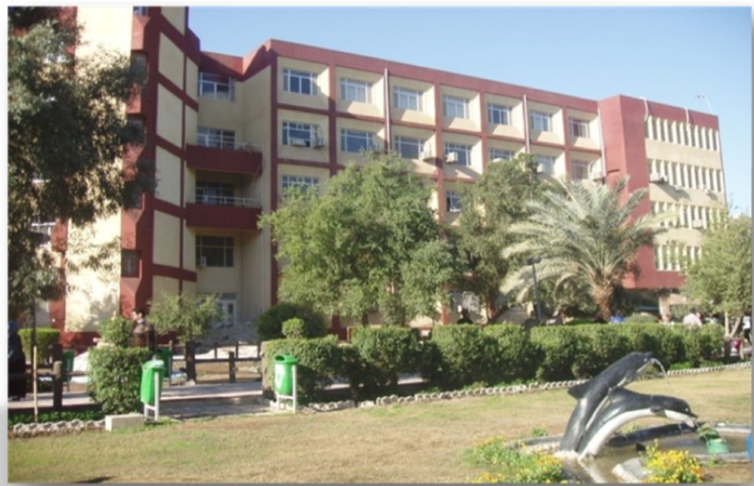
Ministry of Higher Education and Scientific Research

University of Technology

Chemical Engineering Department

B.Sc. Program In Chemical Engineering

OUTLINE OF SYLLABUSES ALLOCATION OF SUBJECTS AND WEEKLY LOAD



(2016 - 2021)

Iraq - Baghdad

Website: http://www.uotechnology.edu.iq/dep-chem-eng/index.htm
E-mail: chemical_eng@uotecnology.edu.iq

1. Introduction:

1.1 Department of Chemical EngineeringHistory

Department of chemical engineering was established in 1975 after the establishment of the University of Technology directly to cover Iraq's growing need for chemical engineers on the basis of industrial development and coverage plans.

Since 1975, the University of Technology has expanded which led to expansion the chemical engineering department. This expansion included the development of the curriculum and establishment of specialized programs of undergraduate studies as well as the accumulated experience of the department has been invested to expand the postgraduate programs of the Diploma, Masters, PhD and increasing the number of students in these programs. The first batch of the students in specialty chemical engineering was graduated in 1979 at a rate of 100 engineers per year in the country.

The department currently offers three programs specialization that are constructed by careful of technical courses to provide specialized knowledge,

1. Chemical Processing Engineering
2. Oil and Gas Refinery Engineering
3. Industrial and Petroleum Pollution Engineering

1.2 Program Educational Objective:

The undergraduate programs in chemical engineering at the university of technology has a strong focus on the integration of engineering science and process design with complementary areas of study in bioprocess engineering, environmental engineering, fuels and energy, materials and oil and gas refining engineering. Undergraduate are prepared for life-long opportunities to participate in diverse sectors of the economy and to assume leadership roles throughout their professional careers.

The graduates of the **Chemical Engineering Programs** are expected to :-

a. To prepared engineers with basic scientific and chemical knowledge.
b. To give the graduates the ability to design the factories which are related to the chemical, petroleum, petrochemical and food industry.
c. To prepare graduates able on operation and management of the chemical factories through concentrating on the theoretical and practical side.
d. To enrich the learning process with the high studies curriculum and the applied scientific researches, also stressing on its role to serve the society and solving its problems.

The educational program of Chemical Processing Engineering program are to produce graduate who:-

1- Able to engage engineering theories with chemical engineering practice to design and analyze process problems taking into account environmental impacts and safety.
2- Effective communication team work and Successful leadership in chemical engineers related careers (industries, water treatment, catalytic reactor).
3- Maintain a lifelong interest in learning for personal and professional developments.

