Chemical and Petroleum Engineering Department

SHARIF UNIVERSITY OF TECHNOLOGY

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Overview

Since the construction of Abadan Refinery, Chemical and Petroleum engineers have been in demand to run the huge and extensive oil, gas and petrochemical plants with a downstream chain of industries, which has played a vital role in the national economy. More than 50 years ago, Chemical Engineering Program at Sharif University of Technology (SUT) was conceived along with three more engineering programs when SUT was established in 1965. Later in 1966, the first students enrolled in the program. Gradually, the department expanded its industry-related research programs in collaboration with major Iranian oil companies including but not limited to the National Iranian

Oil Company (NIOC). Consequently, the department was renamed the Chemical and Petroleum Engineering Department in 2001.

The mission of the undergraduate chemical engineering program is to educate chemical engineers capable of design and operation of chemical process plants with world-class knowledge of mathematics, physics and chemistry along with engineering courses such as material and energy balances, thermodynamics, transport processes, separation processes, kinetics and chemical reactor design, process design and economics and process control. This program prepares the students with deep understanding of basic sciences and their application to real world chemical processes. Chemical engineering concerns the design, scale-up, and operation of chemical processes as well as understanding and design of technologically useful materials. Chemical engineers are responsible for the production of the safe, economical and environmentally benign materials in desired quantities - from grams (recombinant drugs as an example) to tons of a commodity chemical. They employ the same

skills to manipulate natural processes in biological systems. Recently, chemical engineers have advanced in developing materials to assist physicians and medical scientists.

Petroleum engineers play a key role in extracting and refining many of the resources that fuel our modern society. The work of petroleum engineers spans the production process of oil and gas, from exploring and developing new oil and gas fields; to surveying, evaluating and testing wells; to directing and monitoring the plans, programs, equipment and machinery used in oil and gas drilling operations; to researching and developing new, more cost-efficient methods for extraction.

The Department offers B.Sc. in Chemical Engineering, a four-year engineering curriculum accredited by the Iranian Ministry of Science, Research and Technology (MSRT), https://www.msrt.ir. This program prepares students for a vast variety of careers in Chemical Engineering in industry and research laboratories or for further education in graduate school.

The Department also offers B.Sc. in Petroleum Engineering, a four-year engineering curriculum, which is accredited by MSRT. This program prepares students for a broad variety of careers in the petroleum industry. Students can also pursue their research interests in laboratories in graduate school.

The department recruits graduate students in M.Sc. and Ph.D. programs as well, which account for 30 percent of all enrolled. Areas of graduate study and research include Biotechnology, Biomedical Engineering, Environmental Engineering, Polymer Engineering, Process Control and Simulation, Process Design, Thermo-kinetics & Catalyst, Reactor Design, Transport Phenomena, Separation Processes, Reservoir Engineering, Drilling and Extraction, Production Engineering and Enhanced Oil Recovery. Researchers can have access to numerous facilities on campus through the Central Lab initiative. They openly collaborate with scientists throughout the campus and the nation.

Chemical and Petroleum Engineering Department stands honored to be part of a vibrant gathering of talented youthful students and knowledgeable academicians at Sharif University of Technology. After more than five decades of continuous effort in educational, research and technological endeavor, the department anticipates a fruitful future by seeking unprecedented aspirations.

Program Educational Objectives

- Preparing well-qualified engineers who can address various technical challenges related to the chemical process industries.
- Educate the nationally top tanked students capable of tackling the challenging technical problems with ethical and professional responsibility, safety, economical and environmental considerations.
- Preparing the students with capability of trouble shooting in various chemical process industries.
- Preparing the students to work in engineering design activities in various consulting engineers firms.
- In addition to technical aspects, preparing the students with knowledge of general courses including humanities, management, physical education and foreign languages, and elective courses, which gives them the flexibility to serve other related interdisciplinary fields.
- Preparing the students with the flexibility of improving the quality of products in various industries including, oil, gas, petrochemicals, food, pharmaceutical and other chemical industries.
- Preparing the graduates to successfully pursue postgraduate study in chemical and petroleum engineering or other related fields in prestigious universities all around the world.
- Preparing the students with oral and written communication skills.

Faculty

Chemical and Petroleum Engineering Faculty consists of 38 full time members, including 23 professors, 5 associate professors and 10 assistant professors. Following is a quick introduction to our faculty; more information can be found on our website (http://che.sharif.ir).

Ahmad Ramezani Saadatabadi
Ph.D. Laval University, Professor.
"Biopolymers, Tissue Engineering, Bio-transport and Controlled Release Drug Delivery; Nanomaterials, Nanotechnology and Nanoscience application in Polymer and Biomedical Engineering; Theoretical and Experimental Aspects of Polymer Processing and Polymer Blends; Polymer Melt, polymer solutions, and multi-components fluid rheology; Applications of Structured fluids in Enhanced Oil Recovery (EOR) and Drag Reduction Modeling, Simulation and Experimental Approaches; Polymer Reactions Engineering; Membrane and Membrane applications"

Akbar Shojaei
Ph.D. Amirkabir University of Technology, Professor.
"Synthesis, processing, structure and properties of Polymers and Polymer Composites"

Aliasghar Mohammadi
Ph.D. McGill University, Associate Professor.
"Separation Processes, Microfluidics"

Asghar Molaei Dehkordi
Ph.D. Amirkabir University of Technology, Professor.
"Novel techniques for chemical and physical processes, Process intensification, Transport phenomena and separation processes, Desulfurization, Catalytic wet peroxide oxidation, Particulate systems and fluidization engineering, Synthesis of nanoparticles and mixed convection of nanofluids"

Cyrus Ghotbi
Ph.D. Institut Francais du Petrole, Professor.
"Electrolyte Solutions, Phase Equilibrium Calculations, Supercritical Fluid Extraction, Sour Natural Gas Purification, Bio-Thermodynamics, Phase Behavior in Reservoir"

Davood Rashtchian
Ph.D. University of Manchester Institute of Science and Technology, Professor.
"Process Design, Process Integration, Safety and Loss Prevention, Waste Minimization, Heat Transfer and Condensation"

Ehsan Vafa
Ph.D. Sharif University of Technology, Assistant Professor.
"Simulation, optimization and plant-wide control of chemical processes"

Farhad Khorasheh
Ph.D. University of Alberta, Professor.
"Kinetics, Catalysis, Reactor Modeling and Simulation, Hydrocarbon Processing"

Farzam Fotovat
Ph.D. University of British Columbia, Assistant Professor.
"Energy and Environment, Particle Technology, Fluidization Technology"

Hanieh Safari
Ph.D. University of Michigan, Assistant Professor.
"Biomaterials, Drug Delivery, Immunomodulation"

Hassan Mahani
Ph.D. Imperial College London, Assistant Professor.
"Enhanced Oil Recovery (IOR/EOR), Low Salinity/Smart Water flooding, Pore Scale Physics/Digital Rock Physics, Micro-Scale Experimentation, Reservoir Geomechanics"

Hossein Askaripour
Ph.D. Sharif University of Technology, Assistant Professor.
"Enzyme Technology, Biotechnology, Modeling and Simulation of Biological Phenomena, Water and Wastewater Treatment"

Mahmoud Reza Pishvaie
Ph.D. Sharif University of Technology, Professor.
"Simulation and Control"

Maryam Saadatmand
Ph.D. Sharif University of Technology, Assistant Professor.
"Bio-microfluidics, Bio-MEMS, Regenerative Medicine, Biosensors"

Masoud Frounchi
Ph.D. University of New South Wales, Professor.
"Bio-polymer foams , Graphene-based bio-polymers, Bio-polymer Nano-composites, Magnetic polymer Nano-composites, Antibacterial bio-polymer films, Polylactic acid nanocomposites"

Mohammad Bazargan
Ph.D. Stanford University, Assistant Professor.
"Reactive flow in porous media, Air Injection, Acidizing, Gas Condensate Reservoir"

Mohammad Hossein Ghazanfari
Ph.D. Sharif University of Technology, Associate Professor.
"Petroleum/Chemical Engineering"

Mohammad Jafar Abdekhodaie
Ph.D. University of Toronto, Professor.
"Controlled Release Drug Delivery Systems, Tissue Engineering, Artificial Human Organs, Biomedical Engineering, Biopolymers"

Mohammad Kazemeini
Ph.D. University of Illinois at Chicago, Professor.
"Preparation and characterization of industrial catalysts and sorbents, Investigation of design and operation of multi-phase chemical reactors and electrocatalysis via conversion of chemical into electrical energy through fuel cells."

Mohammad Shahrokhi
Ph.D. University of Wisconsin, Professor.
"Process Control, Adaptive Control"

Mohsen Masihi
Ph.D. Imperial College London, Professor.
"Fractured Reservoir Studies, Percolation Approach in Reservoir Modeling, Enhanced Oil Recovery Techniques, Reservoir Characterization"

Ramin Bozorgmehry Bozarjomehry
Ph.D. University of Calgary, Professor.
"Modeling & Simulation of Novel Processes; Analysis, Identification and Control of Nonlinear Processes; Evolutionary Algorithms and Their Applications in Chemical Engineering; Process Synthesis and Optimization; Artificial Intelligence & Its Application in Chemical Engineering; Application of Information Technology in Chemical Engineering"

Saeed Eini
Ph.D. Sharif University of Technology, Assistant Professor.
"Process Systems Engineering, Multi-scale design, Simulation, Optimization, Energy Efficiency, Flexibility analysis, product design"

Saeid Jamshidi
Ph.D. Sharif University of Technology, Assistant Professor.
"Development of professional software applications for various petroleum engineering topics; Drilling & production engineering-related topics; Simulation of fluid flow through porous media using pore-network modeling approach PVT (Phase Behavior Prediction of Petroleum Fluids;) Asphaltene precipitation & deposition study; Pore-scale fluid flow simulation through various conditions in petroleum reservoirs"

Seyyed Abbas Mousavi
Ph.D. Sharif University of Technology, Associate Professor.
"Polymer blending, Polymer reactive extrusion, Research and development of polymeric membranes for different applications, Surface modification and research on biopolymers, Fuel Cells"

Seyyed Mobeen Fatemi
Ph.D. Heriot-Watt University, Assistant Professor.
"Multi-Phase Flow in Porous Media, Special Core Analysis and Flow Functions, Microfluidics, Multi-Phase Flow in Wellbore"

Seyyed Shahaboddin Ayatollahi
Ph.D. University of Waterloo, Professor.
"Enhanced Oil Recovery, Flow in Porous Media, Nano and Bio Technologies in Oil and Gas Industries"

Shohreh Mashayekhan
Ph.D. Osaka University, Assistant Professor.
"Stem Cell research, Tissue engineering, Biomaterials, Nano biotechnology"

Soheila Yaghmaei
Ph.D. Sharif University of Technology, Professor.
"Water and Wastewater Treatment, Simulation of Biological Systems, Soil Bioremediation"

Tayebeh Hamzelouyan
Ph.D. University of Houston, Assistant Professor.
"Kinetics of Heterogeneous Catalytic Reactions, Environmental Catalysis"

Vahid Taghikhani
Ph.D. Amirkabir University of Technology, Professor.
"Electrolyte Solutions, Phase Equilibrium Calculations, Supercritical Fluid Extraction, Sour Natural Gas Purification, Bio-thermodynamics"

Retired

Dariush Bastani
Ph.D. University of Manchester, Professor.
"Liquid-Liquid Extraction, Column Design and Performance Prediction, Rotating Disc Contactors (RDC), Pulsed Plate Extraction Columns (PSE), Separation Processes, Transport Phenomena, Droplet Mass, Transfer Coefficient"

Fathollah Farhadi
Ph.D. Universite de Technologie de Compiegne, Professor.
"Transport Phenomena, Process Simulation and Modeling, Process Analysis, Process Design, Process Instrumentation, Supercritical Fluid Extraction"

Iran Alemzadeh
Ph.D. Institute National des Science Appliques (INSA) Toulouse, Professor.
"Enzyme Technology, Fermentation Technology, Food Technology and Food processing"

Manouchehr Vossoughi
Ph.D. Institute National des science Appliques (INSA) Toulouse, Professor.
"Biochemical engineering, Nano technology, Biotechnology"

Reza Roostaazad
Ph.D. University of Waterloo, Professor.
"Biotechnology, Bioreactor Design, Production of Pharmaceuticals using Fermentation Technology, Food Engineering, Solar Drying in Food Technology"

Seyed Mehdi Borghei
Ph.D. University Newcastle-upon-Tyne, Professor.
"Waste Treatment, Biological Treatment of Industrial Wastes, Chemical Treatment, Bio-film Processes and Environmental Issues"

Majors

The Chemical and Petroleum Engineering Department offers a Bachelor of Science degree in chemical engineering and a Bachelor of Science degree in petroleum engineering which are affirmed by the Iranian Ministry of Science, Research and Technology. The department also recruits graduate students in both disciplines. The graduate students specialize in eight distinct fields of research in chemical engineering and 3 separate fields in petroleum engineering.

MBA in Finance

Students intending to major in the chemical/petroleum engineering should have a strong background in chemistry, physics, and mathematics. The senior year extends this base and builds upon it with courses in systems, design, and electives. Many of the core courses are accompanied by laboratory sessions. Communication skills, both oral and written, are stressed through laboratory and design project reports. Some senior students are exposed to research in a senior projects course; others obtain industrial experience through local internships or co-op opportunities.

Our curricula have been designed to meet several educational and academic objectives, which are stated as goals and abilities we expect our graduates to achieve within a few years of the conferral of their degrees. Our educational objectives read as follow:

1 Applies engineering and science to solve technical problems.

Develops and implements innovative and effective solutions to difficult problems. Shows proficiency in the application of engineering science in the presence of practical constraints or complicating factors to solve real-world technical problems while demonstrating excellence in ethical standards.

2 Interacts well with a broad range of people.

Grows continuously in the range of people with whom he/she interacts professionally, demonstrating the ability to relate well to superiors, subordinates, and peers, inside or outside the organization, perhaps involving difficult circumstances. Provides input that enables others to do their job better. Reaches team leadership positions. Communicates ideas, findings, and knowledge through the composition of papers and/or internal reports, authorship of standards and guidelines, publication of scholarly articles and application for patents. Delivers effective presentations to group leaders, internal and external customers, and at technical conferences, and/or training of coworkers and associates.

Requirements for the B.Sc. in Chemical/Petroleum Engineering

In the B.Sc. program, students must complete a minimum of 140 course units, a B.Sc. project and a period of industrial training and internship to receive the Bachelor of Science degree.

Typically, four years are needed to complete the B.Sc. program. All courses in the B.Sc. program are categorized into four classes as follows:

- Courses in Humanities, Physical Education and Foreign Languages
- Courses in basic science, including Mathematics, Physics, and Chemistry
- Core courses in Chemical/Petroleum Engineering and related laboratories
- Elective and specialty courses.

The details of courses of the Chemical Engineering curriculum, are listed in the following table. Note that the courses are distinguished by their subject area and requirement category (R for required, E for Elective, and SE for Selected Electives).

	Course (Department, Number, Title) List of all courses in the program	Required, Elective or a Selected Elective by an R, an E or an SE.	Subject Area (Credit Hours)			
			Math & Basic Sciences	Engineering Topics	General Education	Other
1st Semester	Mathematical science,22015, General Mathematics I	R	4			
	Chemistry,23011, General Chemistry I	R	3			
	Physics,24001, Physics Lab I	R	1			
	Physics,24011, Physics I	R	3			
	Engineering Graphics Center,35311, Engineering Graphics I	R				2
	Computer Engineering,40151, Computer Programming	R	3			
2nd Semester	Mathematical Sciences,22016, General Mathematics II	R	4			
	Physics,24002, Physics Lab II	R	1			
	Physics,24012, Physics II	R	3			
	Chemical and Petroleum Engineering,26019, Material and Energy Balance	R		3		
	Office of Physical Education,30001, Physical Education I	R			1	
	Language & Linguistics Center, 31123, Foreign Language	SE			3	
	Center of Educational Workshops, 33018, General Workshop	R				1
	Islamic Education & Humanities Center,37447, Islamic Anthropology	SE			2	
3rd semester	Mathematical Science, 22034, Differential Equations	R	3			
	Chemistry,23012, General chemistry II	R	3			
	Electrical Enginnering, 25091, Fundamentals of Electrical Engineering I	R		3		
	Chemical and Petroleum Engineering, 26111, Chemical Engineering Thermodynamics I	R		3		
	Chemical and Petroleum Engineering, 26211, Fluid Mechanics	R		3		
	Language & Linguistics Center, 31119, Introduction to Persian Literature	R			3	
4th Semester	Mathematical Sciences,22035, Engineering Mathematics	R		3		
	Chemistry,23435, Physical Chemistry for Chemical Engineers	R	3			
	Chemical and Petroleum Engineering, 26014, Fluid Mechanics II	R		2		
	Chemical and Petroleum Engineering, 26256, Statics and Mechanics of Solids	R		3		
	Chemical and Petroleum Engineering, 26925, Heat Transfer I	R		3		
	Islamic Education & Humanities Center,37127, Life Style	SE			2	
	Islamic Education & Humanities Center,37626, Islamic Revolution of Iran	SE			2	

5th Semester	Chemical and Petroleum Engineering, 26112, Chemical Engineering Thermodynamics II	R		3		
	Mathematical Sciences, 22063, Engineering Probability and Statistics	SE		3		
	Chemical and Petroleum Engineering, 26248, Mass Transfer	R		3		
	Chemical and Petroleum Engineering, 26323, Introduction to Numerical Methods	R		2		
	Chemical and Petroleum Engineering, 26601, Petroleum lab	E		1		
	Chemical and Petroleum Engineering, 26998, Applied Heat Transfer	R		3		
	Islamic Education & Humanities Center,37445, Islamic Thought I	SE			2	
6th Semester	Chemistry,23001, General Chemistry Lab for Chemical Engineers	R	1			
	Chemistry,23321, Organic Chemistry I for Chemical Engineers	R	3			
	Chemical and Petroleum Engineering, 26245, Kinetics and reactor design	R		3		
	Chemical and Petroleum Engineering, 26667, Corrosion in Petrochemical Industry	SE		3		
	Chemical and Petroleum Engineering, 26705, Fundamentals of Polymer Engineering	SE		3		
	Chemical and Petroleum Engineering, 26912, Applied Mathematics for Chemical Engineers	R		3		
	Office of Physical Education,30004, Sport I	R			1	
	Islamic Education & Humanities Center,37622, The History of Imamate	SE			2	
	Chemical and Petroleum Engineering, 26204, Heat Transfer Lab	R		1		

7th Semester	Chemical and Petroleum Engineering, 26600, B.Sc. Project	R		3		
	Chemical and Petroleum Engineering, 26172, Petroleum Biotechnology	E		2		
	Chemical and Petroleum Engineering, 26201, Fluid Mechanics Lab	R		1		
	Chemical and Petroleum Engineering, 26205, Industrial Unit Operations Lab	R		1		
	Chemical and Petroleum Engineering, 26217, Principles of Food Engineering	SE		3		
	Chemical and Petroleum Engineering, 26243, Industrial Unit Operations	R		3		
	Chemical and Petroleum Engineering, 26301, Process Control Lab	R		1		
	Chemical and Petroleum Engineering, 26346, Process Control	R		3		
	Chemical and Petroleum Engineering, 26895, Water and Wastewater Treatment	E		2		
	Islamic Education & Humanities Center, 37489, Quran Subjective Interpretation	SE			2	
8th Semester	Chemistry, 23207, Analytical Chemistry Lab	R	1			
	Chemistry,23227, Analytical Chemistry for Chemical Engineers	R	3			
	Chemistry,23301, Organic Chemistry Lab I	R	1			
	Chemistry, 23407, Physical Chemistry Lab I	R	1			
	Chemical and Petroleum Engineering, 26022, Industrial Training	R		0		
	Chemical and Petroleum Engineering, 26845, Unit Operations II	R		3		
	Chemical and Petroleum Engineering, 26301, Process Control Lab	R		3		
	Islamic Education & Humanities Center, 37514, The Knowledge of Family and Population	R			0	

OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM	140	

The details of courses of the Petroleum Engineering curriculum, are listed in the following table. Note that the courses are distinguished by their subject area, and requirement category (R for required, E for Elective, and SE for Selected Electives).

