields to satisfy the requirement for economic growth in the industrial sector.
- Strengthening ties between the department and the industrial sector for the development of process industries.

Admission Requirements
- The admission requirements enumerated in the 15th article of the unified law organizing the graduate studies in Saudi universities.
- Bachelor of science in chemical engineering. Other engineering holders can be accepted as well.

Program Tracks
- Chemical and Petrochemical Industries
- Materials Engineering
- Desalination and Water Treatment
- Process Synthesis & Control
- Bioprocess Engineering

Degree Requirements (Thesis Option)
A. Successful completion of a 24 credit hours of graduate courses distributed as follows:
   - Fifteen (15) credit hours from the compulsory courses.
   - Nine (9) credit hours from the elective courses.
B. Completion and successful defense of a thesis.
**Program Structure (Thesis Option)**

<table>
<thead>
<tr>
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<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>5 Compulsory Courses</td>
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<tr>
<td>3 Elective Courses</td>
<td>9</td>
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<tr>
<td>CHE 600 Thesis</td>
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</tbody>
</table>

**Degree Requirements (non-Thesis option)**

A. Successful completion of 42 credit hours of graduate courses distributed as follows:

- Twenty one (21) credit hours from the compulsory courses.
- Fifteen (15) credit hours from the elective courses.

B. Successful completion of a research project which comprises two parts, each having 3 credit hours. Each part is graded pass or fail.

**Program Structure (non-Thesis Option)**

<table>
<thead>
<tr>
<th>Number &amp; Type of Courses</th>
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</thead>
<tbody>
<tr>
<td>7 Compulsory Courses</td>
<td>21</td>
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<tr>
<td>5 Elective Courses</td>
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<tr>
<td>CHE 598 Project 1</td>
<td>3</td>
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<tr>
<td>CHE 599 Project 2</td>
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<tr>
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</table>

**Courses**

**Compulsory Courses**

- GE 501 Simulation of engineering systems on computer
- CHE 543 Advanced chemical engineering thermodynamics
- CHE 544 Advanced reaction engineering
- CHE 545 Advanced transport phenomena 1
  - ... Course to be taken from the list of general science courses

**Elective Courses**

- CHE 546 Advanced transport phenomena 2
- CHE 547 Advanced separation processes
- CHE 548 Multiphase flow
- CHE 549 Combustion engineering and furnaces
- CHE 550 Catalysis in chemical reactors
- CHE 552 Petrochemical processes
- CHE 553 Advanced petroleum refining engineering
CHE 554  Polymer science and engineering  
CHE 555  Oil and natural gas economics  
CHE 556  Chemical engineering application in waste treatment  
CHE 557  Air pollution engineering  
CHE 558  Chemical plant management  
CHE 559  Process safety and occupational health  
CHE 560  Selected topics in chemical and petrochemical industries  
CHE 562  Materials engineering  
CHE 563  Corrosion & its control  
CHE 564  Oil and gas corrosion  
CHE 565  Membrane technology  
CHE 566  Nanotechnology & nanomaterials  
CHE 567  Oxidation at high temperature  
CHE 568  Electrochemical engineering  
CHE 569  Selected topics in materials engineering  
CHE 571  Thermal separation processes  
CHE 572  Membrane separation processes  
CHE 573  Water treatment engineering  
CHE 574  Water quality  
CHE 575  Selected topics in desalination and water treatment  
CHE 577  Computer aided process design  
CHE 578  Process identification  
CHE 579  Process synthesis  
CHE 580  Process integration  
CHE 581  Process optimization  
CHE 582  Computational fluid dynamics  
CHE 583  Nonlinear analysis of dynamic processes  
CHE 584  Advanced control for process industries  
CHE 585  Modern control theory  
CHE 586  Assessment of benefits of advanced control systems  
CHE 587  Data acquisition & digital control in laboratory experiments  
CHE 588  Selected topics in process synthesis & control  
CHE 590  Biochemical engineering  
CHE 591  Bioseparation engineering  
CHE 592  Enzyme engineering  
CHE 593  Bioremediation  
CHE 594  Bioreaction engineering  
CHE 595  Selected topics in bioprocess engineering
CHED 597  Advanced topics in chemical engineering
CHE 600  Thesis
ME 556  Alloy theory

General Science Courses
MATH 505  Numerical linear algebra
MATH 506  Ordinary and partial differential equations
STAT 503  Probability and mathematical statistics
OR 537  Integer and combinatorial optimization

1.2 Master of Science in Polymer Engineering

Program Objectives:
The objectives of the program can be summarized as follows:
- Qualify Saudi engineers to advance and meet the work requirements of the polymers industrial sector.
- Encourage the scientific research in the professional field of polymers engineering and its applications.
- Co-operation with polymer industry to improve manufacturing practice.