The educational program of Oil and Gas RefineryEngineering program are to produce graduate who:-

1- Achievea successful graduated with a broad knowledge in refinery,petrochemicals , gas industries and other related processes.
2- Integrate academic preparation with oil and gas refinery engineering technology developments
3- Work effectively in a team environment and well communicate with other professional collages

The educational program of Industrial and PetroleumPollution Engineeringare to produce graduate who:-

1. Practice environmental engineering science in a manner that is ethically responsible and consistent with regulatory and social concerns.
2. Have a broad knowledge and critical thinking skills required to analyze industrial and petroleum pollution problems taking into account, safety, and societal impact.
3. Be exposed to current and emerging technologies and have the ability to pursue life-long learning through continuing education or post-graduate education.

1.4 Program Outcomes (ABET):

A program outcome is a skill, understanding, knowledge, or any other characteristic that describes what students are expected to know and are able to do bythe time of graduation as well as during their professional career.

The student outcomes for the Chemical Processing Engineering Program , Oil and Gas Refinery EngineeringProgram and Industrial and Petroleum Pollution Engineering Programat the department of chemical engineering - University of technology are encompass all of the ABET Criterion 3 outcomes (a-k):-

a. an ability to apply knowledge of mathematics, science, and engineering.
b. an ability to design and conduct experiments, as well as to analyze and interpret data.
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability .
d. an ability to function on multi-disciplinary teams.
e. an ability to identify, formulate, and solve engineering problems.
f. an understanding of professional and ethical responsibility.
g. an ability to communicate effectively.
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context .
i. a recognition of the need for and an ability to engage in life-long learning.
j. a knowledge of contemporary issues; and.
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice .

1.5 Programs Curriculum

The curriculum for the **Chemical Engineeringprograms** have been designed by the faculty to produce a graduate broadly acquainted with tools and principles that would be used in the engineering field. While designed to develop the essential knowledge, skills, and abilities needed for professional practice or graduate study.
Also, the curriculum is designed that students may acquire the abilities and skills to be productive in the workplace upon graduation. With several additional years of relevant work experience, our graduates are capable of demonstrating that the program educational objectives have been met. The curriculum and its associated prerequisite structure support the attainment of the student outcomes.

1.5.1.Course Description

The **Chemical Engineering** programs curriculum have been deliberately designed in main three categories of courses:

1.**General Engineering (Engineering Science and Engineering Design)**: These courses are common to most undergraduate engineering students and instruct students in general engineering methods. They provide the introduction to engineering fundamentals and complement the mathematics and basic sciences that precede or are taken concurrently with these courses. The general engineering courses rapidly establish the context of the mathematics and basic sciences that students must take, but have trouble appreciating.

2. **Basic Mathematics and Science**: Students in the undergraduate program are required to complete extensive coursework in Mathematics I and II ,EngineeringMathematicsIand II , Chemistry, Physics ,Engineering Drawing, Computer Programming, AutoCAD , Eng. Statistics, Numerical Analysis, Engineering Mechanics &Strength of Materials, Electrical

Technology,Chemical Reaction Kinetics and Basic Principles of Chem. Eng. The mathematics sequence (five courses, 14 credits plus Engineering Statistics) includes calculus through differential equations and an applied math course in engineering.

3. **General Education**: These are largely university requirements, but also support engineering student outcomes. These courses provide the student with the knowledge and skills required to appreciate the global perspective of engineering and to be prepared in technical communications. They also include courses to broaden the horizons of the student and provide opportunities for service learning.

The courses that comprise the topic requirements are listed in Table (1.1, 1.2,1.3).

The CodeCredit"units" are arrangedas the theory 1 hour per semester = 1 Credit, practical 2-3 hours per semester = 1 Credit, and the tutorial hoursCredit = 0.Prerequisites, if any, are indicated at the course description. These have been established to assure an adequate and uniform background for students in advanced classes.