	Course (Department, Number, Title) List of all courses in the program	Elective or a Selected Elective by an R, an E or an SE.	Subject Area (Credit Hours)			
			Math & Basic Sciences	Engineering Topics	General Education	Other
1st Semester	Mathematical Sciences, 22015, General Mathematics I	R	4			
	Chemistry, 23011, General Chemistry I	R	3			
	Physics, 24001, Physics Lab I	R	1			
	Physics, 24011, Physics I	R	3			
	Languages & Linguistics Center, 31119, Introduction to Persian Literature	R			3	
	Computer Engineering,40151, Computer Programming	R	3			
2nd Semester	Mathematical Sciences, 22016, General Mathematics II	R	4			
	Physics, 24002, Physics Lab II	R	1			
	Physics, 24012, Physics II	R	3			
	Chemical and Petroleum Engineering, 26019, Material and Energy Balance	R		3		
	Chemical and Petroleum Engineering, 26155, General Geology	R		2		
	Engineering Graphics Center,35311, Engineering Graphics I	R				2
	Islamic Education & Humanities Center, 37626, Islamic Revolution and It's Roots	SE			2	
3rd Semester	Mathematical Sciences, 22034, Differential Equations	R	3			
	Chemical and Petroleum Engineering, 26111, Chemical Engineering Thermodynamics I	R			3	
	Chemical and Petroleum Engineering, 26153, Structural Geology	R	3			
	Chemical and Petroleum Engineering, 26168, Reservoir Rock Properties	R		2		
	Chemical and Petroleum Engineering, 26211, Fluid Mechanics	R		3		
	Chemical and Petroleum Engineering, 26256, Statics and Mechanics of Solids	R		3		
	Islamic Education & Humanities Center,37445, Islamic Thought I	SE			2	
4th Semester	Electrical Engineering,25091, Fundamentals of Electrical Engineering I	R		3		
	Chemical and Petroleum Engineering, 26112, Chemical Engineering Thermodynamics II	R		3		
	Chemical and Petroleum Engineering, 26123, Petroleum Geology	R		3		
	Chemical and Petroleum Engineering, 26143, Reservoir Fluid Properties	R		2		
	Chemical and Petroleum Engineering, 26271, Petroleum Chemistry	R	3			
	Languages & Linguistics Center, 31123, Foreign Language	SE			3	

	Islamic Education & Humanities Center, 37490, The pinnacle of Eloquence Subjective Interpretation	SE			2	
5th Semester	Mathematical Sciences, 22035, Engineering Mathematics	R		3		
	Mathematical Sciences, 22063, Engineering Probability and Statistics	E		3		
	Chemical and Petroleum Engineering, 26133, Reservoir Engineering 1	R		3		
	Chemical and Petroleum Engineering, 26134, Well Logging	R		3		
	Chemical and Petroleum Engineering, 26172, Petroleum Biotechnology	SE		2		
	Chemical and Petroleum Engineering, 26323, Introduction to Numerical Methods	R		2		
	Chemical and Petroleum Engineering, 26507, Advanced Gas Reservoir	SE		3		
	Islamic Education & Humanities Center, 37446, Islamic Thought II	SE			2	
6th Semester	Chemical and Petroleum Engineering, 26021, Petroleum Engineering Software	SE		1		
	Chemical and Petroleum Engineering, 26125, Transport Phenomena II	R		3		
	Chemical and Petroleum Engineering, 26132, Drilling Engineering I	R		3		
	Chemical and Petroleum Engineering, 26135, Reservoir Engineering II	R		3		
	Chemical and Petroleum Engineering, 26136, Production Engineering I	R		3		
	Chemical and Petroleum Engineering, 26157, Reservoir Management	SE		3		
	Chemical and Petroleum Engineering, 26705, Fundamentals of Polymer Engineering	E		3		
	Office of Physical Education,30003, Physical Education	R			1	

	Islamic Education & Humanities Center,37123, Islamic Ethics	SE			2	
7th Semester	Chemical and Petroleum Engineering, 26128, Geophysics	R	3			
	Chemical and Petroleum Engineering, 26131, Reservoir Rock Properties Lab	R		1		
	Chemical and Petroleum Engineering, 26141, Well Testing	R		3		
	Chemical and Petroleum Engineering, 26146, Production Engineering II	SE		3		
	Chemical and Petroleum Engineering, 26152, Drilling Lab I	R		1		
	Chemical and Petroleum Engineering, 26154, Drilling Engineering II	SE		3		
	Chemical and Petroleum Engineering, 26600, B.Sc. Project	R		3		
	Office of Physical Education, 30004, Sport I	R			1	
	Center of Educational Workshops, 33018, General Workshop	R			1	
8th Semester	Chemistry, 23001, General Chemistry Lab	R	1			
	Chemical and Petroleum Engineering, 26115, Reservoir Fluid Properties Lab	R		1		
	Islamic Education & Humanities Center,37514, The Knowledge of Family and Population	R			0	
	Islamic Education & Humanities Center, 37620, Historiography of Early Islam	SE			2	
	Chemical and Petroleum Engineering, 26022, Industrial Training	R		0		
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM		140				

Graduate Study in Chemical Engineering

The Chemical and Petroleum Engineering faculty have special interest and expertise in eight thrust areas in Chemical Engineering, including:

Biotechnology

Biotechnology is rapidly becoming central to our lives. The use of plants, animals, and bacteria, enhanced by areas such as genetics and genomics, gives rise to new food, fiber, and chemical production routes, and innovative strategies for environmental protection and stewardship, all central requirements as the global population increases over the coming decades.

The graduate degrees in Biotechnology present a cross-disciplinary environment, providing with a unique combination of state-of-the-art science and business skills, in a subject area rapidly expanding as society faces increasingly significant population pressures.

Biomedical Engineering

Over the past half-century, chemical engineers have made a remarkable contribution to various fields of medical sciences, either in diagnosis or treatment, through introduction of state-of-the-art technologies which have led to superior efficiency and safety of drug delivery systems, artificial organs, and etc. The purpose of this orientation is to train professionals in education and research to ultimately meet the needs of nation in the areas of design and development of artificial organs, design and production of controlled drug delivery systems, development of Nano/Micro-systems, development of biocompatible materials and improvement in healing of injured body tissues by tissue engineering approaches.

Environmental Engineering

The graduate program in environmental engineering focuses on the acquisition and application of knowledge related to the natural and built environments. For those who earn a degree in environmental engineering graduate program, there may be exciting careers in areas such as soil, water, and air management, as well as in waste management, bioremediation and valorization technologies.

Modeling, Simulation & Control Engineering

Combination of chemical engineering, programming and computer engineering, has created a new field famously called simulation and control. This area has become widespread in recent years, given the competitive environment in the context of global markets and also efforts made to improve the productivity and efficient use of resources while reducing the overall costs. Control engineers apply engineering principles to design, build, and manage computer-based instrumentation and control systems used in the manufacturing industry. These help monitor chemical engineering processes involved in producing a wide range of products, and give manufacturers a competitive edge.

Introduction to process dynamics as well as control systems governing the processes majorly covers the curriculum of this sub-discipline. The design and adjustment of control systems are undertaken over a chemical process to eliminate potential errors during the design of the process and equipment e.g. towers and reactors.

Process Design

A Chemical Process is a path to convert a substance's shape and properties to attain desired characteristics. A Process Designer is an engineer who conceives this conversion. Generally, an industrial design which is directly or indirectly dependent on the crude oil, refinery or petrochemical products, involves chemical engineers who focus on the designing of the process. In the oil and gas industry they are responsible for the design of the refining processes, which might include a myriad of various towers and exchangers.

A chemical process designer learns the nature of reactions from chemists and by considering the environmental and technoeconomic aspects, studies the feasibility of a process. Of course, in doing so, important elements must be taken into account, including mass transfer, heat transfer and thermodynamic calculations. Accordingly, the reactors and heat exchangers should be meticulously designed. Simulators and design software have become an indispensable part of the field, giving the designers the tools, which operate with the most accuracy and consistency.

Transport Phenomena & Separation Processes

This division focuses on studying and modelling physical and chemical separation of species in different processes. In the area of transport phenomena, faculty members of this division explore topics such as microfluidics, surface science, membrane processes, particle technology and fluidization. Moreover, developing multiphase systems, in particular, gas-solid processes, with novel applications in the energy and environmental sectors is another research interest of faculties of this division.

Thermo-kinetics & Catalyst

As its name implies, this sub-discipline specializes in topics of thermodynamics and chemical reactions. Fundamentals of catalysis in chemical engineering, electrochemical processes, and advanced thermodynamics are typical courses taught under this sub-discipline.

The group's activities are mainly divided in two branches: Thermodynamics & kinetics and Catalyst. The first branch investigates the thermodynamic concepts such as:

1. Application of Thermodynamics in petroleum and gas industries
2. Electrolyte Solutions
3. Thermodynamics in polymeric solutions
4. Application of Nanomaterials

The latter focuses on two main topics in catalyst context:

1. Kinetics of homogenous and heterogenous reactions and their corresponding reactors
2. Fundamentals and methods of synthesis and physicochemical assessment of catalysts and sorbents

Polymer Engineering

The field of polymers is highly dynamic and interdisciplinary, and our program in Polymer Engineering naturally reflects that perspective. We provide both a broad-based and fundamental introduction to all the major polymer subfields as well as individualized courses of study. Although some students enter the program with previous polymer experience, either academic or industrial, a polymer background is not required. This program will provide the graduates with a broad view of the discipline in order to be able to work in various research and professional opportunities.

Master of Science Degree in Chemical Engineering

M.Sc. students admitted to each of the abovementioned sub-disciplines are required to complete their dissertation under the supervision of faculty members of the pertinent groups. Accordingly, the M.Sc. students receive a master's degree in chemical engineering hyphenated by their entry sub-discipline.

Required Background

Graduates from Bachelor's degree of all chemical engineering sub-disciplines can enroll in M.S. programs provided they meet the general admission requirements mandated by MSRT. Applicants should take part in the National Entrance Examination for Master's degree in chemical engineering. Students are admitted according to their ranking in the test results and the priority of choices they have submitted beforehand. The whole procedure of admission is supervised by the National Organization of Educational Testing (NOET, http://www.sanjesh.org)

Requirements

An M.Sc. program in chemical engineering requires the students to complete 29 course units. These units include 21of required, elective and selected elective course units, 1 unit of seminar and 6 units of final dissertation. The following table collates the courses for all the sub-disciplines in chemical engineering.

Subdiscipline	No.	Course Title	Course Type	No. of Course Units
Biotechnology	26886	Biotechnology Lab.	Make-up	3
	26967	Industrial Microbiology and Fermentation Processes	Required	3
	26975	Enzyme Technology	Required	3
	26267	Advanced Numerical Mathematics	Required	3
	26966	Bioreactor Design	Required	3
	26646	Biological Treatment of Wastewater	Required	3
	26974	Transport Phenomena in Biological Systems	Required	3
	26973	Bio-separation	Required	3
	26326	Seminar in Biotechnology and Biomedical Engineering	Required	1
Modeling, Simulation and Control Engineering	26246	Advanced Mathematics	Required	3
	26312	Modern and Optimal Control	Required	3
	26028	Dynamic simulation of chemical processes	Required	3
	26175	Advanced Transport Phenomena	Required	3
	26324	Application of AI in Chemical Engineering	Required	3
	26490	Nonlinear Control	Required	3

	26345	Adaptive Control	Required	3
	26327	Seminar in Modeling, Simulation and Control	Required	1
Polymer Engineering	26703	Polymer Engineering Lab.	Make-up	1
	26273	Mechanical Properties of Polymers	Required	2
	26583	Rheology of Polymers	Required	3
	26347	Advanced Reactor Design	Required	3
	26519	Mechanics of Composites	Required	2
	26715	Polymer Reaction Processing	Required	3
	26976	Physical Chemistry of Polymers	Required	3
	26177	Plastics Processing	Required	2
	26356	Composite and Rubber Processing	Required	3
	26328	Seminar	Required	1
Transport Phenomena and Separation Processes	26267	Advanced Numerical Mathematics	Required	3
	26426	Advanced Heat Transfer	Required	3
	26175	Advanced Transport Phenomena	Required	3
	26347	Advanced Reactor Design	Required	3
	26218	Fluidization	Required	3

	26328	Seminar in Reaction and Separation Systems	Required	1
	26162	Advanced Liquid-liquid Extraction	Selected Elective	2
	26165	Scale-up of Processes	Selected Elective	2
	26166	Modeling and Simulation in Chemical Engineering	Selected Elective	2
	26333	Membrane Separation Processes	Selected Elective	2
	26120	Interfacial Phenomena	Selected Elective	3
	26490	Multi-phase Separation	Selected Elective	2
	26025	Design of Experiments	Selected Elective	2
Thermo-kinetics and Catalyst	26267	Advanced Numerical Mathematics	Required	3
	26347	Advanced Reactor Design	Required	3
	26114	Advanced Chemical Engineering Thermodynamics	Required	3
	26644	Fundamentals of Catalysis in Chemical Engineering	Required	3
	26668	Solution Thermodynamics	Required	2
	26698	Advanced Surface Engineering	Required	2
	26238	Electrochemical Process Engineering	Required	2
	26328	Seminar in Reaction and Separation Systems	Required	1
	26225	Advanced Fluid Mechanics	Selected Elective	3

	26249	Advanced Mass Transfer	Selected Elective	3
	26558	Advanced Convective Heat Transfer	Selected Elective	3
Process Design Engineering	26267	Advanced Numerical Mathematics	Required	3
	26915	Computer Aided Process Design	Required	3
	26580	Safety and Loss Prevention in the Process Industry	Required	3
	26319	Chemical Process Equipment Design	Required	3
	26325	Conceptual Design of Chemical Processes	Required	3
	26327	Seminar in Modeling, Simulation and Control	Required	1
	26225	Advanced Fluid Mechanics	Selected Elective	3
	26175	Advanced Transport Phenomena	Selected Elective	3
	26669	Process Optimization	Selected Elective	3
	26282	CFD Application in Chemical Engineering	Selected Elective	3
Environmental Engineering	26802	Water & Wastewater Engineering Lab.	Make-up	1
	26804	Microbiology Lab.	Make-up	1
	26347	Advanced Reactor Design	Required	3
	26855	Wastewater Treatment Engineering	Required	3
	26828	Water Treatment Engineering	Required	3

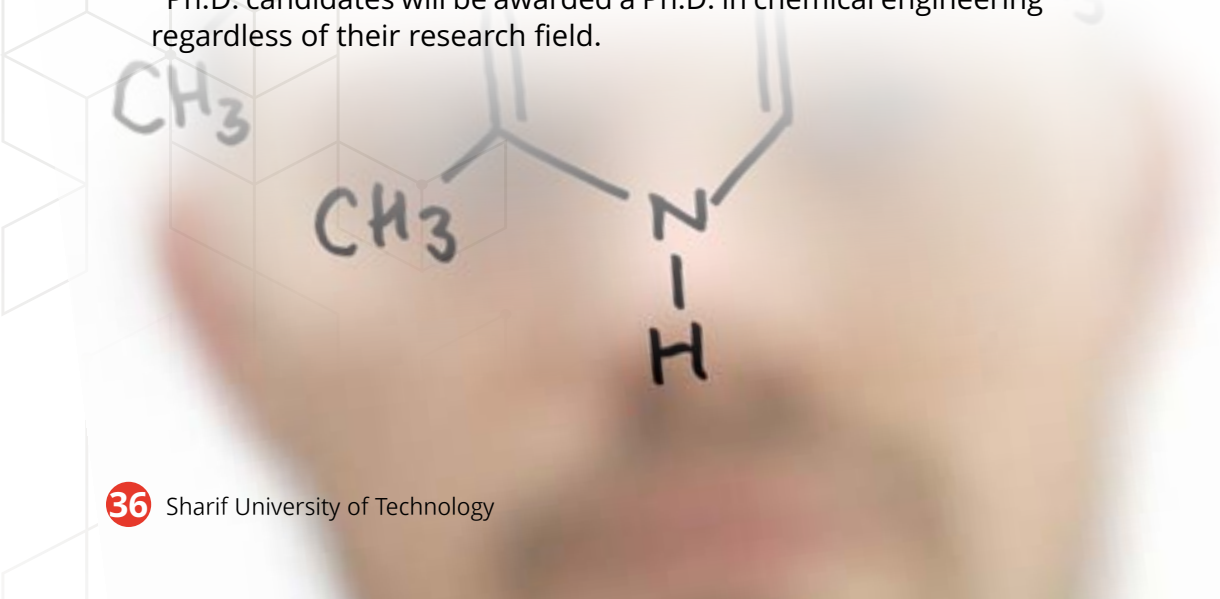
	26970	Solid Waste Engineering	Required	3
	26965	Air Pollution Control Engineering	Required	3
	26326	Seminar in Environmental Engineering	Required	1
	26225	Advanced Fluid Dynamics	Selected Elective	3
	26249	Advanced Mass Transfer	Selected Elective	3
	26269	Bioremediation Technology	Selected Elective	3
	26009	Bio-fuel Production	Selected Elective	3
Biomedical Engineering	26882	Physiology and Anatomy	Make-up	1
	26114	Advanced Chemical Engineering Thermodynamics	Required	3
	26654	Controlled Release Drug Deliver	Required	3
	26246	Advanced Mathematics	Required	3
	26266	Tissue Engineering	Required	3
	26282	Micro and Nano Systems in Biomedical Engineering	Required	3
	26829	Transport Phenomena in the Human Body	Required	3
	26277	Artificial Organs	Required	3
	26331	Seminar in Biotechnology and Biomedical Engineering	Required	1

Doctor of Philosophy Degree in Chemical Engineering

The Ph.D. Program in Chemical Engineering aims at training of specialist individuals with exceptional potential in research and education in various scientific fields related to Chemical Engineering discipline. Graduates from this program are expected to demonstrate the capacity to oversee academic activities based on their professional and ethical doctrine.