Admission Requirements:
- The admission requirements enumerated in the unified bylaws organizing the graduate studies in Saudi universities.
- Bachelor of science in chemical engineering. Other Bachelors holders can be accepted as well.

Degree Requirements:
A. Successful completion of a 24 credit hours of graduate courses distributed as follows:
   - Fifteen (15) credit hours from core courses.
   - Nine (9) credit hours from elective courses.
B. Completion and successful defense of a master thesis. The student is allowed to register the thesis after completion of 12 credit hours.

Program Structure:

<table>
<thead>
<tr>
<th>Number &amp; Type of Courses</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>5  Core Courses</td>
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<tr>
<td>3  Elective Courses</td>
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</tr>
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<td>Thesis</td>
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Courses

Core Courses:

<table>
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<th>Course Code</th>
<th>Course title</th>
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<tbody>
<tr>
<td>CHE 511</td>
<td>Advanced Topics in Transport Phenomena</td>
</tr>
<tr>
<td>CHE 561</td>
<td>Fundamentals of Polymer Engineering</td>
</tr>
<tr>
<td>CHE 562</td>
<td>Polymer Reaction Engineering</td>
</tr>
<tr>
<td>CHE 563</td>
<td>Polymer Properties and Rheology</td>
</tr>
<tr>
<td>CHE 564</td>
<td>Polymer Processing</td>
</tr>
</tbody>
</table>

Elective Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 502</td>
<td>Advanced Chemical Reaction Engineering</td>
</tr>
<tr>
<td>CHE 565</td>
<td>Polymer Characterization and Synthesis Laboratory</td>
</tr>
<tr>
<td>CHE 566</td>
<td>Polymers Degradation</td>
</tr>
<tr>
<td>CHE 567</td>
<td>Micromechanics</td>
</tr>
<tr>
<td>CHE 568</td>
<td>Polymer Surfaces and Adsorption</td>
</tr>
<tr>
<td>CHE 569</td>
<td>Advanced topics in Polymer Engineering</td>
</tr>
<tr>
<td>CHE 570</td>
<td>Modeling and Simulation in Polymer Synthesis &amp; Processing</td>
</tr>
<tr>
<td>CHE 571</td>
<td>Non Newtonian Flow and heat transfer in Polymers</td>
</tr>
<tr>
<td>MATH 506</td>
<td>Ordinary and Partial Differential Equations</td>
</tr>
<tr>
<td>CHEM 581</td>
<td>Polymer Solutions</td>
</tr>
</tbody>
</table>
1.3 Master Course’s Description

**CHE 501: Advanced Chemical Engineering Thermodynamics 3(3,0,0)**

**CHE 502: Advanced Chemical Engineering Reaction 3(3,0,0)**
External and internal resistance (non-isothermal pellets). Fixed bed reactors (isothermal and non-isothermal). Fluidized bed reactors (isothermal and non-isothermal). Other types of multiphase reactors, polymerization reactors, multiplicity of steady states.

**CHE 503: Catalysis in Chemical Reactors 3(3,0,0)**
Catalysts definition and properties, Catalysts Characterization and Selection, Characterization Techniques and Equipment, Analysis of Heterogeneous Reactions, Supported Catalysts, Diffusion in Porous Catalysts, Catalyst Deactivation, Advanced topics on External and Internal resistance.

**CHE 511: Advanced Topics in Transport Phenomena 3(3,0,0)**

**CHE 512: Advanced Heat Transfer 3(3,0,0)**
Advanced topics in conduction, convection, and radiation. Development of equations for steady state and unsteady state conduction of heat through solids of various configurations. Use of both graphical and analytical methods including mapping and relaxation techniques. Applications of advanced techniques in design of heat transport equipment.

**CHE 513: Advanced Momentum Transport 3(3,0,0)**
Non-Newtonian momentum transfer. The differential equation of momentum transfer and solution for special cases. Boundary layer theory. Turbulence. Numerical methods in momentum transfer. Two phases flow.