Course code is presented according to three requirements:

1- University requirement
2- Engineering College requirement
3- Department or Program Requirement

Course code started by capital letters **CES** then latter represent the programand followed bynumber of 3-digits as following:
1st digit represents the class number
2nd digit represents the courserequirement
3rd digit represents the course number

The code for three programs
CES.P…. Chemical Processing Engineering
CES.R…Oil and Gas Refinery Engineering
CES.E…. Industrial and Petroleum Pollution Engineering

Example:-

CES.P.211	Computer Programming II	1st digit represents the 2nd class , 2nd digit represents university requirement , 3rd digit represents the course number
CES.P.431	Unit Operations II	1st digit represents the 4ed class , 2nd digit represents Program requirement , 3rd digit represents the course number

Table (1.1) Courses Comprising the Topic Requirements for **Chemical Processing Engineering**

Categories	Subject	L	P	T	Crds	Total Crds
General Education(Humanities and Social Sciences)	Technical English I	2	0	0	2	6
	Technical English II	2	0	0	2	
	Human Rights	1	0	0	1	
	Democracy	1	0	0	1	
Math & Basic Sciences	Mathematics I	2	0	1	2	35
	Mathematics I I	2	0	1	2	
	Chemical Engineering Principles I	2	0	1	2	
	Chemistry I	2	2	0	3	
	Chemistry I I	2	2	0	3	
	Physics	2	0	0	2	
	Electrical Technology	1	0	1	1	
	Computer Programming I	1	2	0	2	
	AutoCAD	1	2	0	2	
	Engineering Drawing	1	2	0	2	
	Engineering Mechanics &Strength of Materials	2	0	1	2	
	Engineering MathematicsI	2	0	1	2	
	Engineering MathematicsII	2	0	1	2	
	Eng. Statistics	2	2	1	3	
	Numerical Analysis	2	2	1	3	
	Chemical Reaction Kinetics	2	0	0	2	
Engineering	Chemical Engineering Principles II	2	0	1	2	92
	Workshop I	0	6	0	-	
	Workshop I I	0	6	0	-	
	Energy Balance	2	0	1	2	
	Material &Energy Balance	2	0	1	2	
	Fluid FlowI	2	2	1	3	
	Fluid FlowII	2	2	1	3	
	Physical ChemistryI	2	2	0	3	
	Physical ChemistryII	2	0	0	2	
	Computer Programming II	1	2	1	2	
	Computer Programming III	1	2	1	2	
	Materials Eng. I	2	0	1	2	
	Materials Eng. II	2	2	1	3	
	Fuel's Technology	2	2	0	3	
	Renewable Energy	2	0	0	2	
	Thermodynamics I	2	2	1	3	
	Thermodynamics I I	2	0	1	2	
	Applied Mathematics in chemical Engineering	2	0	1	2	
	Mass Transfer	2	2	1	3	
	Unit Operation I	2	0	1	2	
	Reactor Design	2	0	1	2	
	Heat Transfer I	2	0	1	2	
	Heat Transfer II	2	2	1	3	
	Chemical Process IndustriesI	2	0	0	2	
	Chemical Process Industries II	2	3	0	3	
	Bio Chemical Engineering	2	0	0	2	
	Particles& Nanotechnology	2	0	0	2	
	Equipment Design	2	0	1	2	
	Equipment Design Using CAD	2	2	1	3	
	Project I	1	2	0	2	
	Project II	1	2	0	2	
	Unit Operations II	2	2	1	3	
	Unit Operations III	2	0	1	2	
	Process dynamics	2	0	1	2	
	Process Control and Instruments	2	2	1	3	
	Petroleum Refinery Processing	2	0	1	2	
	Petrochemical Industries	2	0	1	2	
	Heterogeneous Reactor &Catalysis	2	0	1	2	
	Industrial Management and Ethics	2	0	0	2	
	Corrosion Eng.	2	0	0	2	
	Environment Eng. & Industrial Safety	2	0	1	2	
	Optimization	2	0	1	2	
Total						133