According to the bylaws of the Higher Education Department, a doctoral degree requires the satisfactory completion of an approved program of advanced study and original research of high quality. The program, therefore, consists of 1 year of course-work education prior to taking the comprehensive exam. An oral defense is mandated to be delivered before the referees to receive approval for the research proposal. Ph.D. candidates are required to deliver three 3-unit courses as a Teaching Assistant. Moreover, two seminars should be delivered as zero-unit courses, besides annual reports on the thesis progress in presence of referees. A dissertation thesis submitted in the Persian language in addition to a final oral defense will complete the program. The overall program is expected to be accomplished in 4 academic years (or 8 semesters).

Ph.D. candidates will be awarded a Ph.D. in chemical engineering regardless of their research field.

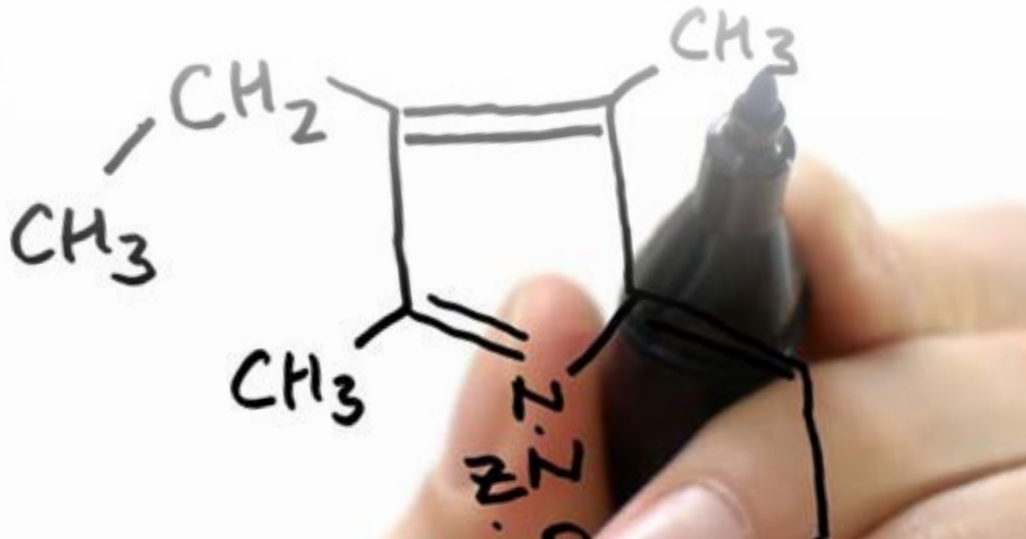


Required Background

Ph.D. applicants with a master's degree/professional doctorate affirmed with either MSRT or MOHME are eligible to enroll in Ph.D. programs of the department. Additionally, proficiency in a foreign language must be verified through standard proficiency tests. Applicants should take part in the National Entrance Examination for Ph.D. in chemical engineering. Competent applicants are invited for an interview with a group of faculty members. Curriculum vitae of applicants along with recommendation letters are advised to be submitted beforehand. The whole procedure of admission is supervised by the National Organization of Educational Testing (NOET, http://www.sanjesh.org)

Requirements

Ph.D. requires the students to complete 12 course units. These units include two courses of the required core curriculum, and two courses related to the research orientation. At the end of the first academic year, the comprehensive exam is taken, which examines four course topics from the graduate curriculum. Two of the courses must be taken from the core list, and the others are selected under the discretion of the supervisor and affirmation of the Higher Education Committee. In the following section, the graduate courses in chemical engineering are listed.



Courses

26973 - Bio-separation- 3 Units (Group: Biotechnology)

This course is an introduction to the separation and purification of biological materials. It contains both practical and theoretical aspects. It covers not only the need of graduate students, but also the scientist with low engineering background and engineers with low biochemical knowledge. An overview of bio-separation processes; Filtration & microfiltration; Centrifugation; Cell disruption; Extraction; Adsorption; Elution chromatography; Precipitation; Ultrafiltration & electrophoresis; Crystallization; Drying; Ancillary operations

- *Prerequisite:*

Mathematics, Biochemistry

26974 - Transport Phenomena in Biological Systems - 3 Units (Group: Biotechnology)

We aim to integrate the development of fundamental principles of transport processes, the mathematical expression of these principles and the solution of transport equations, along with characterization of composition, structure and function of the living systems to which they are applied. This lecture covers topics in fluid mechanics and mass transfer in biological systems. Fluid mechanics: Velocity Distributions in Laminar Flow, Flow of a falling film, Flow through a circular tube, Flow through an annulus, Creeping flow around a solid sphere (Falling ball viscometer), The equation of change for isothermal systems, The Equation of Continuity , The Equation of Motion (examples), The equation of mechanical energy, Velocity Distribution with more than one independent variable (examples), Introduction to Non-Newtonian fluids; Mass transfer: The role of transport process in biological system , Transport within cells and transcellular transport, Application of transport processes in diseases treatment and device development, Fundamentals and application of mass transport in biological system (steady and unsteady diffusion), Diffusion with convection, Transport in porous media.

26246 - Advanced Mathematics - 3 Units (Group: Modeling, Simulation & Control/ Biomedical Engineering)

The objective of this course is making the students familiar with analytical approaches for solving the partial differential equations which have several applications in different fields of engineering. Matrices, solving simultaneous linear ordinary differential equations, Ordinary differential equations with variable coefficients, Special second order differential equations (Bessel, Associated Bessel, Legendre, Associated Legendre, ...), Boundary value problems and Sturm-Liouville Theorem, Solving of special partial differential equations (Laplace, Poisson, Helmholtz, Diffusion and Wave equations), Calculus of variations, Complex variables and conformal mapping.

26312 - Modern and Optimal Control - 3 Units (Group: Modeling, Simulation & Control)

Thoughts are taught about advanced approaches and modern time domain analysis & control synthesis aside the classical frequency domain analysis and design. The hard core of course is the mathematical concept of state- space -for both continuous and discrete variants- in a system sense and obviously its implementation and realization in a practical and engineering approach. The systematic synthesis of controller is emphasized through state feedback, pole placement and linear optimal control. State estimators or observers design will be discussed thoroughly.

- Prerequisite:

Mathematics (Linear Algebra, Matrices Theory), MATLAB

26028 - Dynamic Simulation of Chemical Processes - 3 Units (Group: Modeling, Simulation & Control)

In this course, students are familiarized with fundamentals of dynamic modeling and simulation of chemical processes such as separation processes, chemical reactors and particulate processes. Design and control of those processes are usually challenging problems due to their inherent complexity and unique dynamic behaviors, therefore dynamic modeling and simulation studies are inevitably required for such a purpose. In this course, students learn how to make dynamic modeling of various processes such as distillation columns, continuous stirred tank reactors, tubular reactors and crystallizers.

- Prerequisite:

Mathematics (Ordinary Diff. Eqn.), MATLAB, AspenHysys

- Corequisite:

Transport Phenomena.

26490- Nonlinear Control - 3 Units (Group: Modeling, Simulation & Control)

The objective of this course is to familiarize the students with the fundamental knowledge of nonlinear systems and the way these systems are treated in the analysis and control study. Nonlinear System Characteristics and Behaviors; Nonlinear System Stability Analysis Methods; An Introduction to Differential Geometry Concepts; Nonlinear System Analysis through Differential Geometry; Differential Geometric Control (State Feedback Linearization Methods); Nonlinear Feed Forward Control; Nonlinear Time-Delay Compensation; Nonlinear Internal Model Control (Differential Geometric Approach); Nonlinear Model Predictive Control (Differential Geometric Approach); State Estimation techniques for Nonlinear Systems

- Prerequisite:

Modern and Optimal Control

26175 - Advanced Transport Phenomena - 3 Units (Groups: Modeling, Simulation & Control/ Transport Phenomena and Separation)

Transport phenomena include three closely related topics: fluid dynamics, heat transfer, and mass transfer. A good grasp of transport phenomena is essential for understanding many processes in engineering, agriculture, biology, material science, and other areas. The major aim of this course is to give a balanced overview of the field of transport phenomena, present the fundamental equations of the subject, and illustrate how to use them to solve problems.

26345 - Adaptive Control - 3 Units (Group: Modeling, Simulation & Control)

The main objective of this course is to familiarize the students with different adaptive control strategies both for continuous and discrete systems. The well-known adaptive control techniques are introduced and their designs and stability proofs are discussed. System representation; Stability analysis via Lyapunov function; Identification of continuous systems; Identification of discrete systems; Adaptive observer design; Classification of adaptive control strategies; One step ahead adaptive controller; Self-tuning regulator; Adaptive model predictive control; Adaptive model reference control; Adaptive sliding mode control; Adaptive backstepping control

- Prerequisite:

Modern and Optimal Control

26324 - Application of Artificial Intelligence in Chemical Engineering - 3 Units (Group: Modeling, Simulation & Control)

The objective of this course is to familiarize the students with the fundamental knowledge of nonlinear systems and the way these systems are treated in the analysis and control study. Expert Systems and their development with Relational Databases; Fuzzy Logic in general and Fuzzy Logic Control and Optimization; Various types of Artificial Neural Networks and their application in Process Identification and Control; Evolutionary algorithms and their applications in optimization problems

- Prerequisite:

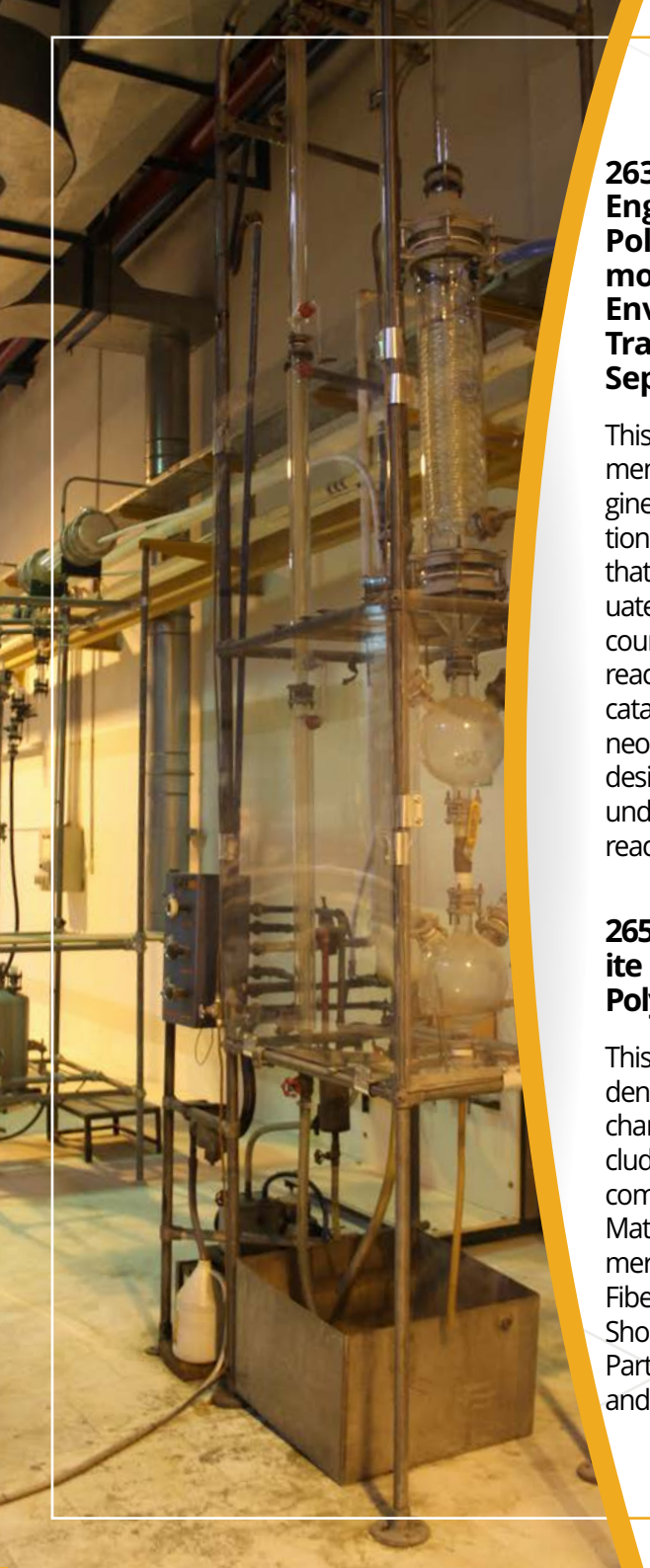
Object Oriented Analysis, Design and Simulation

26273 - Mechanical Properties of Polymers - 2 Units (Group: Polymer Engineering)

The course deals with mechanical, viscoelastic and fracture properties of plastics and rubbers. Complex, storage, loss moduli and tangent delta are defined with examples and dynamic methods of measurements are presented. The viscoelastic models such as Zener model is discussed comprehensively. Creep. Stress relaxation, frequency response of the polymers and time temperature equivalence and shift factor concepts are presented. Elasticity of rubbers, crosslink density and modulus-temperature relationship are discussed. Yielding of polymers, strain energy release rate and stress intensity factor relations of linear elastic fracture mechanics for polymers are derived. Various examples of the subjects are worked out.

26273- Rheology of Polymers - 3 Units (Group: Polymer Engineering)

The objective of this course is to provide students with the fundamental knowledge of rheological properties and rheological concepts that is needed for the engineering design of systems used in the characterization, flow, processing, storage and handling of polymeric materials.



26347 - Advanced Reactor Engineering - 3 Units (Group: Polymer Engineering, Thermo-kinetics and Catalyst, Environmental Engineering, Transport Phenomena and Separation Processes)

This course is intended to complement the knowledge of chemical engineering students in chemical reaction engineering and reactor design that they have gained at undergraduate level. The major areas that the course focuses are: non-isothermal reactor design, non-ideal flow and catalytic and non-catalytic heterogeneous reaction kinetics and reactor design. The objective is to give a basic understanding of the behavior of real reactors with industrial applications.

26519 - Mechanics of Composite Materials - 2 Units (Group: Polymer Engineering)

This course is to familiarize the students with the principles of the mechanics of composite materials including the multi-ply and single-ply composite structures. Constituent Materials for Fiber Reinforced Polymer Composites; Long (continuous) Fiber Reinforced Composites; Short-Fiber Reinforced Composites; Particulate composites with Micro and Nano reinforcements.

26715 - Polymer Reaction Processing - 3 Units (Group: Polymer Engineering)

This course deals with step polymerization, chain polymerization and Ziegler-Natta polymerization.

Topics:

- Linear polycondensation kinetics, Carothers and Flory equations for average molecular weights
- Network forming polycondensation, Carothers and Flory equations for gel point predictions
- Radical, anionic, cationic polymerization kinetics, molecular weight distributions
- Radical copolymerization
- Effect of temperature and chain transfer on molecular weight and rate of polymerization
- Bulk, solution, suspension and emulsion polymerization processes
- Ziegler-Natta polymerization kinetics
- Polyolefins polymerization, slurry and gas-phase polymerization
- Batch, CSTR, tubular polymerization reactor design

26715 - Physical Chemistry of Polymers - 3 Units (Group: Polymer Engineering)

This course deals with polymer molecular chain conformations, thermodynamics of polymer solutions, solubility of polymers, crystallinity, thermal transitions, rubber elasticity, swelling of polymer networks and permeability.