**CHE 514: Advanced Mass Transfer 3(3,0,0)**

**CHE 521: Advanced Chemical Process Control II 3(3,0,0)**

**CHE 522: Process analysis and Optimization 3(3,0,0)**

**CHE 523: Chemical Plant Management 3(3,0,0)**
System approach to the firm: as a technological system. As a resource flow system, as information processing and decision making system. Principles of decision making and problem solving in an industrial environment. Brief description of LP applications. Administrative structures and problems of the firm. Organization theories and achievement of objectives. The firm and the economy, the component of aggregate demand with special reference to investment and inflation. Efficient use of resources and energy. The firm and technical change, R & D.

**CHE 524: Application in Waste Treatment 3(3,0,0)**
Control of gaseous pollutants: conversion methods, thermal and catalytic processes. Absorption, adsorption, condensation, control of SO2 emission, control of NOx emission. Wastewater treatment: Objectives and regulations, classification and application of waste water treatment methods, physical and chemical treatment processes, neutralization, coagulation and flocculation, sedimentation, ion exchange, electrodialysis. Solid waste: definitions, characterization, engineered systems for solid waste handling and disposal, ultimate disposal, hazardous waste treatment technologies.

**CHE 531: Material Engineering 3(3,0,0)**

**CHE 532: Corrosion and Its Control 3(3,0,0)**

**CHE 533: High Temperature Oxidation 3(3,0,0)**

**CHE 534: Polymer Science and Engineering 3(3,0,0)**
Structure of polymer and their properties. Kinetic and mechanism of formation of polymers, Polymer rheology. Manufacturing and processing techniques.
CHE 541: Advanced Petroleum refining Engineering I  3(3,0,0)

CHE 542: Recent Trends in Desalination  3(3,0,0)

CHE 551: Advanced Topics in Chemical Engineering  3(3,0,0)
Topics of current interest in the field of chemical engineering will be offered.
2. Ph.D. Program

The Ph.D. program in Chemical Engineering was approved in 1417 H (1997 G). The program aims at meeting the needs of the Kingdom for qualified individuals with such a highly specialized degree. Graduates are expected to lead in research and development. The program aims also at strengthening the links between the university and the industry through Ph.D. research in specific industrial problems. It also aims at developing and conduct fundamental Chemical Engineering Research. The Ph.D. program has four main specialization (options):

1. Transport Phenomena
2. Process Control
3. Chemical Industries
4. Material Engineering

2.1 Admission requirements

Students with an M.S. in Chemical Engineering with grades of at least “very good” are admitted to the program. The applicant is also required to score at least 500 in the TOEFL (Test Of English as Foreign Language). In case of admission of students with M.S. degree from disciplines other than Chemical Engineering, completion of additional courses may be required from those students.

2.2 Course requirements

The study for Ph.D. degree in Chemical Engineering requires the student to complete 18 credit units from graduate courses listed in Table (3) together with successful completion of the comprehensive examination. The student is also required to conduct an original and novel scientific research and write a thesis in one of the Chemical Engineering topics. The student is required to take six compulsory units (CHE 602 and CHE 618) and 12 units chosen from one of the four departmental specializations (options).
2.3 Doctorate Program Courses

Compulsory Ph.D. Courses
602 CHE Advanced Reaction Engineering (2)
618 Unsteady State Transport Phenomena

Material Engineering Option
604 CHE Advanced Numerical Techniques
605 CHE Properties of Gases & Liquids
607 CHE Advanced Electrochemical Engineering
611 CHE Advanced Separation Processes
631 CHE Advanced Extractive Metallurgy
632 CHE Advanced Physical Metallurgy (1)
633 CHE Composite Materials
634 CHE Advanced Physical Metallurgy (2)
635 CHE Hot Corrosion Engineering
636 CHE Corrosion Control
643 CHE Advances in Polymerization
654 CHE Selected Topics in Chemical Engineering
621 CHEM Structure Analysis
631 CHEM Advanced Physical Chemistry

Control & System Engineering Option
603 CHE Complex Dynamics & Chaos
604 CHE Advanced Computational Techniques
621 CHE Computer Aided Design for Chem. Industries
622 CHE Simulation of Chem. Processes
623 CHE Computer Aided Control of Chemical Plants
624 CHE Digital Control of Experiments
625 CHE Artificial Intelligence in Chemical Industries
626 CHE Chemical Processes
627 CHE Advanced Control of Processes
654 CHE Selected Topics in Chemical Engineering
656 EE Non-linear Control Systems
657 EE Stochastic Control Systems