Table (1.2) Courses Comprising the Topic Requirements for Oil and Gas Refinery Engineering

Categories	Subject	L	P	T	Crds	Total Crds
General Education(Humanities and Social Sciences)	Technical English I	2	0	0	2	6
	Technical English II	2	0	0	2	
	Human Rights	1	0	0	1	
	Democracy	1	0	0	1	
Math & Basic Sciences	Mathematics I	2	0	1	2	35
	Mathematics I I	2	0	1	2	
	Chemical Engineering Principles I	2	0	1	2	
	Chemistry	2	2	0	3	
	Chemistry of Petroleum	2	2	0	3	
	Physics	2	0	0	2	
	Electrical Technology	1	0	1	1	
	Computer Programming I	1	2	0	2	
	AutoCAD	1	2	0	2	
	Engineering Drawing	2	0	1	2	
	Engineering Mechanics &Strength of Materials	2	0	1	2	
	Engineering MathematicsI	2	2	1	3	
	Engineering MathematicsII	2	2	1	3	
	Eng. Statistics	2	0	0	2	
	Numerical Analysis	2	0	1	2	
	Chemical Reaction Kinetics	2	0	1	2	
Engineering	Chemical Engineering Principles II	2	0	1	2	92
	Workshop I	0	6	0	-	
	Workshop I I	0	6	0	-	
	Energy Balance	2	0	1	2	
	Material &Energy Balance	2	0	1	2	
	Fluid FlowI	2	2	1	3	
	Fluid FlowII	2	2	1	3	
	Physical ChemistryI	2	2	0	3	
	Physical ChemistryII	2	0	0	2	
	Computer Programming II	1	2	1	2	
	Computer Programming III	1	2	1	2	
	Materials Eng. I	2	0	1	2	
	Materials Eng. II	2	2	1	3	
	Properties of Petroleum fuels	2	2	0	3	
	Properties of Petroleum Products	2	0	0	2	
	Thermodynamics I	2	2	1	3	
	Thermodynamics I I	2	0	1	2	
	Applied Mathematicsin chemical Engineering	2	0	1	2	
	Mass Transfer	2	2	1	3	
	Unit Operation I	2	0	1	2	
	Reactor Design	2	0	1	2	
	Heat Transfer I	2	0	1	2	
	Heat Transfer II	2	2	1	3	
	Combustion	2	0	0	2	
	Petroleum and Gas Field Processing	2	0	0	2	
	Chemicals from Petroleum	2	0	1	2	
	Petroleum Refinery Eng I	2	2	1	3	
	Equipment Design	2	0	1	2	
	Equipment, Storage Design Using CAD	2	2	1	3	
	Project I	1	2	0	2	
	Project II	1	2	0	2	
	Unit Operations II	2	2	1	3	
	Unit Operations III	2	0	1	2	
	Process dynamics	2	0	1	2	
	Process Control and Instruments for Petroleum Refinery	2	2	1	3	
	Petroleum Refinery Eng II	2	0	1	2	
	Refinery Economics	2	0	0	2	
	Heterogeneous Reactor &Catalysis	2	0	1	2	
	Industrial Management and Ethics	2	0	0	2	
	Corrosion Eng. In Petroleum Refinery	2	0	0	2	
Total						133

Table (1.3) Courses Comprising the Topic Requirements for Industrial and Petroleum Pollution Engineering