Topics:

- Chain conformations and Helices
- Flory-Huggins Lattice Theory, Interaction coefficient
- Solubility parameter
- Thermodynamic methods for molecular weight measurements (MO, VPO)
- Light scattering, SAXS, SANS • Intrinsic viscosity and molecular weight measurements
- Spherulites and chain folding in crystallites
- Glass transition and melting temperatures
- Theory of rubber elasticity
- Swelling of polymer gels and networks
- Permeability of polymers

26177 - Plastics Processing - 2 Units (Group: Polymer Engineering)

The objective of this course is to provide the student with an understanding of different unit polymer processes, including extrusion, injection, calendaring and primary and secondary processes including power handling, melting, pressurization, blow molding, film blowing and thermoforming. The principles behind the processes will be discussed with the intent of giving the students the opportunity to have a deep knowledge and simulation ability of a broad range of polymer manufacturing processes.

26356 - Composite and Rubber Processing - 3 Units (Group: Polymer Engineering)

This course is to familiarize the students with the fundamentals of processing of two important classes of polymeric material including polymer composite and elastomeric materials. An Introduction to Manufacturing Processes; Transport Equations; Processing Science of Reactive Resins; Processing Science of Thermoplastic Composites; Processing Science of Fiber Reinforcements; Process-induced Residual Stresses in Composites; Rubber and Rubber Compounds; Rubber Vulcanization; Processing of Rubbers and Manufacturing Techniques.

26703 - Polymer Engineering Laboratory - 1 Units (Group: Polymer Engineering)

The main Objective of this lab is providing a good overview of the most important polymer shaping processes and related rheological and physical-mechanical properties of raw and finished products. Topics include Extrusion and die swell Phenomenon; Film Blowing; Rubber Compounding; Compression Molding of thermoplastic and thermoset parts; Polyurethane Foam; Melt Flow Index Measurements; Plastisol Coating; Melt Capillary Viscometer; Intrinsic Viscosity and Molecular weight Determination; Tensile and Impact Strength; Hardness; Electrospinning.

26426 - Advanced Heat Transfer - 3 Units (Group: Transport Phenomena and Separation Processes)

The objective of this course is to present explanation of equations of change in several coordinates, convective heat transfer, conduction of heat in solids and approximate solutions of relevant differential equations. Energy Shell Balance, temperature Distributions in solid and in laminar flow, examples; The Equation of Change for Non-Isothermal Systems, The equation of Energy; Transpiration cooling, free Convection heat transfer from a Vertical Plate, examples; Temperature distributions with, more than one independent Variable, Heating of a Semi-Infinite slab, Steady heat conduction in laminar flow of a viscous fluid, Boundary layer theory, Heat Transfer in forced convection laminar flow along a heated wall; Introduction to heat transfer in solids, Formulation of heat Transfer problems, examples.

26218 - Fluidization - 3 Units (Group: Transport Phenomena and Separation Processes)

Fluidization is one of the important techniques in chemical engineering processes which has been used widely in chemical and physical processes. Hence, in this course we study the fundamental basis of fluidized bed (F.B) reactors and contactors including hydrodynamic and engineering aspects.

Topics:

I) Hydrodynamic Basis

- Introduction
- Fluidization state
- Single particle suspension
- Fluid flow through particle beds
- Homogeneous fluidization
- First equation of change for fluidization
- Particle-bed model
- Two-phase particle bed model
- Two-phase particle bed model predictions
- Generalized two-fluid model

II) Engineering Basis

- Introduction
- Fluidization and mapping of Regimes
- Dense Beds: Distributors and gas jets
- Bubbles in dense beds
- Bubbling fluidized bed (F.B)
- Entrainment & Elutriation from F.B
- High–velocity fluidized beds
- Solids mixing and segregation

26162 - Advanced Liquid – Liquid Extraction - 3 Units (Group: Transport Phenomena and Separation Processes)

The objective of this course is to introduce advanced liquid – liquid extraction including mass transfer and hydrodynamic models of drops inside the liquid-liquid extraction columns.

Topics:

- Introduction
- Selection of Solvent
- Column Hydrodynamics
- Hydrodynamics Models ((Olney's Model, Mizek's Model, Barnea-Mizrahi's Model))
- Column Constriction Factor
- Column Diameter Calculation (Uniform Drop Size Distribution)
- Column Diameter Calculation (Drop Size Distribution)
- Column Mass Transfer
- Ideal Models (Completely Mixed and Plug Flow Models)
- Real models
- Plug Flow with Axial Dispersion Model
- Stagewise Model with Backflow
- Axial Dispersion Coefficient Measurement
- Drop- Side Mass Transfer Models
- Rigid Drop Model
- Laminar Circulating Model
- Turbulent Circulating Model
- Turbulent Oscillating Model
- Introduction to Liquid – Liquid Extraction Equipment

26165 - Scale-up of Processes - 3 Units (Group: Transport Phenomena and Separation Processes)

As one of the major roles of chemical engineers is the process development, this course was designed to strengthen the ability of the graduate students, particularly the Ph.D. students, to better understand the techniques of scale-up. The complexities of scale-up of chemical engineering processes, as compared with other engineering disciplines such as mechanical and civil engineering, will be highlighted, several case studies will be presented to ensure that the student will grasp the subject.

Topics:

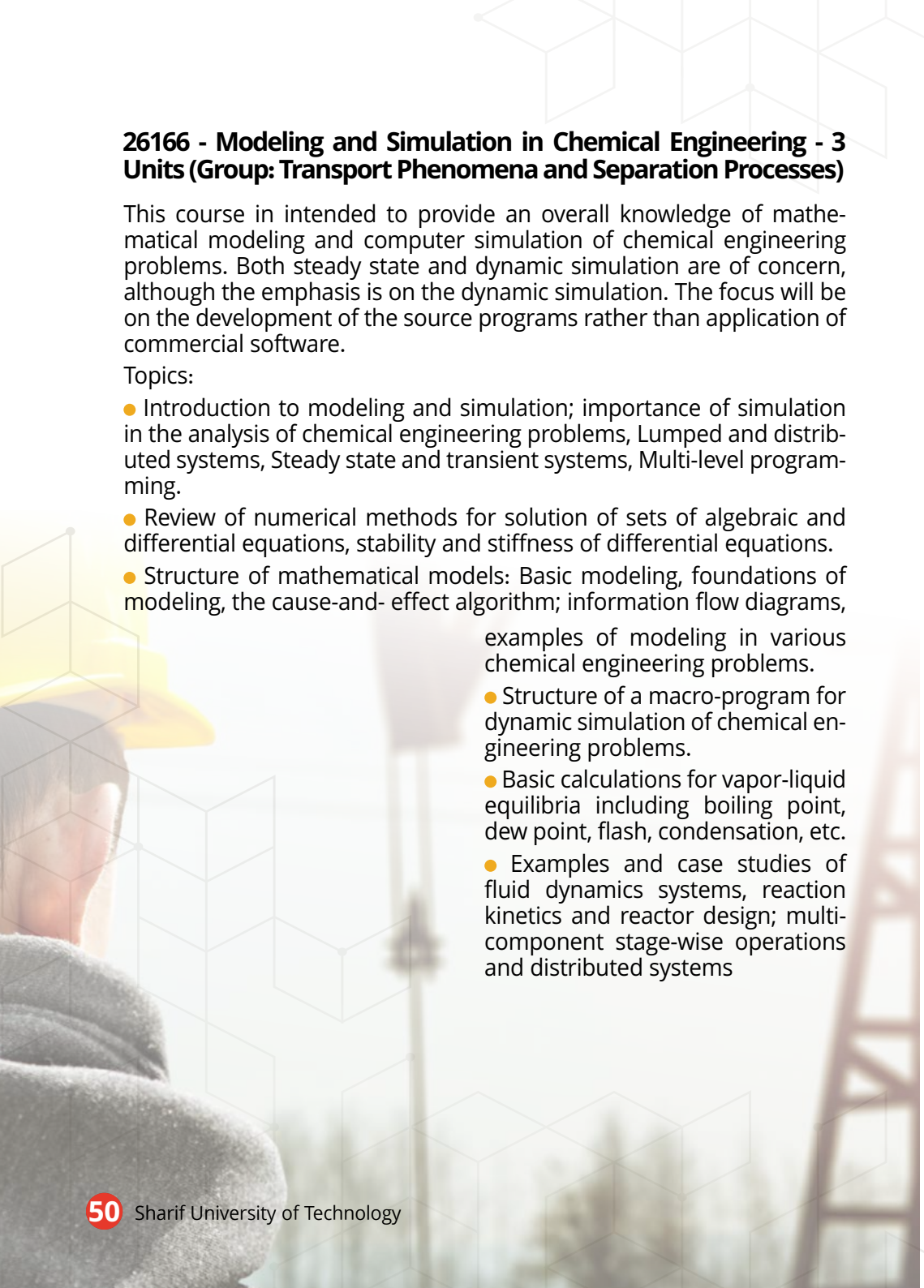
- Introduction and approaches to scale-up
- Fundamentals of scale-up: dimensional analysis and theory of models; similitude and approximation theory, mathematical modeling and simulation
- Dimensionless groups: the Buckingham theorem; generation of the π sets by matrix transformation and the π-space, scale-invariance of the π-space.
- Dimensional analysis in the absence of mathematical models; dimensionless numbers with variable physical properties
- Dimensional analysis in the presence of mathematical models: the fundamental approach.
- Examples of scale-up problems in mechanical unit operations, heat and mass transfer unit operations and chemical reactors

26166 - Modeling and Simulation in Chemical Engineering - 3 Units (Group: Transport Phenomena and Separation Processes)

This course in intended to provide an overall knowledge of mathematical modeling and computer simulation of chemical engineering problems. Both steady state and dynamic simulation are of concern, although the emphasis is on the dynamic simulation. The focus will be on the development of the source programs rather than application of commercial software.

Topics:

- Introduction to modeling and simulation; importance of simulation in the analysis of chemical engineering problems, Lumped and distributed systems, Steady state and transient systems, Multi-level programming.
- Review of numerical methods for solution of sets of algebraic and differential equations, stability and stiffness of differential equations.
- Structure of mathematical models: Basic modeling, foundations of modeling, the cause-and- effect algorithm; information flow diagrams, examples of modeling in various chemical engineering problems.
- Structure of a macro-program for dynamic simulation of chemical engineering problems.
- Basic calculations for vapor-liquid equilibria including boiling point, dew point, flash, condensation, etc.
- Examples and case studies of fluid dynamics systems, reaction kinetics and reactor design; multicomponent stage-wise operations and distributed systems



26333 - Membrane Separation Processes - 3 Units (Group: Transport Phenomena and Separation Processes)

This course is intended to provide an overview of artificial membranes (non-biological) and their applications as separation processes. The aim is to introduce various types of membranes, their synthesis, fabrication and characterization along with their applications in chemical engineering.

Topics:

- Introduction to membrane processes
- Various driving forces for different membrane processes
- Size distribution of particles to be separated
- Membrane synthesis and characterization
- Reverse osmosis, nanofiltration, ultrafiltration, micro-filtration, gas separation, dialysis, electrodialysis, hybrid systems including: membrane reactors, membrane bioreactors, membrane distillation, etc.
- Membrane modules and their design
- Membrane separation process design
- Applications in water desalination, gas separation, waste treatment, biomedical engineering, etc.

26490 - Multicomponent Separation - 3 Units (Group: Transport Phenomena and Separation Processes)

The objective of this course is to familiarize students with multicomponent flash calculations, multicomponent distillation using different methods, multicomponent absorption and their relevant calculation methods.

Topics:

- Total Calculation of Simple and Flash Multicomponent Evaporation
- Multicomponent Distillation 1. Short – Cut Methods: - Minimum Reflux Ratio Calculations, Underword and Geddes Methods - Minimum Number of Trays (Fersk's Equation) - Gilliland Cosselations - Calculation of Products Component 2. Tray by Tray Calculation: - Lewis – Matheson Method - Geddes Method
- Multicomponent Absorption: - Isothermal &Non-Isothermal
- Separation of Mixtures by Density and Size (solids, liquids)
- Point, Plate and Column Efficiency - Total Liquid Mixing - Partial Liquid Mixing (AICHE Model) - Tray with Liquid Velocity Profile.

26025 - Design of Experiments - 3 Units (Group: Transport Phenomena and Separation Processes)

This course is addressed towards students carrying out experiments in their fields of study and work. The first part of the course deals with random variables, typical probability distributions, random sampling, confidence intervals on population parameters and hypothesis testing. These form the basic background of statistical analysis. In the second part of this course, design of experiments is introduced. The factorial design of experiments involving two or more factors is discussed in detail. Properties of orthogonal designs and other popular design strategies such as response surface methodology are also discussed. The characteristic features of experimental design strategies are defined and compared. After understanding this course material, the experimentalists will develop the confidence to identify an appropriate design strategy suited for their work. They will also be able to interpret the results of the experiments in a scientific manner and communicate them unambiguously. Learning the basics of Minitab® to design the experiments and analyze the experimental results is another objective of this course.

26120 - Interfacial phenomena - 3 Units (Group: Transport Phenomena and Separation Processes)

This course in intended to introduce the basic knowledge occurring in the interface of two immiscible phases, such as liquid-liquid, and solid-liquid interfaces.

Topics:

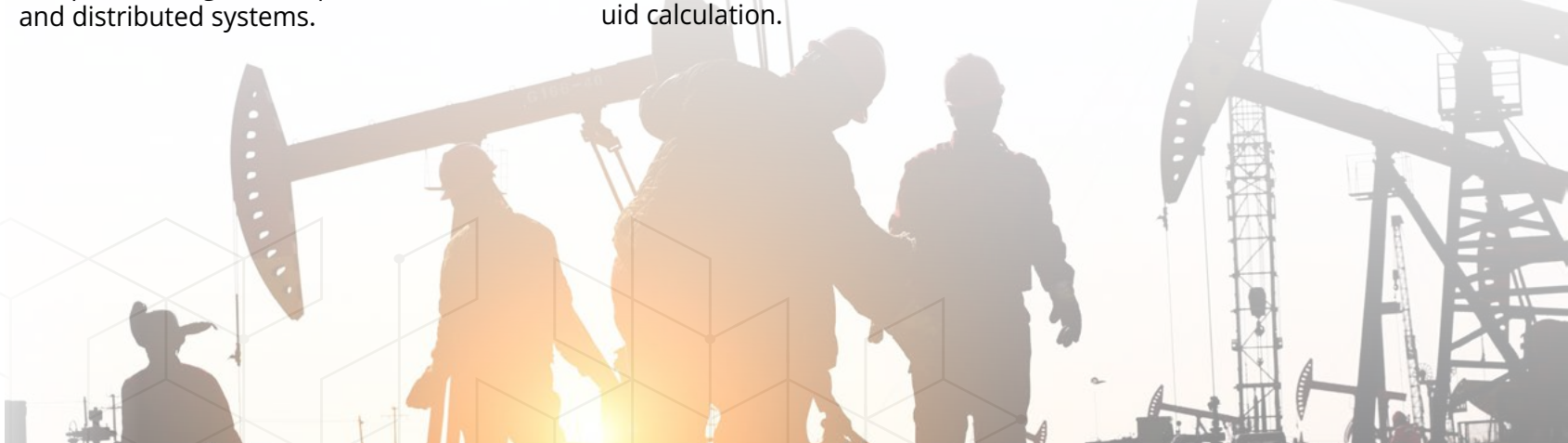
- Introduction to interfacial phenomena.
- Thermodynamics of surfaces.
- Electro-kinetics.
- Examples and case studies of fluid dynamics systems, reaction kinetics and reactor design; multicomponent stage-wise operations and distributed systems.

26114 - Advanced Chemical Engineering - 3 Units (Groups: Thermo-kinetics and Catalyst, Biomedical Engineering)

Molecular thermodynamics is an engineering science and its goal is to provide estimates of equilibrium properties for mixtures as required for chemical process. The aim of this course is offer appropriate methods for correlating the mixture properties and the equilibrium conditions.

Topics:

- Review of classical Thermodynamics relations for predicting the thermophysical properties and equilibrium conditions for pure and mixtures in liquid and vapor phases.
- A review of cubic equations of state.
- Introducing fundamental relations for estimating thermodynamic properties from equations of state
- A brief review of intermolecular forces, potential functions, corresponding states theory, and osmotic coefficient.
- Introducing different methods based on molecular and classical thermodynamics to estimate the properties of gas mixtures.
- Introducing the excess functions based on Lewis and Henry law.
- Introducing different solution models based on molecular and classical thermodynamics to correlate the properties of liquid mixtures.
- Stability analysis, vapor- liquid, liquid- liquid, and vapor- liquid- liquid calculation.



26644 - Fundamentals of Catalysis in Chemical Engineering - 3 Units (Group: Thermo-kinetics and Catalyst)

To familiarize Thermo-kinetics and Catalysis group students with fundamentals of Synthesis, Kinetics and Characterization of heterogeneous catalytic systems.

Topics:

1-Fundamental definitions:

- Heterogeneous and Homogeneous Catalysis
- Turnover number, rate and frequency
- Sabatier golden rule of catalysis
- Chemisorption, physisorption and Catalysis

2-Kinetics of Heterogeneous Catalysis:

- Internal and external diffusion limitations
- Kinetic and Mass Transfer resistances in thin film theory
- Effectiveness factor and the Thiele modulus
- Experimental methods to check kinetic and mass transfer limitations
- Isotherms applicable to heterogeneous catalytic kinetics (BET, Frundlich, Temkin, Potemkin, Longmuir and Longmuir Hinshlewood)

3- Catalyst synthesis:

- Wet and dry impregnation
- Coprecipitation
- Sol-gel technique

4- Characterization technique:

- Chemisorption and dispersion
- Surface and measurements
- X-ray diffraction • SEM and STEM

26238 - Electrochemical Process Engineering - 2 Units (Group: Thermo-kinetics and Catalyst)

In this course, an advanced study of fundamentals and applications of electrochemical processes are presented.