Transport Phenomena Option
601 CHE Statistical Thermodynamics
604 CHE Advanced Computational Techniques
605 CHE Properties of Gases & Liquids
608 CHE Chemical Engineering. Experimentation
611 CHE Advanced Separation Processes
612 CHE Multiphase Flow
614 CHE Advanced Heat Transfer (2)
615 CHE Combustion Engineering
617 CHE Advanced Topics in Diffusion
654 CHE Selected Topics in Chemical Engineering

**Chemical Industries Option**
604 CHE Advanced Computational Techniques
605 CHE Properties of Gases & Liquids
606 CHE Topics in Biomedical Engineering
607 CHE Advanced Electrochemical Engineering
611 CHE Advanced Separation Processes
613 CHE Biochemical Engineering
616 CHE Chemical Engineering. Applications in Electronics
626 CHE Chemical Processes
636 CHE Corrosion Control
641 CHE Advanced Petroleum Refining (2)
642 CHE Design of Chemical Industrial Systems
643 CHE Advances in Polymerization
654 CHE Selected Topics in Chemical Engineering
621 CHEM Structure Analysis
631 CHEM Advanced Physical Chemistry
2.4 PhD Course’s Description

CHE 601: Statistical Thermodynamics
Modern techniques for the investigation of fluid properties from statistical mechanics point of view. Studies on liquid state, hard spheres, soft spheres, lennard-Jones fluids, perturbation theory, adsorption on solid surfaces, electrolyte solution, molten salts, and transport properties. Computer applications on the above topics.

CHE 602: Advanced Chemical Reaction engineering II

CHE 603: Complex dynamics and chaos in chemical & biochemical systems
Introduction to the bifurcation theory, sources of instabilities in chemical and biochemical systems. Identification of stable and unstable regions. Practical implication of bifurcation and instabilities. Introduction to chaos, strange attractors and fractal structures.

CHE 604: Advanced Computational Techniques in chemical Engineering

CHE 605: Properties of Gases and Liquids
Introduction to physical properties estimation, experimental data validation, consistency tests, pure component constants, various estimation procedures for properties of pure compound and mixtures of gases and liquids, PVT and other thermodynamic properties, mixing rules and their effects on mixture properties, group contribution methods in property estimation, linear and nonlinear regression in property estimation. Computer application on the above topics.

CHE 606: Topics in Biomedical Engineering
Review of human anatomy and physiology. Application of the principles of heat, mass and momentum transfer laws to human systems, artificial organs and life support systems. Modeling and simulation of respiratory, circulatory, gastroenterology, nephrology systems.
CHE 607: Advanced Electrochemical Engineering

CHE 608: Chemical Engineering Experimentation
Main statistical characteristics of random variables, parameters of the distribution function, the analysis of variance, correlation and regression analysis, design of experiments factorial design, empirical modeling.

CHE 611: Advanced Separation Processes
Relatively new separation technologies, gas and liquid chromatography, electrophoresis, membrane processes and pressure swing adsorption.

CHE 612: Multiphase Flow with Phase Change
Fluid dynamic of multiphase flow, thermodynamic characteristic of multiphase systems, interphase heat transfer, instability of two phase flow.

CHE 613: Biochemical Engineering

CHE 614: Advanced Heat Transfer II

CHE 615: Combustion Engineering
Arabia: desalination, fuels, power generation, building materials’ industries, safety and environmental issues

**CHE 616: Chemical Engineering application in Electronic industry**
Introduction to microelectronic processing, chlorosilanes from metallurgical grade silicon, bulk crystal growth from melts, chemical vapor deposition (CVD), low pressure chemical vapor deposition (LCVD), thermal laser assisted CVD, photochemical CVD, CVD in optical fiber fabrication, glow discharge (plasma) characteristics, plasma reactors, liquid phase epitaxy (LPE), physical vapor deposition (PVD), catalytic and non-catalytic etching. Oxidation of silicon.

**CHE 617: Advanced Topics in Diffusion**
Diffusion for multi-component systems, in solids and membrane. Steady state diffusion with homogeneous and/or heterogeneous chemical reaction, dispersion in different flow region, measurements of diffusion coefficients. Unsteady state diffusion without and with chemical reactions.

**CHE 618: Unsteady State Transport Processes**
General unsteady state transport equations for mass, heat and momentum transfer with and without generation in the system. Solution of the unsteady state transport equations using analytical, graphical, and numerical methods. Application to actual industrial cases.