Categories	Subject	L	P	T	Crds	Total Crds
General Education(Humanities and Social Sciences)	Technical English I	2	0	0	2	6
	Technical English II	2	0	0	2	
	Human Rights	1	0	0	1	
	Democracy	1	0	0	1	
Math & Basic Sciences	Mathematics **I**	2	0	1	2	35
	Mathematics **II**	2	0	1	2	
	Chemical Engineering Principles **I**	2	0	1	2	
	Chemistry	2	2	0	3	
	Bio- Chemistry	2	2	0	3	
	Electrical Technology	1	0	1	1	
	Physics for Environmental Engineering	2	0	0	2	
	Computer Programming **I**	1	2	0	2	
	AutoCAD	1	2	0	2	
	Engineering Drawing	1	2	0	2	
	Engineering Mechanics &Strength of Materials	2	0	1	2	
	Engineering MathematicsI	2	0	1	2	
	Engineering MathematicsII	2	0	1	2	
	Eng. Statistics	2	2	1	3	
	Numerical Analysis	2	2	1	3	
	Chemical Reaction Kinetics	2	0	0	2	
Engineering	Chemical Engineering Principles II	2	0	1	2	92
	Workshop **I**	0	6	0	-	
	Workshop **II**	0	6	0	-	
	Energy Balance	2	0	1	2	
	Material &Energy Balance	2	0	1	2	
	Fluid FlowI	2	2	1	3	
	Fluid FlowII	2	2	1	3	
	Physical Chemistry and colloid science	2	2	1	3	
	Physical Chemistry	2	0	1	2	
	Computer Programming II	1	2	1	2	
	Computer Programming III	1	2	1	2	
	Materials Eng. I	2	0	1	2	
	Materials Eng. II	2	2	1	3	
	Fuel's Technology	2	2	0	3	
	Fundamentals of Environmental Engineering	2	0	0	2	
	Thermodynamics I	2	2	1	3	
	Thermodynamics I I	2	0	1	2	
	Applied Mathematics in Environmental Engineering	2	0	1	2	
	Mass Transfer	2	2	1	3	
	Unit Operation I	2	0	1	2	
	Biochemical Reaction Eng.	2	0	0	2	
	Heat Transfer I	2	0	1	2	
	Heat Transfer II	2	2	1	3	
	Air Pollution Control Engineering	2	0	0	2	
	Solid Waste Treatment	2	0	0	2	
	Industrial Safety	2	0	0	2	
	Environmental Instrumentation and Analysis	2	2	0	3	
	Equipment Design	2	0	1	2	
	Equipment Design in Environmental Engineering Using CAD	2	2	1	3	
	Project I	1	2	0	2	
	Project II	1	2	0	2	
	Unit Operations II	2	2	1	3	
	Unit Operations III	2	0	1	2	
	Process dynamics	2	0	1	2	
	Process Control and Instruments for Petroleum Pollution	2	2	1	3	
	Water and Wastewater Treatment Engineering I	2	0	1	2	
	Water and Wastewater Treatment Engineering II	1	2	1	2	
	Industrial & Petroleum Pollution Control	2	0	1	2	
	Reactor Design	2	0	0	2	
	Corrosion and degradation	2	0	0	2	
Total						133

1.5.2.Graduation Requirements:

1-University Requirement						
No.	Code Course	Subject	L	P	T	Credits
1	CES.P.111	Technical English I	2	0	0	2
2	CES.P.112	Technical English I I	2	0	0	2
3	CES.P.113	Computer Programming I	1	2	0	2
4	CES.P.114	AutoCAD	1	2	0	2
5	CES.P.115	Human Rights	1	0	0	1
6	CES.P.211	Computer Programming II	1	2	1	2
7	CES.P.212	Computer Programming III	1	2	1	2
8	CES.P.213	Democracy	1	0	0	1