Topics:

- An introduction to basic concepts and applications
- Kinetics of electron transfer at the electrode surfaces and activation polarization
- Mass transfer at the electrode surface and concentration polarization
- Migration of ions and conductivity of solutions
- Adsorption and chemical reactions on electrode surfaces
- Transport mechanism in membrane separators
- Design of electrochemical reactors- batch, plug, mixed, re-circulating reactors
- Electroplating processes

26249 - Advanced Mass Transfer - 3 Units (Groups: Thermo-kinetics and Catalyst/ Environmental Engineering)

The objective of this course, is to familiarize students with mass transfer mechanisms as well as theoretical and empirical methods for estimating diffusivities in different phases. Mass transfer problems commonly encountered in chemical engineering processes are also presented and concentration profile in different systems are obtained using overall mass balance equations along with the species mass balance equations.

Topics:

- Diffusivity and the mechanism of mass transfer o Diffusivities in gases o Diffusivities in liquids o Diffusivities in solids o Diffusivities in polymer solutions
- Concentration distributions in solids and laminar flow o Shell mass balances o Diffusion with a heterogeneous chemical reaction o Diffusion with a homogeneous chemical reaction o Diffusion into a Falling Liquid Film o Diffusion into a Falling Liquid Film (Solid Dissolution) o Diffusion and Chemical Reaction inside a Porous Catalyst
- Equations of change for multicomponent systems o The Equations of Continuity for a Multicomponent Mixture o Use of the Equations of Change for Mixtures o Dimensional Analysis of the Equations of Change for Nonreacting Binary Mixtures
- Mass transfer coupled with heterogeneous chemical reactions
- Dispersion from a stackuir and Longmuir Hinshlewood)

26558 - Advanced Mass Transfer - 3 Units (Groups: Thermo-kinetics and Catalyst/ Transport Phenomena and Separation Processes)

Convective heat transfer occurs in almost all branches of engineering and the knowledge of the methods used to model convective heat transfer is therefore required by many practicing engineers. This course provides a comprehensive coverage of the subject giving a full discussion of a comprehensive discussion of forced, natural and mixed convection.

Topics:

- Fundamental Equations of Convective Heat Transfer
- Boundary Layer Approximation for Laminar Flow
- Heat Transfer in Incompressible Laminar External Boundary Layers
- Integral Boundary Layer Equations
- Forced Convection Heat Transfer in Laminar Flow through Pipes and Channels
- Forced Convection in Turbulent Flow
- Combined Convection
- Convective Heat Transfer Through Porous Media

26225 - Advanced Fluid Mechanics - 3 Units (Groups: Thermo-kinetics and Catalyst/ Transport Phenomena and Separation Processes)

This course is designed as an advanced course in Fluid Mechanics. The course begins with an introduction to basic definitions, basic laws as conservation of matter, momentum, and energy. Different flow regimes are introduced and equations governing fluid flow systems are presented.

Topics:

- Vectors and tensors, Momentum balance, Fluid statics
- Fluid dynamics, Equation of Motion, Conservation of Momentum
- Equations of Mechanical, Thermal and Total Energy
- Dimensional Analysis, Boundary layer theory, rotational and irrotational flow, Potential flow.
- Analytical solutions of Navier-stoke Eq. in B.L. Integral Method, Boundary Layer Separation.
- Turbulent flow, Turbulent Channel flow
- Prandtl's Mixing Length Theory

26668 - Thermodynamics of Solutions - 2 Units (Group: Thermo-kinetics and Catalyst)

The aim of this course is to introduce the theoretical basis of appropriate methods for correlating the mixture properties and the equilibrium conditions of non-ideal solutions, electrolytes and polymer solutions.

Topics:

- Introduction to the non-ideal solution theories
- Simple Theories for non-ideal solutions (van Laar, Scatchard-Hildebrand, and Lattice Theories)
- N- Liquid Theory • Chemical Theory
- Perturbed Theories
- Introduction to the electrolyte solution Thermodynamics (definitions and concepts)
- Fundamental models for activity coefficients of electrolyte solutions
- Debye-Huckel limiting law
- MSA based models
- Pitzer model
- Models based on the local composition concept
- Thermodynamics of polymer solutions
- Lattice models
- Equations of state for polymer solutions
- Free volume-based models for polymer solutions

26698 - Advanced Surface Engineering - 2 Units (Group: Thermo-kinetics and Catalyst)

The objective of this course is to introduce Thermo-kinetic and catalysis group MS students with surface engineering and its relationship to catalysis.

Topics:

1. Capillary phenomena

- Surface Tension and Surface free Energy
- Equation of Young and Laplace
- Treatment of Capillary rise
- Different methods for determining the surface tension

2. Gibbs Monolayer

3. Electrical Aspects of surface chemistry

- Electrical double and triple layers
- Stern treatment of the electrical double layer

4. Different electrical potentials applied to emulsions

- Zeta Potential
- Electrophoresis
- Electro osmosis
- Sedimentation potential

5. Chemisorption and catalysis

6. Surface activation and Deactivation

7. Adsorption isotherms and related iso-esteric heats

26915 - Computer-Aided Process Design - 3 Units (Group: Process Design Engineering)

The aim of this course is to introduce and familiarize graduate students with Process Simulators.

Topics:

- Introduction to Process Simulation, Brief presentation of Commercially available Process simulation packages
- Thermo- Physical Properties Data Banks: DIPPR, Dechema, Janaf, TRC and API
- Equations of state and Equilibrium for single components, Defined mixtures (Ideal and non-ideal, azeotropic) and undefined mixtures (petroleum and non-petroleum): Activity coefficients and functions, VLE and VLLE
- C7+Characterization, ASTM and API characterizations Methods, Pseudo components
- Unit operations: flash types and calculations, Heat Exchangers (simple and Rigorous TEMA type Detail Design by Bell Method), Distillation (shortcut and Rigorous, I/O method, convergences, Pump Around, multiple feed and side streams, multiple columns)
- Advanced commands: recycle streams, Calculator, optimizer and conceptual alternatives
- Case study, Reaction, Optimization, Integration

26580 - Safety & Loss Prevention in Process Industry - 3 Units (Group: Process Design Engineering)

The objective of this course is to provide an understanding of the major hazards encountered in the process industries and how process design can be carried out to minimize such hazards.

Topics:

- Introduction, Toxicology, Industrial Hygiene
- Source models, Toxic release and dispersion model
- Fires and Explosions, Design to prevent fires and explosions
- Introduction to reliefs, relief sizing
- Hazard Identification, HAZOP, Fault Tree Analysis, Event Tree Analysis
- Risk assessment, Accident investigations
- Case studies

26319 - Chemical Process Equipment Design - 3 Units (Group: Process Design Engineering)

The objective of this course is to familiarize graduate students with basic chemical process equipment design.

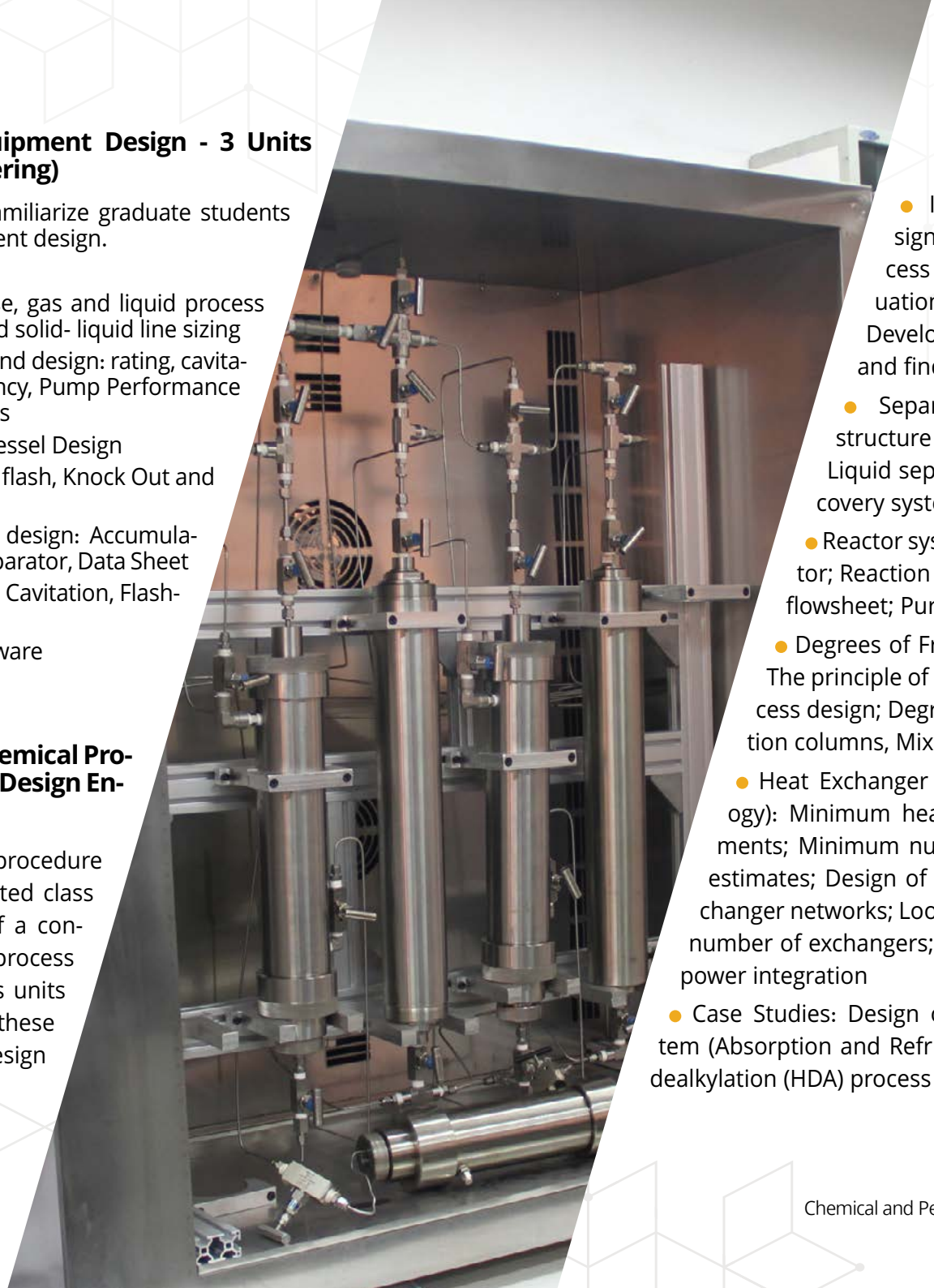
Topics:

- Review on Line sizing: single phase, gas and liquid process line sizing, two phases gas- liquid and solid- liquid line sizing
- Review of centrifugal pump sizing and design: rating, cavitation, Affinity laws and H vs. Q-Efficiency, Pump Performance evaluation, Data Sheet and Standards
- Liquid-Liquid separation Process Vessel Design
- Vapor liquid process vessel design: flash, Knock Out and Steam out drums
- Vapor-liquid-liquid process Vessel design: Accumulator, Reflux drum, Flash Drum, VLE Separator, Data Sheet
- Control Valve selection and Design: Cavitation, Flashing, Choking, Two Phase flow
- Rating, Noise, Data Sheet and Software

26325- Conceptual Design of Chemical Processes - 3 Units (Group: Process Design Engineering)

This course covers a systematic procedure for the conceptual design of a limited class of chemical processes. The goal of a conceptual design is to find the best process flowsheet (i.e. to select the process units and the interconnections among these units) and estimate the optimum design conditions.

Topics:



- Introduction: Process design, process synthesis, process evaluation; Economic evaluation, process optimization; Developing a conceptual design and finding the best flowsheet
- Separation Systems: General structure of separation systems o Liquid separation systems; Vapor recovery systems; Azeotropic systems
- Reactor systems: Basic choice of reactor; Reaction paths; Recycle structure of flowsheet; Purge structure of flowsheet
- Degrees of Freedom in Process Design: The principle of degrees of freedom in process design; Degrees of freedom of: Distillation columns, Mixers, Heat Exchangers
- Heat Exchanger Networks (Pinch Technology): Minimum heating and cooling requirements; Minimum number of exchangers, area estimates; Design of minimum energy heat exchanger networks; Loops and paths, reducing the number of exchangers; Stream splitting, heat and power integration
- Case Studies: Design of a solvent recovery system (Absorption and Refrigeration Systems); Hydrodealkylation (HDA) process for toluene

26669 - Process Optimization - 3 Units (Group: Process Design Engineering)

The students are acquainted with engineering judgment and formulation of optimization problems in chemical processes and related issues. The basic aim is to familiarize student with three key components of an optimization problem, namely, the objective function, the process model, and convenient formulation and suitable method of both static and dynamic optimizations. This is especially the case when they are encountered with Chem. Eng.-oriented problems.

Topics:

- Introduction to optimization formulation.
- Mathematical backgrounds.
- Unconstrained static optimization methods.
- Constrained static optimization methods.
- Dynamic optimization, Variational approach.
- Application and case studies.
- Advanced topics

26282 - Computational Fluid Dynamics - 3 Units (Group: Process Design Engineering)

The students are acquainted with engineering judgment and analysis of results obtained from simulation of flow processes, albeit within the context of chemical engineering. The basic aim is to familiarize students with key components of Computational Fluid Modeling (CFM) and Computational Fluid Dynamics (CFD) with an emphasis on reactive flow systems. In general terms, the course can be designated as a Computational Transport Phenomena (CTP) course. In the early sections of the lectures (named FDM and FEM), students are brought the paradigm of discretization and functional schemes of Partial Differential Equations (PDEs). The remaining parts, named Finite Volume Methods, discuss about the well-established flow formulations and solution techniques of underlying equations.

Topics:

- Preface
- Introduction
- Finite Difference Methods
- Weighted Integral Methods (Orthogonal Collocation & FEM)
- Finite Element Methods
- Finite Volume Methods
- Algorithms for Pressure-Velocity coupled problems

26855 - Wastewater Treatment Engineering - 3 Units (Group: Environmental Engineering)

The objective of this course is to promote the ability for recognition and treatment of industrial wastewater.

Topics:

- Introduction, Sources of Industrial waste
- Pretreatment Processes
- Sedimentation and Floatation
- Coagulation and Chemical Precipitation
- Biological Treatment Processes
- Sludge Handling and Disposal
- Land Treatment
- Membrane Processes

26828 - Water Treatment Plant Design - 3 Units (Group: Environmental Engineering)

The objective of this course is to introduce water treatment processes and enable students to design water treatment plants.

Topics:

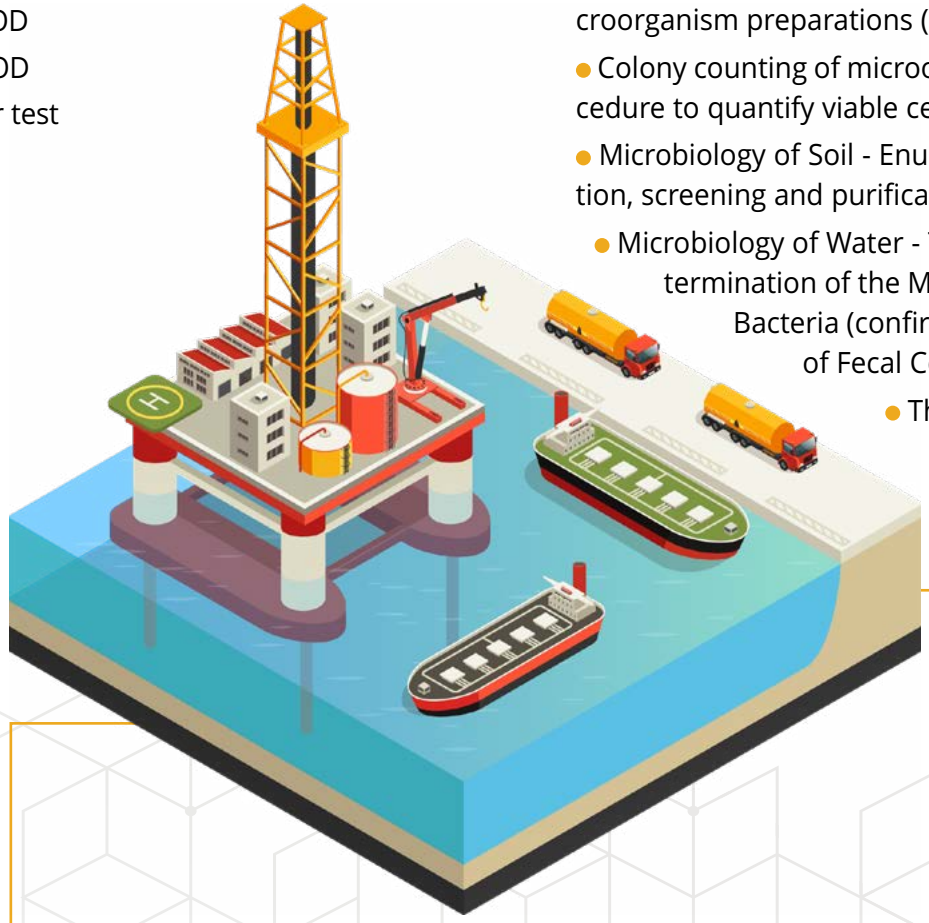
- The quality of natural water
- Water chemistry and microbiology
- Unit operations in water treatment
- The principles of physical treatments
- Aeration Process
- Clarification, Coagulation and Flocculation
- Filtration
- Water disinfection (Chlorination, Ozonation& UV application)
- Lime and Soda Process
- Ion Exchange Process
- De-alkalization and Demineralization
- Desalting processes (Reverse Osmosis)
- Corrosion and Scale Control
- Water Treatment plant design

26802 - Water and Wastewater Engineering Laboratory - 1 Units (Group: Environmental Engineering)

The objective of this course is to familiarize students with the common tests used for water analysis.