**CHE 621: Computer-Aided Design for Chemical Industries**
Principles of developing advanced user's friendly software packages for the design of industrial reactors, distillation columns, absorption towers, heat exchangers, etc

**CHE 622: Simulation of Chemical Processes**

**CHE 623: Digital Computer Control of Chemical Plants**
CHE 624: Data Acquisition & Digital Control in Laboratory Experiments

CHE 625: Neural Networks in Chemical Processes

CHE 626: Process Synthesis

CHE 627: Advanced Chemical Process Control II
Direct synthesis and time delay compensation. Selected topics on one or two of the following advanced control strategies: Statistical process control, Fuzzy logic control, Internal model control, Supervisory control (real time optimization), Linear multivariable control, Nonlinear multivariable control, Adaptive control, distributed parameter control systems, Model predictive control.

CHE 631: Advanced Extractive Metallurgy
Advanced theory and practice of mineral dressing. Mineral dressing in relation to mineral resources and economics of the society. Quality control on ore dressing. Design of mineral dressing systems and dust control. Advanced study of reaction rate theories as applied to the solid state reactions and multiphase reactions of chemical metallurgy, fuel and refractories. Ion exchange theories and their application in hydrometallurgy, electrolysis and electro-extraction of metals and metal refining.

CHE 632: Advanced Physical Metallurgy I
The free electron theory of metals, the zone theory of metals, magnetism and electrical conductivity. Dislocation and mechanical properties of metals, dislocation interactions and properties of dislocation arrays. X-ray
diffraction as applied to the study of metals and alloys, interpretation of multi-component phase diagrams for metal systems. Physical and chemical metallurgy of primary metals in the nuclear field. Graphite and other non-metallic, fuel elements, container materials and moderators, radiation damage, and liquid metals.

**CHE 633: Composite Materials**

**CHE 634: Advanced Physical Metallurgy II**

**CHE 635: Hot Corrosion Engineering**

**CHE 636: Corrosion Control and Monitoring**

**CHE 641: Advanced Petroleum Refining Engineering II**
Design methods and procedures of the following units: Hydrotreating, hydrocracking, fluid catalytic cracking, catalytic reforming.

**CHE 642: Petrochemical systems Design**
Description and evaluation of processes designed to manufacture petrochemicals. Sources, availability, and characterization of feedstocks. Process design procedure.
CHE 643: Advanced Topics in Polymerization
Mathematical modeling and reactor design for polymerization processes including step growth and chain growth mechanisms. Topics cover poly-condensation and free radical processes in various reacting media and reactor configuration (emulsion, suspension, solution polymerization, etc). Catalytic olefin polymerization.

CHE 654: Selected Topics in Chemical Engineering
Selected advanced topics of recent progress in subjects related to chemical engineering.
DEPARTMENT LABORATORIES

Student Laboratories
The chemical engineering department has four main undergraduate laboratories where students can practice and integrate all of their knowledge from the undergraduate courses into realistic applications. These laboratories is classified as follows:

1. Unit operation laboratory:
In this laboratory the students are introduced to and trained on different laboratory-scale chemical processes such as distillation, drying, cooling tower, liquid phase chemical reactors (batch, continuous, tubular) and heat exchanger. The students also learn about many chemical and physical phenomena such as diffusion of liquids and gases, thermal conductivity, solid handling, fluidization and filtration.

2. Petroleum refining laboratory
In this laboratory, the students are trained on distillation of crude oil and learn how to estimate oil properties such as pour and cloud point, melting point of wax, specific gravity & viscosity of oil and flash & fire point by open cup method. The training also includes water and sediment removal by centrifuge.

3. Material science laboratory
In this laboratory students learn how to study and analyze the surface and structure of various types of minerals.

4. Process control laboratory
This laboratory contains several equipment, which are used to introduce the student to process dynamics in open loop and closed-loop modes, instrumentation and control valves. The student also trained on how to tune the conventional PID controller.
**Research Laboratories**

The chemical engineering department has the following research laboratories:

1. Phosphate manufacturing and processing laboratory
2. Electrochemistry and hydrogen production laboratory
3. Heat transfer and scale & fouling laboratory
4. Catalysis and characterization laboratory
5. Catalytic chemical reaction laboratory
6. Mass transfer enhancement laboratory
7. Advanced Process control application laboratory
8. Hydrodynamics of gas lift reactors laboratory

In addition, the department has the following characterization and analytical equipments:

1. XRF Spectrometer
2. Scanning Electron Microscopy
3. Total Organic Carbon
4. Kruss Tensiometer
5. HACH Spectrophotometer
6. Atomic Absorption Spectrometer
7. Lazer Particle Size Analyzer
8. Thermal Gravimetric/Differential Thermal Analyzr (TG/DTA)
9. Carbon Sulphur Analyzer
10. Vapor Pressure Analyzer
11. Digital Rotational Viscometer
12. KS Stress Test
13. Hardness Tester
14. Cyclic Corrosion Tester
15. Surface Analyzer
16. Infra Red Spectroscopy
### RESEARCH GROUPS

#### Catalysis and Reactor Engineering

**Description**
Professional investigations and design of single phase and multiphase reactors; Reaction kinetics including petrochemicals, polymers, ... etc; Catalysis and catalysts's development including preparation, characterization and testing; Modeling and simulation of chemical and petrochemical reactors.