2-Collage Requirement						
No.	Code Course	Subject	L	P	T	Credits
1	CES.P.121	Mathematics I	2	0	1	2
2	CES.P.122	Mathematics II	2	0	1	2
3	CES.P.123	Chemistry I	2	2	0	3
4	CES.P.124	Chemistry II	2	2	0	3
5	CES.P.125	Physics	2	0	0	2
6	CES.P.126	Engineering Mechanics &Strength of Materials	2	0	1	2
7	CES.P.127	Engineering Drawing	1	2	0	2
8	CES.P.128	Electrical Technology	1	0	1	1
9	CES.P.129	Workshop I	0	6	0	-
10	CES.P.1210	Workshop II	0	6	0	-
11	CES.P.221	Engineering Mathematics I	2	0	1	2
12	CES.P.222	Engineering Mathematics II	2	0	1	2
13	CES.P.223	Materials Eng. I	2	0	1	2
14	CES.P.224	Materials Eng. II	2	2	1	3
15	CES.P.225	Eng. Statistics	2	2	1	3
16	CES.P.321	Numerical Analysis	2	2	1	3
17	CES.P.322	Applied Mathematics in chemical Engineering	2	0	1	2
18	CES.P.421	Project I	1	2	0	2
19	CES.P.422	Project II	1	2	0	2
20	CES.P.423	Industrial Management &Ethics	2	0	0	2

3-Program Requirement						
No.	Code Course	Subject	L	P	T	Credits
1	CES.P.131	Chemical Engineering Principles I	2	0	1	2
2	CES.P.132	Chemical Engineering Principles II	2	0	1	2
3	CES.P.231	Energy Balance	2	0	1	2
4	CES.P.232	Material &Energy Balance	2	0	1	2
5	CES.P.233	Fluid FlowI	2	2	1	3
6	CES.P.234	Fluid FlowII	2	2	1	3
7	CES.P.235	Physical ChemistryI	2	2	0	3
8	CES.P.236	Physical ChemistryII	2	2	0	3
9	CES.P.237	Fuel's Technology	2	2	0	3
10	CES.P.238	Renewable Energy	2	0	0	2
11	CES.P.331	Thermodynamics I	2	2	1	3
12	CES.P.332	Thermodynamics II	2	0	1	2
13	CES.P.333	Mass Transfer	2	2	1	3
14	CES.P.334	Unit OperationI	2	0	1	2
15	CES.P.335	Chemical Reaction Kinetics	2	0	0	2
16	CES.P.336	Reactor Design	2	0	1	2
17	CES.P.337	Heat Transfer I	2	0	1	2
18	CES.P.338	Heat TransferII	2	2	1	3
19	CES.P.339	Chemical Process IndustriesI	2	0	0	2
20	CES.P.3310	Chemical Process Industries II	2	3	0	3
21	CES.P.3311	Bio Chemical Engineering	2	0	0	2
22	CES.P.3312	Particles& Nanotechnology	2	0	0	2
23	CES.P.3313	Equipment Design	2	0	1	2
24	CES.P.3314	Equipment Design using CAD	2	2	1	3
25	CES.P.431	Unit Operations II	2	2	1	3
26	CES.P.432	Unit Operations III	2	0	1	2
27	CES.P.433	Process Dynamics	2	0	1	2
28	CES.P.434	Process Control and Instruments	2	2	1	3
29	CES.P.435	Petroleum Refinery Processing	2	0	1	2
30	CES.P.436	Petrochemical Industries	2	0	1	2
31	CES.P.437	Heterogeneous Reactor &Catalysis	2	0	1	2
32	CES.P.438	Environment Eng. & Industrial Safety	2	0	1	2
33	CES.P.439	Corrosion Eng.	2	0	0	2

Universityof Technology
Department of Chemical Engineering

First Year
Chemical Processing Engineering

No.	First Semester					
	Code Course	Subject	L	P	T	Credits
1	CES.P.111	Technical English I	2	0	0	2
2	CES.P.121	Mathematics I	2	0	1	2
3	CES.P.131	Chemical Engineering Principles I	2	0	1	2
4	CES.P.123	Chemistry I	2	2	0	3
5	CES.P.125	Physics	2	0	0	2
6	CES.P.127	Engineering Drawing	1	2	0	2
7	CES.P.113	Computer Programming I	1	2	0	2
8	CES.P.129	Workshop I	0	6	0	-
		Total	12	12	2	**15**
		Hours/week		**26**		