Topics include:

- Analysis of water for measurement of:
- Cations (Ca, Mg, Fe, Na, K)
- Anions
- COD
- BOD
- Jar test



26804 - Microbiology laboratory - 1 Units (Group: Environmental Engineering)

The basic knowledge of microbiology and its application in industrial processes should be introduced to students in the environmental engineering field. The major areas that the course focuses on are: basic laboratory techniques for cultural characterization, cultivation, enumeration and isolation of aerobic and anaerobic microorganisms from soil, water and wastewater and other substances.

Topics:

- Preparation of media and cultivation of microorganisms in solid, semi solid and liquid cultures
- Macroscopic and microscopic examination of living and stained microorganism preparations (Bacteria and Fungi)
- Colony counting of microorganisms - Serial dilution –agar plate procedure to quantify viable cells (Pour plate and Spread plate)
- Microbiology of Soil - Enumeration of microbial populations - Isolation, screening and purification of microorganism
- Microbiology of Water - Total count of microbial populations - Determination of the Most Probable Number (M.P.N) of Coliform Bacteria (confirmed and completed test) - Determination of Fecal Coliform Bacteria
- The bacterial growth study - Determination of cell biomass - Determination of cell suspension optical density

26269 - Bioremediation Technology - 3 Units (Group: Environmental Engineering)

This course is an introduction to the variety of biological methods for the removal of environmental pollutants in soil and groundwater. A general overview on biodegradable substances and the function of microorganisms on contamination removal in various modes will be given, as well.

Topics:

- Introduction
- Different environmental pollutants in water and soil (aliphatic hydrocarbons, aromatic hydrocarbons, chlorinated hydrocarbons, etc.)
- A review on remediation technologies
- Advantages of bioremediation against other methods
- An introduction to microbiology: Introduction, prokaryotic cells, Biodegradability of pollutants (aerobic and an-aerobic), Biodegradability of pollutants (cycle of elements, biodegradation petroleum compounds), Microbial metabolism, Bacterial growth, Biodegradation kinetics, Taxonomy
- Site assessment and characteristics for bioremediation
- In-situ bioremediation
- Calculations required for bioremediation
- Case studies
- Bioremediation modeling

26009 - Biofuel Production Technology - 3 Units (Group: Environmental Engineering)

The main objective of this course is introducing the thermochemical conversion methods of biomass to energy and fuel. In this regard, students learn the overview of world energy situation and the importance of biomass as one of the key resources of renewable energy in the world. Students also learn the methods of preparation and pre-processing of biomass as well as the techniques used to convert biomass into energy or solid/liquid/gaseous fuels. By passing this course, students are expected to gain an insight into the techno-economic challenges of bioenergy/biofuel production and be able to develop a conceptual design of a biorefinery plant.

Topics:

- Introduction to biomass as a renewable source of energy (The overview of world energy, Classification of biomass materials)
- Chemistry of biomass
- Preparation and pre-processing of biomass
- Thermochemical conversion methods of biomass to energy/fuels (Combustion, Gasification, Pyrolysis)
- Cleanup, conditioning, and utilization of syngas
- Upgrading fast pyrolysis liquids
- Hydrothermal processing
- Costs of Thermochemical Conversion of Biomass to Power and Liquid Fuels

26070 - Solid Waste Engineering - 3 Units (Group: Environmental Engineering)

The purpose of this Course is to introduce the students to the field of solid waste management and to identify the demands that must be met by those practicing in the field.

Topics:

- Evolution of solid waste management
- Legislative trends and impacts
- Sources, types and composition of solid wastes
- Solid waste Generation and collection rates
- Waste Handling and separation, storage, and processing at the source
- Classic Solid Waste Disposal Methods (Composting, land filling, incineration, etc.)
- Handling Hazardous Solid Wastes
- Modern and Emerging Technologies and Trends

26965 - Air Pollution Control Engineering - 3 Units (Group: Environmental Engineering)

This course is designed to teach the fundamentals of air pollution control engineering to first year graduate students with environmental engineering option. The objective is to give an overall view of the subject with emphasis on chemical engineering aspects of air pollution control.

Topics:

- Introduction to air pollution: definition of air pollution, local and global pollutions, types of air pollutants; sources of air pollutants, air pollution effects on human health; other air pollution impacts, air pollution laws, ambient air quality standards, emission standards; emissions and emission factors; air pollution measurements.
- Meteorology for air pollution engineering (micrometeorology): the atmosphere, general circulation models, temperature and pressure gradients in the atmosphere; turbulent mixing, humidity, wind speed, wind direction and wind rose.
- Air pollution modeling: types of models, concentration distribution in the atmosphere, Lagrangian and Eulerian modeling, boundary conditions for point, line and area sources, box models; dispersion models: (Gaussian and Puff models), multi-source models, grid models.
- Air pollution control: nature of particulate matters, classification of particles; particle dynamics in the atmosphere and particle size distribution functions; control of particulate matters (PM): design of PM control equipment: sedimentation; cyclones; electrostatic precipitators (ESP), surface and depth filters; scrubbers.
- Control of volatile organic compounds (VOCs), oxides of nitrogen (NOx), carbon monoxide (CO) and oxides of Sulphur (SOx).
- Motor vehicles air pollution
- Greenhouse gases and global warming.

26882 - Physiology & Anatomy - 3 Units (Group: Biomedical Engineering)

This course is an introduction to the physiology and anatomy required by students to work in the field of Biomedical Engineering. Therefore, student should be able to understand the human physiology and anatomy to use the principles of chemical engineering and physiology and/or anatomy to design and construct medically related devices such as artificial organs and controlled release systems.

Topics:

Physiology and Anatomy:

- Cell
- Kidney
- Glands
- Heart
- Blood Circulation
- Nerve
- Respiration
- Bone
- Digestion

Immunology:

- Cells, tissues and lymph nodes
- Phagocytosis mechanism

Type:

- Make-up Course

26654 - Controlled Release Drug Delivery Systems - 3 Units (Group: Biomedical Engineering)

Introduction to controlled release drug delivery system is the main objective of this course. Designing, mathematical modeling, applications and clinical examples, fabrication methods of different drug delivery system will be discussed.

Topics:

- Advantages, basic considerations, classifications of controlled release drug delivery systems
- Designing, mathematical modeling, applications and clinical examples, fabrication methods of different systems including: - Diffusional release systems - Swelling controlled systems - Osmotic release systems - Biodegradable systems - Directed release systems - Pumps
- Nanocarriers in drug delivery
- Targeted drug delivery

26266 - Tissue Engineering - 3 Units (Group: Biomedical Engineering)

This course provides an understanding of the principles of biology and materials science and their integration that are inherent in tissue engineering design. We will study cells, materials for scaffolding, bioreactor design, and design strategies for practical applications for tissue repair.

Topics:

- Introduction - Cell and tissue - Biomaterials
- Cell therapy
- Guiding tissue regeneration
- Bioreactors in tissue engineering
- Challenges and applications

26282 - Micro and Nano Systems in Biomedical Engineering - 3 Units (Group: Biomedical Engineering)

Introducing Micro and Nano systems applied in biomedical engineering is the main objective of this course. Scaling law, materials and methods of fabrication, transport phenomena in Micro and Nano scale, microfluidics, Lab on Chip and system applications will be discussed.

Topics:

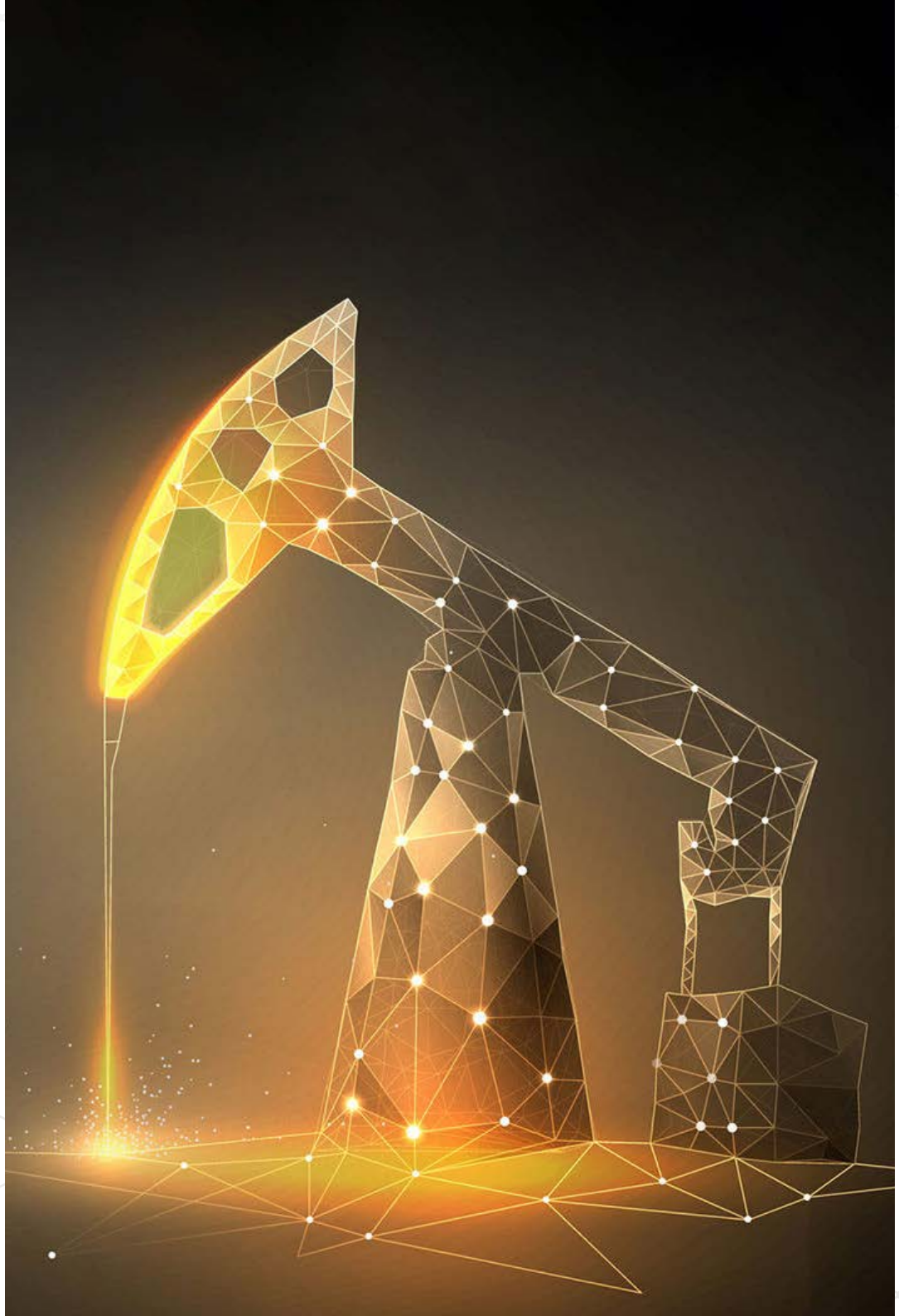
- Introduction, Miniaturization, Scaling Laws
- Materials and Fabrication Methods in Micro/Nano Scale
- Transport Phenomena in Micro and Nano Fluidic Systems
- Microfluidics, Concepts and Components
- Lab on Chip, Concepts and Design
- Applications of Micro/Nano Systems: - Diagnosis - Biomolecules/ Cells Separation - Bio Microarrays - Biosensors - Drug Delivery - Cell Studies - Tissue Engineering
- Market and Future Perspective

26829 - Transport Phenomena in the Human Body - 3 Units (Group: Biomedical Engineering)

Introduction to the transport phenomena in the human body is the main objective of this course. Different concepts in the bio-fluid mechanics, bio-mass transfer, and bio-heat transfer with the specific examples from examples from the human body will be discussed.

Topics:

- Bio-fluid mechanics - Physical, chemical and rheological properties of the blood - Dynamics of the circulatory systems - Mechanical properties of blood vessels - Non-Newtonian fluid flow in elastic tube - Pulsatile flow in rigid and elastic ducts (Newtonian and non-Newtonian fluids) - Diseases related to the fluid mechanical such as atherosclerosis, stenosis, etc.
- Bio-mass transfer - Diffusion under the influence of different gradients - Diffusion with bio-chemical reactions - General Nernst equation - Transports through the cell members - Oxygen diffusion from blood vessel to tissue - Mass transfer in the circulatory systems



- Bio-heat transfer - Heat production in the human body - Heat loss from the human body - Heat transfer within the body - Temperature distribution in the human organs such as arms, legs, etc. - Hypothermia – Thermotherapy

26277 - Artificial Organs - 3 Units (Group: Biomedical Engineering)

Introducing artificial related to chemical engineering is the main objective of this course. Material properties, governing equations, mathematical modeling, and fabrication methods will be discussed.

Topics:

- Biocompatible materials
- Blood compatible materials
- Artificial kidney (Hemodialyzer)
- Artificial lung (Blood oxygenator)
- Artificial liver
- Artificial polymeric organs such as heart valves, internal lens, ...
- Various shunts, stunts, ...

Graduate Study in Petroleum Engineering

Three major fields of research in the upstream Petroleum Engineering are vigorously practiced in our department, including:

Reservoir Engineering

This program, among the most prestigious majors in technical and engineering schools, aims at the training of specialists equipped with the knowledge and necessary skills to perform projects, direct optimal production methods, and run oil and gas reservoir modeling. The program focuses on subjects, including fluid mechanics, gas dynamics, fluid thermodynamics, mass transfer, reservoir fluid properties, drilling engineering, petroleum geology, reservoir engineering, and enhanced oil recovery (EOR) methods. Graduates will be able to demonstrate skills in;

- Assessment of production potential from a reservoir based on modern methods of analysis and modeling,
- Analysis of pressure distribution in a reservoir, explanation of pressure-drop and solutions to control it,
- Specifying operational conditions for production based on the reservoir's behavior and characteristics,
- Selection of appropriate technologies for EOR based on techno-economic considerations,
- Management and sustainability of oil and gas fields,
- Appraisal of the prospects of EOR methods on the environment.

Production Engineering

This program, among the most prestigious majors in technical and engineering schools, aims at the training of specialists equipped with the knowledge and necessary skills to perform projects in optimal production methods from oil and gas fields. Today, most of Iran's petroleum reservoirs are inflicted with pressure drop, prohibiting natural rise of oil to the surface. Therefore, production engineers, who undertake more scientific and methodical procedures, are increasingly in demand. The program focuses on subjects, including fluid mechanics, gas dynamics, fluid thermodynamics, mass transfer, drilling engineering, design and engineering economics, reservoir engineering and production engineering. Graduates will be able to demonstrate skills in;

- Assessment of production potential from reservoirs and feasibility study of production methods,
- Techno-economic assessment of reservoirs and production equipment,
- Design and administration of optimal production operations,
- Recognition of characteristics and production behavior in different wells,
- Selection and justification of appropriate technologies for production and EOR, based on technical and economic considerations,
- Management and sustainability of oil and gas fields,
- Strategic appraisal of the prospects of production methods on the environment.

Graduates can work in various fields of oil and gas production industry, giving rise to efficiency and productivity of this section, and as well can play an effective role in curbing the problems inflicted to production industry.

Drilling Engineering

Design of equipment and administration of drilling operations in the most appropriate condition, besides assessment of effects of drilling and extraction technologies on the environment as well as the establishment of feasible solutions to prevent pollution, consists the activities under this field. In general, a drilling engineer provides procedures that minimize the cost and maximize the efficiency of operation. Graduates will be able to demonstrate skills in;

- Employment of technical and scientific data in drilling and extraction operation,
- Techno-economic assessment of drilling procedures, and selection of a suitable operation for drilling and extraction,
- Design of drilling equipment and administration of operations in the most optimal way,
- Techno-economic comparison between different drilling procedures, and presenting approaches to upgrade related technologies in the country
- Management and sustainability of drilling equipment besides preventing the waste of facilities and materials,
- Appraisal of the prospects of extraction methods on the environment, and presenting methods to prevent potential environmental hazards.

Graduates can successfully work in the drilling industry, exhibiting their crucial role in improving efficiency of operations by presenting optimal operational programs.

Master of Science Degree in Petroleum Engineering

M.Sc. students admitted to each of the abovementioned sub-disciplines are required to complete their dissertation under the supervision of faculty members of the pertinent groups. Accordingly, the M.S. students receive a master's degree in petroleum engineering hyphenated by their entry sub-discipline.

Required Background

Graduates from Bachelor's degree of all Petroleum engineering sub-disciplines can enroll in M.Sc. programs provided they meet the general admission requirements mandated by MSRT. Applicants should take part in the National Entrance Examination for Master's degree in petroleum engineering. Students are admitted according to their ranking in the test results and the priority of choices they have submitted beforehand. The whole procedure of admission is supervised by the National Organization of Educational Testing (NOET, http://www.sanjesh.org).

Requirements

An M.Sc. program in petroleum engineering requires the students to complete 28 course units. These units include 21 of required, elective and selected elective course units, 1 unit of seminar and 6 units of final dissertation. The following table collates the courses for all the sub-disciplines in petroleum engineering.