**Faculty Expertise**
Dr. Yusuf alZeghyer, Dr. Saeed AlZahrani, Dr. Ahmed Abasaeed, Dr. Mohammad Abashar, Dr. Fahad AlMubaddel.

#### Process Dynamic, Optimization and Control

**Description**

**Faculty Expertise**
Dr. Emad Ali, Dr. Khalid alHumaizi, Dr. Abdelhamid ajbar, Dr. Mohamed alHaj Ali

#### Powder Technology and Hydrodynamic of Multiphase Processes

**Description**
Professional investigation of hydrodynamic characteristics and mass transfer enhancement of multiphase reactors, Electro capacitance tomography, fluidization and fluidized beds engineering. Flow in porous media. Nano Material handling.

**Faculty Expertise**
Dr. Mohammad Asif, Dr. Waheed AlMasry, Dr. AbdelHamid Ajbar, Dr. Emad Ali, Dr. Fahad AlMubaddel

#### Renewable Energy and Hydrogen Production

**Description**
Professional investigation of alternative energy resources such as solar energy, fuel cells, biofuel and hydrogen production. Design and testing fuel cells. Fuel progressing, hydrogen production and storage. Advanced modeling and design analysis tools.

**Faculty Expertise**
Dr. Anis Fakeeha, Dr. Mohammad Abashar, Dr. Farag AbdelAleem, Dr. Hasan Atiyeh

#### Desalination and Wastewater Treatment

**Description**
Professional investigation of water desalination technologies, RO and MSF desalination design and optimization, Environmental protection, water resources and demand, wastewater treatment technologies. Nanofiltration Technology. Ground water pretreatment and facilities.

**Faculty Expertise**
Dr. Ibrahim AlMutaz, Dr. Malik Alahmad, Dr. Farag Abdelaleem
### Chemical and Biochemical Processes

**Description**
Professional investigation of chemical industries, flowsheeting, process development and alternatives, economic and feasibility studies. Ore and Mineral extraction and processing. Natural gas processing. Biochemical and biomedical processes design and technology. Food Processing.

**Faculty Expertise**
Dr. Inas AlNashef, Dr. Mourad bumaza, Dr. Yusuf Bakhbakhki, Dr. Hasan Atiyeh, Dr. Waheed AlMasry, Dr. Yusuf AlZaghyer, Dr. Fahad AlMubaddel, Dr. Tariq AlFariss, Dr. Hamid Mustafa, Dr. Ahmed Abasaeed

### Material Science and Engineering

**Description**
Professional investigation of industrial and building materials properties, material structure and enhancement, corrosion detection and control, electrochemical engineering application, advanced materials characterization and application.

**Faculty Expertise**
Dr. Mansour alHazaa, Dr. Maher AalOdan Dr. Mansour alHoshan, Dr. Farag Abdelaleem

### Polymer Science and Engineering

**Description**
Provides professional research and consultations in the different aspects of polymer engineering. Some of these aspects are: properties' characterization, process optimization, failure prevention & analysis, material selection, environmental effects, material improvements, production, and many other aspects of polymer engineering.

**Faculty Expertise**
Dr. Mohammad AlHaj, Dr. Othman ALOthman, Dr. Saeed ALZahrani, Dr. Ahmed Abasaeed, Dr. Rabeh Elleithy (consultant)

### Process Synthesis and Integration

**Description**
Professional investigation of Process flowsheet optimization. Process Flowsheet integration and intensification, Process technologies and synthesis, Hybrid systems, Membrane Reactors, Membrane technology, Economic Evaluation & Profitability Analysis

**Faculty Expertise**
Dr. AbdulRahman AlRabiah, Dr. Abdulaziz alMutlaq, Dr. Kamil Wagialla


52. Mansour Alhazzaa and I alnashef, Electrochemical corrosion Behavior of some metals in Selected Ionic Liquids, the 7th Saudi Engineering Conference, (26-28) November 2007


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