No.	Second Semester					
	Code Course	Subject	L	P	T	Credits
1	CES.P.112	Technical EnglishII	2	0	0	2
2	CES.P.122	Mathematics II	2	0	1	2
3	CES.P.132	Chemical Engineering Principles II	2	0	1	2
4	CES.P.124	Chemistry II	2	2	0	3
5	CES.P.126	Engineering Mechanics &Strength of Materials	2	0	1	2
6	CES.P.114	AutoCAD	1	2	0	2
7	CES.P.128	Electrical Technology	1	0	1	1
8	CES.P.1210	Workshop II	0	6	0	-
9	CES.P.115	Human Rights	1	0	0	1
		Total	13	10	4	15
		Hours/week		**27**		

University of Technology
Department of Chemical Engineering

Second Year
Chemical Processing Engineering

No.	*First Semester*					
	Code Course	Subject	L	P	T	Credits
1	CES.P.221	Engineering Mathematics I	2	0	1	2
2	CES.P.231	Energy Balance	2	0	1	2
3	CES.P.233	Fluid Flow I	2	2	1	3
4	CES.P.235	Physical ChemistryI	2	2	0	3
5	CES.P.211	Computer Programming II	1	2	1	2
6	CES.P.223	Materials Eng. I	2	0	1	2
7	CES.P.237	Fuel's Technology	2	2	0	3
8	CES.P.213	Democracy	1	0	0	1
		Total	14	8	5	18

Second Semester					
Code Course	Subject	L	P	T	Credits
CES.P.222	Engineering Mathematics II	2	0	1	2
CES.P.232	Material &Energy Balance	2	0	1	2
CES.P.234	Fluid FlowII	2	2	1	3
CES.P.236	Physical ChemistryII	2	0	0	2
CES.P.212	Computer Programming III	1	2	1	2
CES.P.224	Materials Eng. II	2	2	1	3
CES.P.238	Renewable Energy	2	0	0	2
CES.P.225	Eng.Statistics	2	2	1	3
	Total	15	8	6	19
	Hours/week		29		

University of Technology
Department of Chemical Engineering

Third Year
Chemical Processing Engineering

No.	***First Semester***					
	Code Course	Subject	L	P	T	Credits
1	CES.P.331	Thermodynamics I	2	2	1	3
2	CES.P.321	Numerical Analysis	2	2	1	3
3	CES.P.333	Mass Transfer	2	2	1	3
4	CES.P.335	Chemical Reaction Kinetics	2	0	0	2
5	CES.P.337	Heat Transfer I	2	0	1	2
6	CES.P.339	Chemical Process Industries I	2	0	0	2
7	CES.P.3311	Bio Chemical Engineering	2	0	0	2
8	CES.P.3313	Equipment Design	2	0	1	2
		Total	16	6	5	19
		Hours/week	**27**			

Second Semester					
Code Course	Subject	L	P	T	Credits
CES.P.332	Thermodynamics I I	2	0	1	2
CES.P.322	Applied Mathematicsin chemical Engineering	2	0	1	2
CES.P.334	Unit Operation I	2	0	1	2
CES.P.336	Reactor Design	2	0	1	2
CES.P.338	Heat TransferII	2	2	1	3
CES.P.3310	Chemical Process Industries II	2	3	0	3
CES.P.3312	Particles& Nanotechnology	2	0	0	2
CES.P.3314	Equipment Design Using CAD	2	2	1	3
	Total	16	7	6	19
	Hours/week	**29**			

Fourth Year
Chemical Processing Engineering

No.	***First Semester***					
	Code Course	Subject	L	P	T	Credits
1	CES.P.421	Project I	1	2	0	2
2	CES.P.431	Unit Operations II	2	2	1	3
3	CES.P.433	Process Dynamics	2	0	1	2
4	CES.P.435	Petroleum Refinery Processing	2	0	1	2
5	CES.P.437	Heterogeneous Reactor &Catalyst	2	0	1	2
6	CES.P.423	Industrial Management &Ethics	2	0	0	2
7	CES.P.438	Environment Eng. & Industrial Safety	2	0	1	2
		Total	13	4	5	15
		Hours/week	**22**			