Sub-discipline	No.	Course Title	Course Type	No. of Course Units
Reservoir Engineering	26267	Advanced Numerical Mathematics	Required	3
	26499	Fluid Phase Behavior in Petroleum Reservoir	Required	3
	26504	Fluid Flow Through Porous Media	Required	3
	26254	Geo-statistics & Spatial Modeling	Required	3
	26835	Fractured Reservoir Engineering	Required	3
	26832	Reservoir Modeling and Simulation	Required	3
	26836	Enhanced Oil Recovery	Required	3
	26329	Seminar	Required	1
Production Engineering	26267	Advanced Numerical Mathematics	Required	3
	26509	Advanced Reservoir Engineering	Required	3
	26276	Multi-phase Flow in Well	Required	3
	26207	Advanced Formation Damage	Required	3
	26252	Advanced Production Engineering	Required	3
	26839	Advanced Well Testing	Required	3
	26004	Hydraulic Fracturing	Required	3
	26329	Seminar	Required	1
	26174	Well Completion	Selected Elective	3
	26505	Advanced Well Logging	Selected Elective	3
		Surface Facilities	Selected Elective	3
		Flow Assurance	Selected Elective	3
	26836	Enhanced Oil Recovery	Selected Elective	3
	26499	Reservoir Fluids Phase Behavior	Selected Elective	3
		Advanced Rock Mechanics	Selected Elective	3
	26254	Geo-statistics & Spatial Modeling	Selected Elective	3
		Advanced Drilling Fluids	Selected Elective	3
	26661	Special Topics	Selected Elective	3
Drilling Engineering	26267	Advanced Numerical Mathematics	Required	3
	26505	Advanced Well Logging	Required	3
	26173	Advanced Drilling	Required	3
	26180	Well Control	Required	3
	26181	Horizontal Well	Required	3
	26004	Hydraulic Fracturing	Required	3

	26329	Seminar	Required	1
	26174	Well Completion	Selected Elective	3
	26276	Multi-phase Flow in Well	Selected Elective	3
		Advanced Drilling Fluids	Selected Elective	3
	26207	Advanced Formation Damage	Selected Elective	3
	26839	Advanced Well Testing	Selected Elective	3
	26509	Advanced Reservoir Engineering	Selected Elective	3
	26252	Advanced Production Engineering	Selected Elective	3
	26254	Geo-statistics & Spatial Modeling	Selected Elective	3
	26661	Special Topics	Selected Elective	3
	26206	Well Design Plan	Selected Elective	3

Doctor of Philosophy Degree in Petroleum Engineering

The Ph.D. Program in Petroleum Engineering aims at training of specialist individuals with exceptional potential in research and education in various scientific fields related to Petroleum Engineering discipline. Graduates from this program are expected to demonstrate the capacity to oversee academic activities based on their professional and ethical doctrine.

According to the bylaws of the Higher Education Department, a doctoral degree requires the satisfactory completion of an approved program of advanced study and original research of high quality. The program, therefore, consists of 1 year of course-work education prior to taking the comprehensive exam. An oral defense is mandated to be delivered before the referees to receive approval for the research proposal. Ph.D. candidates are required to deliver three 3-unit courses as a Teaching Assistant. Moreover, two seminars should be delivered as zero-unit courses, besides annual reports on the thesis progress in presence of referees. A dissertation thesis submitted in the Persian language in addition to a final oral defense will complete the program. The overall program is expected to be accomplished in 4 academic years (or 8 semesters).

Ph.D. candidates will be awarded a Ph.D. in petroleum engineering regardless of their research field.

Required Background

Ph.D. applicants with a master's degree/professional doctorate affirmed with either MSRT or MOHME are eligible to enroll in Ph.D. programs of the department. Additionally, proficiency in a foreign language must be verified through standard proficiency tests. Applicants should take part in the National Entrance Examination for Ph.D. in petroleum engineering. Competent applicants are invited for an interview with a group of faculty members. Curriculum vitae of applicants along with recommendation letters are advised to be submitted beforehand. The whole procedure of admission is supervised by the National Organization of Educational Testing (NOET, http://www.sanjesh.org).

Requirements

Ph.D. requires the students to complete 12 course units. These units include two courses of the required core curriculum, and two courses related to the research orientation. At the end of the first academic year, the comprehensive exam is taken, which examines four course topics from the graduate curriculum. Two of the courses must be taken from the core list and the others are selected under the discretion of the supervisor and affirmation of the Higher Education Committee. In the following section, the graduate courses in petroleum engineering are listed.

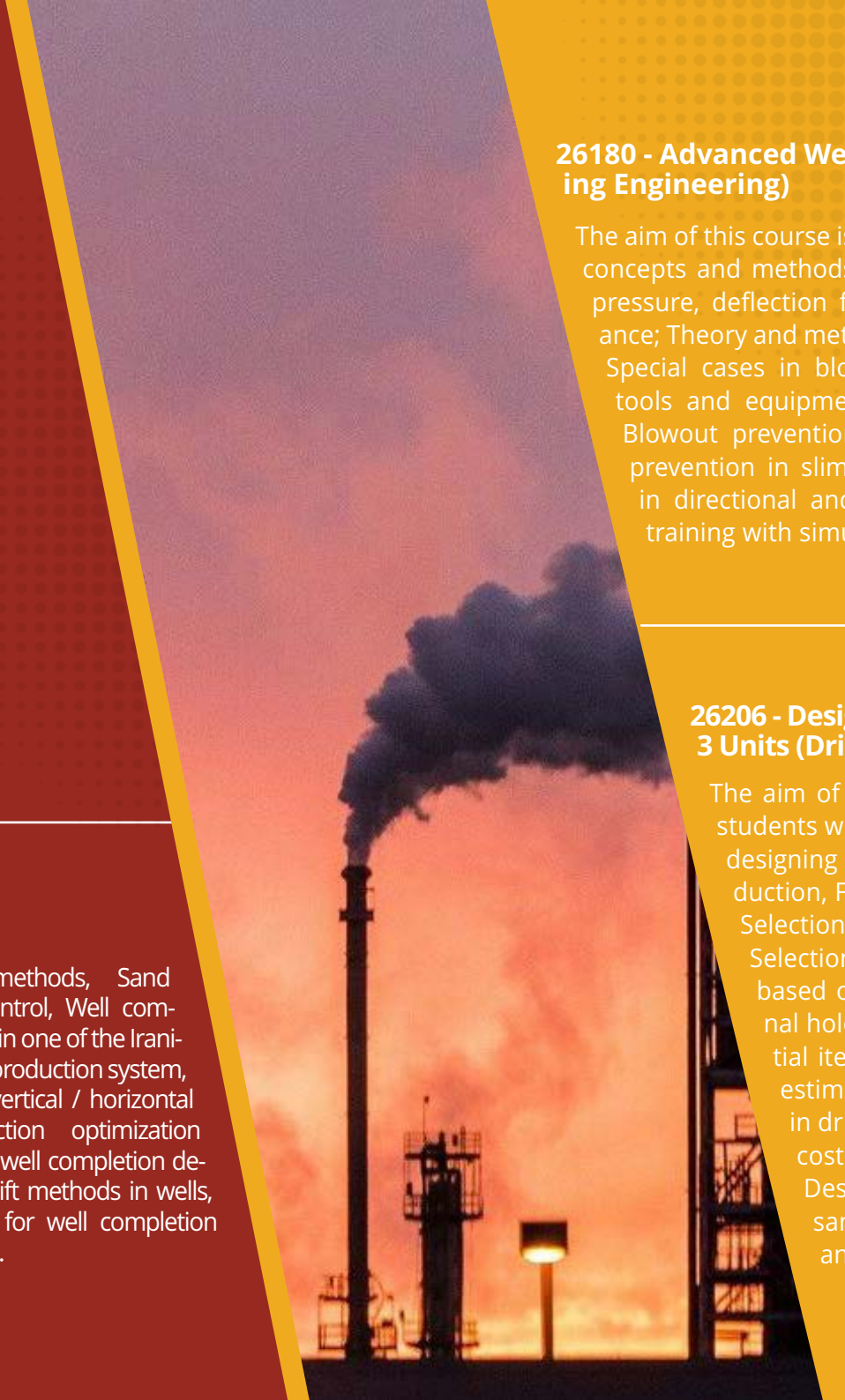
Courses

26173 - Advanced Drilling Engineering- 3 Units (Group: Drilling Engineering)

The aim of this course is to familiarize students with drilling operation problems and their solutions as well as modern technologies used in these operations. Making a hole, Drilling optimization and prediction methods, Drilling problems and solutions, Directional and horizontal drilling, Under□balanced drilling (UBD), Coiled tubing, Snubbing and stripping, Modern technologies.

26174 - Well Completion- 3 Units (Drilling Engineering, Production Engineering)

The aim of this course is to familiarize students with concepts and methods of well completion and improved productivity. Methods of well completion, well completion design, plug back and water shut off systems in wells, Formation damage, Well stimulation methods, Sand production control, Well completion design in one of the Iranian wells, Well production system, Fluid flow in vertical / horizontal wells, Production optimization and optimum well completion design, Artificial lift methods in wells, Coiled tubing for well completion and work-over.



26180 - Advanced Well Control- 3 Units (Drilling Engineering)

The aim of this course is to familiarize students with concepts and methods of well control. Formation pressure, deflection factor and formation resistance; Theory and methods of blowout prevention; Special cases in blowout prevention; Required tools and equipment for blowout prevention; Blowout prevention in deep waters; Blowout prevention in slim holes; Blowout prevention in directional and horizontal wells; Practical training with simulator apparatus.

26206 - Design and Planning of Wells- 3 Units (Drilling Engineering)

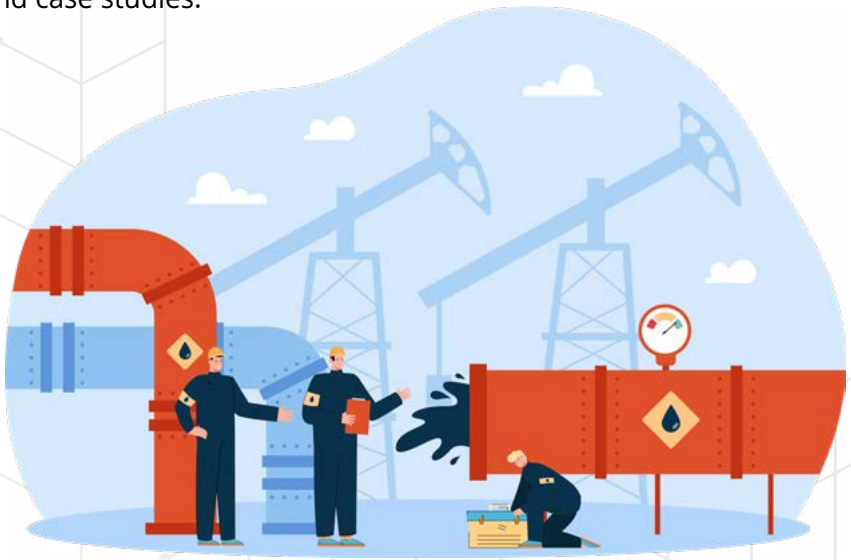
The aim of this course is to familiarize students with concepts and methods of designing and planning of wells. Introduction, Fundamentals of well design, Selection of casing and liner points, Selection of well completion method based on production curves and final hole diameter, Design of essential items in each well, Scheduling estimate methods, Risk analysis in drilling operations, Methods of cost estimates in different wells, Designing and planning of a sample well in one of the Iranian reservoirs

26207 - Advanced Formation Damage- 3 Units (Production Engineering)

The aim of this course is to familiarize students with basic concepts and causes of formation damage as well as its associated diagnostic and controlling methods. Reservoir rock characterization for formation damage; Formation damage due to fines migration; Formation damage due to invasion of mud filtrate; Formation damage due to mineral depositions; Formation damage due to asphaltene precipitation; Formation damage due to asphaltene precipitation; Formation damage due to perforation operations; Analysis of experimental results of formation damage; Field applications of formation damage and case studies.

26252 - Advanced Production Engineering- 3 Units (Production Engineering)

This course gives a profound understanding of challenges involved in the stimulation procedures and the efforts to optimize the efficiency of hydrocarbon production from the well. Reservoir rocks and related Minerals; Clay Minerals and their Importance in Formation Damage; Fundamentals of Surface Charge; Description of Point of Zero Charge; Cations and Anions found in the Stimulation and Formation Fluid; Physical and Chemical Properties of Polymers used in the Stimulation Fluids; Surfactants used in the Stimulation Fluids; Different Types of Stimulation Procedures; Acids used in Matrix Acidizing; Determination of Acid Reaction related; Simulation of Matrix Acidizing in Sandstone Reservoirs (Amundson Method); Simulation of Cased-hole acidizing in Sandstone Reservoirs; Different Stages of Acidizing; Formation Damage Caused by Matrix Acidizing in Sandstone Reservoirs; Discussion of Aqueous Chemistry and its effect on the Stimulation Procedures; Carbonate Acidizing Principles; Different Models for Carbonate Acidizing Simulation; Challenges of Rigorous Carbonate Acidizing Simulation; Acid Additives; Acid Diversion and its Simulation.



26254 - Geo-statistics and Spatial Modeling- 3 Units (Reservoir Engineering)

An introduction to basic concepts of probability, statistics and geo-statistics as well as deterministic and probabilistic estimation of the petrophysical properties of reservoir rock in order to be used in the reservoir static model. Basic concepts in probability and statistics; Spatial statistics; Estimation and simulation of reservoir properties; Other modeling approaches; Evaluation of model.

26267 - Advanced Numerical Mathematics - 3 Units (Reservoir Engineering, Production Engineering, Drilling Engineering)

The objective of this course is to familiarize the students with the numerical methods required to solve all the mathematical models of various systems encountered in the field of petroleum engineering. Matrix decomposition techniques; Numerical interpolation, differentiation and integration techniques; Numerical solution of ordinary differential equations; Partial differential equations; Introduction to finite element methods; Solving PDE's with orthogonal collocation; Software workshop.

26276 - Multi-phase Flow in Wellbore - 3 Units (Production Engineering)

The aim of this course is to familiarize students with concepts of multi‐phase flow in pipes and wellbores as well as calculation of associated flow rates and pressure drops. Introduction; Multi-phase flow models which are independent to flow pattern; One-dimensional multi-phase flow models and flow pattern determination; Calculation of pressure drop in bubbly flow; Calculation of pressure drop in slug flow; Calculation of pressure drop in annular flow; Generalized methods for calculation of pressure drop; Pressure drop calculation and flow pattern specification (solid, liquid and gas); Design of slug catchers.

26499 - Fluid Phase Behavior in Petroleum Reservoir- 3 Units (Reservoir Engineering)

The aim of this course is to introduce the theoretical basis of reservoir fluid phase behavior and use of phase diagrams to investigate equilibrium conditions of petroleum fractions in reservoir ambience. Phase equilibria; Equations of state; Phase behavior calculations; Fluid characterization; Gas injection; Interfacial tension; Grouping; Tuning of equations of state; Wax and asphaltene phase behavior; Gas hydrates; Applications and case studies; Software workshop.

26504 - Fluid Flow Through Porous Media - 3 Units (Reservoir Engineering)

The aim of this course is to familiarize students with microscopic and macroscopic models of single and multi‐phase fluid flow through porous media as well as different injection methods and phase change. Modeling of three‐phase flow through porous media; Modeling of water injection in petroleum reservoirs; Microscopic modeling; Streamline simulation; Diffusivity equation; Fluid flow with phase change; Dispersion and diffusion.

26505 - Advanced Well Logging - 3 Units (Production/Drilling Engineering)

The course will explore the tools response explained from their physical principles as well as their relationship with the rock and fluid properties; most existing open hole logging technologies will be covered explaining their main applications and limitations. Advanced interpretation methods will be discussed with numerous examples and exercises including complex lithology interpretation techniques. At the end of the course we will hold a mini-workshop on optimum logging program selection based on minimum set of logs needed for a proper evaluation, company budget and tools' limitations.

This training course will feature:

- Discussions on tools physical principles and applications
- Tool limitations on different borehole environments
- Tips and examples to identify and understand common logging issues
- Explanation of petrophysical concepts and techniques for advanced formation evaluation
- Application of interpretation methods in several examples and exercises

26509 - Advanced Reservoir Engineering - 3 Units (Production/Drilling Engineering)

This course covers the reservoir engineering concepts by describing how different methods can be used to assess development potential of oil and gas reservoirs, identify the principal displacement mechanisms controlling performance and validate the predictions of the numerical simulators. Reservoir rocks and fluids; Reservoir Volume and Fluid Flow; Prediction of Oil and Gas Recovery; Water drive Mechanism and Coning; Naturally Fractured Reservoirs (NFR); Enhanced Oil Recovery (selected processes); Stimulation of oil reservoirs.

26661 - Special Topics in Petroleum Engineering - 3 Units (Production/Drilling/Reservoir Engineering)

Based on the operational and research requirements of the petroleum industry in the fields of reservoir, drilling, production and exploration as well as the availability of the instructor, different special 3□unit courses will be offered.

Prior to presentation, course syllabus should be discussed and confirmed by the related group.

26832 - Reservoir Modeling and Simulation - 3 Units (Reservoir Engineering)

The students are acquainted with engineering judgment and formulation of simulation problems in oil/gas reservoirs and related issues. The basic aim/focus is to familiarize students with three key approaches of numerical solution of Partial Differential Algebraic Equations (PDAEs) – namely FDM, FVM/FEM and BEM – along with singularities (injection/production wells). The students learn to deal with the reservoir simulation problems through convenient formulation and suitable method of solution. The graduates of this course are equipped with theoretical and practical knowledge of both numerical and professional reservoir engineering. Prerequisites: Advanced Numerical Mathematics, Fluid Phase Behavior in Petroleum Reservoir, Fluid Flow Through Porous Media.

26835 - Fractured Reservoir Engineering - 3 Units (Reservoir Engineering)

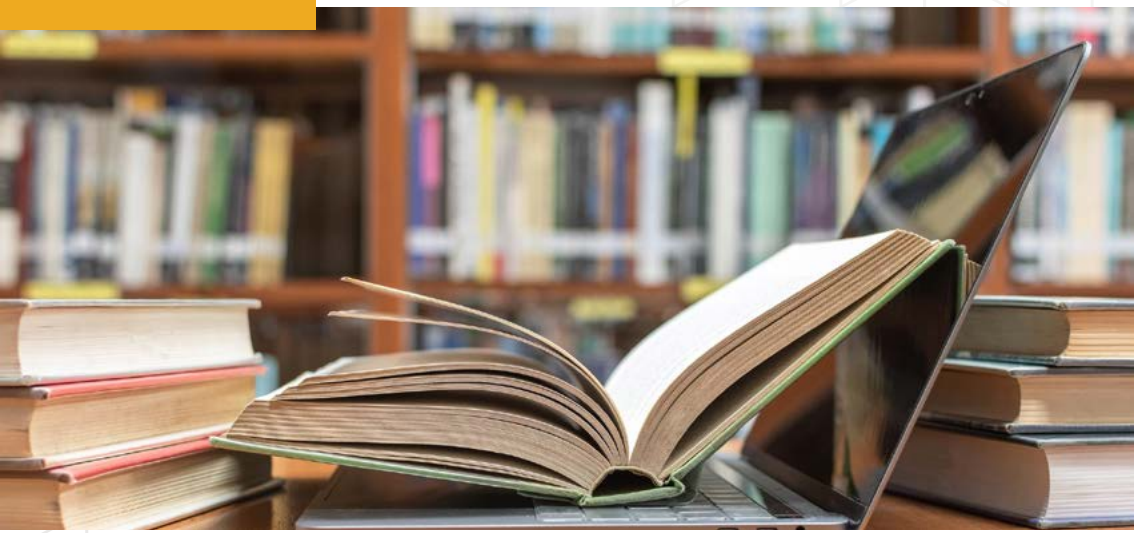
Introduction to reservoir properties and other parameters describing fractured reservoirs, such as porosity, permeability, compressibility, relative permeability and capillary pressure; fracture characterization and geometric modeling of fractures; modeling of fluid flow through fractured rocks; recovery mechanisms and EOR scenarios in fractured reservoirs. Introduction to geometric (static) modeling of fractures in fractured reservoirs, deterministic and stochastic methods, fractal methods, methods based on optimization; Modeling fluid flow through fractured reservoirs; Fluid displacement and primary mechanisms of production. Corequisite: Fluid Flow Through Porous Media.

26836 - Enhance Oil Recovery - 3 Units (Reservoir Engineering)

This course is intended to cover the main techniques used in EOR processes. Enhanced Oil Recovery is referred to the techniques used to recover more oil after the first depletion (primary oil recovery) of the reservoirs. Oil price and its effect on petroleum industry; Oil Trapping due to Heterogeneities; An introduction to EOR techniques, Description and Challenges; EOR Screening; Immiscible vs. Miscible flooding; Modified water-flooding; MEOR Process; Thermal recovery techniques; Wettability alteration and EOR; GOGD process.

26839 - Advanced Well Testing - 3 Units (Production Engineering)

The aim of this course is to familiarize students with design, interpretation and analysis techniques of well testing. Fundamentals of well testing; History of well testing; Well test analysis techniques; Use of Laplace transformation to solve diffusivity equation with different boundary conditions; Different regions of well test models; Use of straight line methods to determine near wellbore effects; Use of straight line methods to determine reservoir behavior; Model determination and parameter estimation using type curves; Pressure derivatives; Simultaneous use of pressure and pressure derivative type curves for homogeneous reservoirs; Simultaneous use of pressure and pressure derivative type curves for dual porosity reservoirs; Use of pressure derivative to determine near wellbore effects, reservoir behavior and boundary effects; Analysis of well test data in horizontal wells; Analysis of well test data in gas wells; Well test design; Practical aspects in well test data analysis; Practical training of a standard simulator; Assigning a project of well test data analysis in one of the Iranian reservoirs.



CENTERS

Biochemical and Bioenvironmental Research Center (BBRC)

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Biochemical and Bioenvironmental Research Centre (BBRC) was established in 1968 at Sharif University of Technology. The top mandate of this research center was training researchers for fast developing Iranian industries in areas such as environmental issues, food, agriculture, biomedicine and biotechnology. Soon, BBRC was one of the best-known institutes in the whole region as an important and progressive center for advanced research in biotechnology. Scientific development of "Single Cell Protein" from waste material and oil-based hydrocarbons at a time that only a few countries in the world were looking at mineral oil and gas as future food was a significant step towards success. The center was well en route of becoming an important academic institute at home as well as gaining international and worldwide recognition for high technology in industrial microbiology. Many scientists from different local universities and from Asian and European scientific communities applied to BBRC to receive training or take part in advanced research and gain experience. Today BBRC, based on its significant reputation and well-placed position in Iranian academic arena is still one of the most important organizations and a top destination for biotechnologists for research and advanced studies. In this respect, training of skilled researchers, top quality engineers and expert academicians familiar with industrial work is still a major goal at BBRC.

BBRC offers services on a consultation basis to governmental and non-governmental sectors. Apart from analytical services for food, water and wastewater samples, the engineering division also offers advice on problems of pollution control and treatment policies, recycling and water recovery. Feasibility studies and the preparation of reports and designs related to engineering and consultancy, forms a major part of the work performed within the framework of the bioenvironmental engineering section. Lab-scale pilot plant studies are conducted when necessary in order to evaluate the effects of various parameters in qualitative and quantitative control of pollution in water and wastewater. Many technical reports including industrial surveys are also produced on demand as part of this institutes cooperation with the industrial sector.

Along with the problems of pollution in air and water, created by both urban and industrial sector, the population growth in Iran demands an increased improvement in current techniques of food production, conversion and storage. Relevant research into this area of concern is also carried out at the center. Related subjects in food technology, fermentation, and biochemical engineering have a high demand for young graduates who seek their future career in this domain.

Students are encouraged to carry out applied research while studying for their degrees. For this reason, practical as well as theoretical courses are offered by the center for the postgraduate and undergraduate students studying for degrees in Chemical Engineering, Civil Engineering and Chemistry. Short courses in pollution control and bioengineering are also offered to the industrial sector on demand, including training courses for technicians and plant operators.

Research results are published in the form of scientific articles in first-class international journals by academic affiliates of BBRC regularly.

Areas of Research

Biotechnology

- Fermentation of Organic Acids, Amino Acids, Proteins, etc.,
- Bioconversion of Agricultural Waste
- Enzyme Technology

Nanobiotechnology

- Polymer chemistry and macromolecular engineering
- Nanomedicine, Drug delivery systems, and targeted drug delivery
- Biomaterials, Biopolymers and Biocompatible Polymers
- Colloids/ Nanogels and supramolecular self-assembly

Food Engineering

- Development of New Food Additives
- Higher Quality Food Production
- Conversion of Agricultural Waste
- New Sources of Edible Food

Bioenvironmental Engineering

- Wastewater treatment and engineering
- Environmental impact assessment
- Bioconversion, biofuel, and energy from waste
- Development of new biological reactors
- Aerobic/Anaerobic Digestion of Strong Wastes
- Reuse and Recycling of wastewater and treated effluents
- Bioremediation of solid waste

Pharmaceuticals

Advances in science and technology have made research in the production of pharmaceutical chemicals an important part of the theoretical structure and practical application of medicine. The center has a history of research in antibiotics, namely: Penicillin G, Ampicillin, Amoxycillin, 6APA, Erythromycin, Bacitracin

Microbiology

Apart from the routine microbiological analysis of water, wastewater and soil, isolation of microorganisms is carried out to introduce new techniques in the bioremediation of various elements.

Sharif Upstream Petroleum Research Institute (SUPRI)

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Web: supri.sharif.edu

Sharif Upstream Petroleum Research Institute (SUPRI) in Sharif University of Technology has been established in 2013 as a technology oriented center for scientific, fundamental and applied research in oil and gas industry. Members of this Institute are professors from various departments of Sharif University of Technology and other visiting professors with the research backgrounds in upstream petroleum industry. This institute is currently involved in several research projects financially supported by oil industry. The aim of this institute is as follow:

- Cooperation of various research centers, Institutes and departments in order to improve the quality of research projects for the upstream petroleum Industry
- Technological knowledge Development for oil and gas industry at the national and international level
- Definition and execution of industrial and research projects for oil and gas industry
- Reservoir studies and cooperation in oil and gas field development
- Recognition of new technologies in oil and gas industry and localization of them
- Organizing applied and specific workshops for oil and gas industry

Research Groups

Reservoir Characterization and Modeling Group

Reservoir characterization and modeling is an important research area for development and management of hydrocarbon reservoirs. In this field of study, new technologies in hydrocarbon reservoir exploration and appraisal (using seismic, petrophysics, geology, etc.) can be used.Then by using these data the static reservoir model is built. This model is used in flow simulation, reservoir performance evaluation, new well placement selection, estimation of oil in place, selection of optimized method for reservoir management and history matching.

Reservoir Production Improvement and EOR Group

One of the major areas of research in oil industry is to improve the oil production and studying the EOR methods. Sufficient knowledge of reservoir production mechanisms, the conditions of the reservoir fluid and rock properties can lead to better designing of enhanced oil recovery processes. Moreover, researches in reservoir evaluation methods, reservoir modeling and simulation and well stimulation (such as acidizing, hydraulic fracturing, formation damage removal and other efficient methods) are very important.

New Technologies and Smart Systems Group

As the economic measures depend on the oil production, development of oil industry is important which depends on new science and technologies that can be very helpful in cost reduction and efficiency improvement. New methods in drilling and well completion as well as use of smart wells and e-fields lead to easier production and enhancement in oil recovery which needs the use of previous experience and new technologies.

Geophysics and related Technologies Group

Formation evaluation and reservoir exploration need various data from drilling of exploration wells and geological study as well as geophysics studies. One of the main area is the geophysical technologies which has been developed during last two decade significantly to monitor and manage the drilling and production activities.

DEPARTMENTAL FACILITIES

The department has provided educational and research-oriented facilities for undergraduate and graduate students, which are listed below:

Analysis Lab.

The Analysis Laboratory in the Chemical and Petroleum Engineering Department specializes in compositional characterization on a variety of materials. The laboratory is equipped with state-of-the-art equipment by reputable manufacturers such as Agilent, and Waters, and employs specialized operators to ensure day-to-day operation and data integrity. UV-Vis Spectrophotometer, Gas Chromatography-Mass Spectrometry (GC-MS), High-Performance Liquid Chromatography (HPLC), and Natural Gas Analyzer besides other practical equipment such as Freeze dryer and Ultrasonic Probe Homogenizer are among the major equipment in this facility. The Analysis Laboratory primarily provides sup-

port for graduate research projects. Our aim is to encourage users of the service to obtain the highest functionality from all instruments regardless of their experience, in a safe, clean working environment.

Process Control Lab.

The process control laboratory has been designed to present a practical application of process modeling and control. Students will become familiar with basic principles like nonlinearity and hysteresis as well as different control methods, including feedback and cascade control. Besides, various PID controller tuning methods are discussed and applied in experiments. Students will also learn how to use Simulink in order to simulate and check the controller performance. The laboratory is equipped with modern and world-class facilities and instruments which provide a high-quality education for students. Experiments which are conducted here include pressure control, temperature control, flow control, level control and cascade control.

Unit Operations Lab.

The primary goal of the unit operation laboratory is to acquaint students with the fundamentals of basic industrial processes in pilot scale, and familiarize them with the principles of chemical engineering in such processes. The laboratory program prepares students to deal with various challenges in real chemical industries such as refineries, food industries, and so forth. Chemical Engineering students take the laboratory during their last year after they pass the course of Unit Operation I. The Laboratory program demonstrates the practical usage of most of the Chemical Engineering major courses in one package. Equipment and Facilities of the laboratory include Boiler, Solid-Liquid Extraction, Liquid-Liquid Extraction, Raising Film Evaporation, Double Effect Evaporation, Spray Dryer, Rotary Dryer, Distillation in Packed Column, Distillation Tower, Gas Absorption, and Fluidized Bed. Students carry out these experiments and deliver the reports.

Fluid Mechanics Lab.

The Fluid Mechanics Lab, among educational lab facilities, hosts our undergraduate students of the chemical and petroleum engineering. This laboratory combines a series of experimental systems for investigation of the concepts students learn in Fluid Mechanics I. The lab is designed to give students hands-on experience with fluid flows. It features a multitude of equipment, including pressure drop measurement bench, friction pipes flow bench, jet impact apparatus, Bernoulli's apparatus, Osborne-Reynolds apparatus, water flow measuring apparatus, hydrostatic bench, cavitation demonstration apparatus, centrifugal pump demonstration set, fluidized bed apparatus, wind tunnel, pump test bench and deadweight gauge tester.

LAB

Heat Transfer Lab.

This lab is dedicated to Chemical / Petroleum Engineering B.Sc. Students to make them understand the principles of i.e. conduction, convection, radiation, boiling and condensation modes of heat transfer and principles of Refrigeration and Air Conditioning. The Heat Transfer lab consists of nine experimental set up, including: Conduction in solids, rods, plate and fins; Heat transfer in agitated vessels (coiled and externally heated liquid in an agitated vessel); Cross flow forced convection on a tube bank; Natural convection heat transfer; Plate, coiled, double pipe and shell & tube heat exchanger Rig; Drop & film condensation; Fin fan cooler, Overall heat transfer coefficient and bundle arrangement; Shell & tube heat exchanger with variable Number of tube passes; Radiation, IR, visible and shield.

Petroleum Lab.

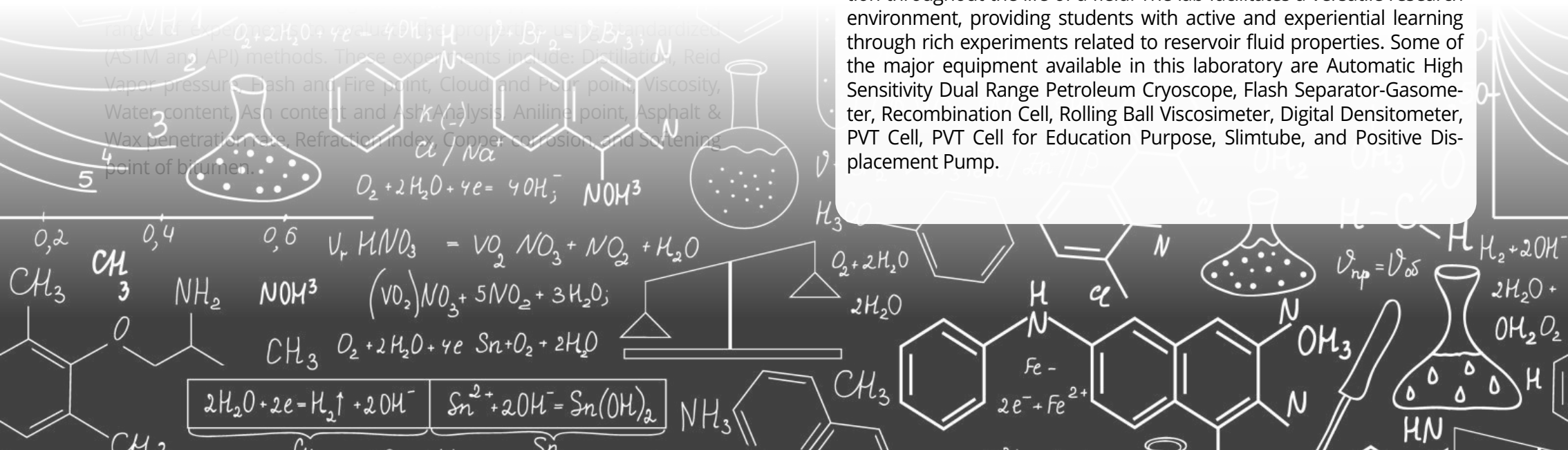
This laboratory holds significant importance for the fields of petroleum

Reservoir Rock Properties Lab.

Rock Properties include all measurements and tests which would routinely be made on core samples. These samples can include conventional core, plugs drilled from conventional core, rotary sidewall cores, and percussion sidewall cores. The lab facilitates a versatile research environment, providing students with active and experiential learning through rich experiments related to reservoir rock properties. Some of the major equipment available in this laboratory are: Helium Porosimeter, Mercury Intrusion Porosimeter, Benchtop Relative Permeameter, Automatic Saturator, Multi-sample un-S-S Gas Permeameter and Porosimeter, Capillary Pressure and Resistivity System, Natural Gamma Logger, Overburden Acoustic Velocity System, Interfacial Tension Meter, Electrical Properties System, Capillary Desaturation Cell, Dean–Stark apparatus, and Retort Oven Device.

Reservoir Fluid Properties Lab.

Reservoir fluid analysis is critical for understanding the changing character of produced hydrocarbons over time, and for optimizing production throughout the life of a field. The lab facilitates a versatile research environment, providing students with active and experiential learning through rich experiments related to reservoir fluid properties. Some of the major equipment available in this laboratory are Automatic High Sensitivity Dual Range Petroleum Cryoscope, Flash Separator-Gasometer, Recombination Cell, Rolling Ball Viscosimeter, Digital Densitometer, PVT Cell, PVT Cell for Education Purpose, Slimtube, and Positive Displacement Pump.



Drilling Lab.

Drilling fluid tests are performed in the field and/or laboratory to evaluate the properties and characteristics of the fluid, and to determine its performance limitations. The aim of this laboratory is to familiarize B.Sc. student with drilling and completion related instruments. Working as a team in the lab, students simulate wellbore conditions in the laboratory and evaluate completion products under actual reservoir conditions. The test supported by the drilling and completion equipment help students to design an effective drilling fluid and completion cement which can optimize well productivity. The lab is equipped with Mud Balance Instruments, High Pressure High Temperature Dynamic Filter Press, Rheometers, and Mixers.

Besides being able to utilize the facilities at the Chemical and Petroleum Engineering Department, the graduate students can have access to other departments' services through the Central Lab.
initiative (http://centrallab.sharif.ir/).

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