Second Semester					
Code Course	Subject	L	P	T	Credits
CES.P.422	Project II	1	2	0	2
CES.P.432	Unit Operations I I I	2	0	1	2
CES.P.434	Process Control and Instruments	2	2	1	3
CES.P.436	Petrochemical Industries	2	0	1	2
CES.P.424	Optimization	2	0	1	2
CES.P.439	Corrosion Eng.	2	0	0	2
	Total	11	4	4	**13**
	Hours/week	**19**			

First Year
Oil and Gas Refinery Engineering

No.	*First Semester*					
	Code Course	Subject	L	P	T	Credits
1	CES.R.111	Technical English I	2	0	0	2
2	CES.R.121	Mathematics I	2	0	1	2
3	CES.R.131	Chemical Engineering Principles I	2	0	1	2
4	CES.R.123	Chemistry	2	2	0	3
5	CES.R.125	Physics	2	0	0	2
6	CES.R.127	Engineering Drawing	1	2	0	2
7	CES.R.113	Computer Programming I	1	2	0	2
8	CES.R.129	Workshop I	0	6	0	-
		Total	12	12	2	15
		Hours/week	**26**			

Code Course	Subject	L	P	T	Credits
CES.R.112	Technical English **II**	2	0	0	2
CES.R.122	Mathematics II	2	0	1	2
CES.R.132	Chemical Engineering Principles**II**	2	0	1	2
CES.R.124	Chemistry of Petroleum	2	2	0	3
CES.R.126	Engineering Mechanics &Strength of Materials	2	0	1	2
CES.R.114	AutoCAD	1	2	0	2
CES.R.128	Electrical Technology	1	0	1	1
CES.R.1210	Workshop**II**	0	6	0	-
CES.R.115	Human Rights	1	0	0	1
	Total	13	10	4	15
	Hours/week	**27**			

University of Technology
Department of Chemical Engineering

Second Year
Oil and Gas Refinery Engineering

No.	First Semester					
	Code Course	Subject	L	P	T	Credits
1	CES.R.221	Engineering Mathematics I	2	0	1	2
2	CES.R.231	Energy Balance	2	0	1	2
3	CES.R.233	Fluid Flow I	2	2	1	3
4	CES.R.235	Physical ChemistryI	2	2	0	3
5	CES.R.211	Computer Programming II	1	2	1	2
6	CES.R.223	Materials Eng. I	2	0	1	2
7	CES.R.237	Properties of Petroleum fuels	2	2	0	3
8	CES.R.213	Democracy	1	0	0	1
		Total	14	8	5	18
		Hours/week	27			

Second Semester					
Code Course	Subject	L	P	T	Credits
CES.R.222	Engineering Mathematics II	2	0	1	2
CES.R.232	Material &Energy Balance	2	0	1	2
CES.R.234	Fluid FlowII	2	2	1	3
CES.R.236	Physical ChemistryII	2	0	0	2
CES.R.212	Computer Programming III	1	2	1	2
CES.R.224	Materials Eng. II	2	2	1	3
CES.R.238	Properties of Petroleum Products	2	0	0	2
CES.R.225	Eng. Statistics	2	2	1	3
	Total	15	8	6	19
	Hours/week		29		

Universityof Technology
Department of Chemical Engineering

Third Year
Oil and Gas Refinery Engineering

No.	First Semester					
	Code Course	Subject	L	P	T	Credits
1	CES.R.331	Thermodynamics I	2	2	1	3
2	CES.R.321	Numerical Analysis	2	2	1	3
3	CES.R.333	Mass Transfer	2	2	1	3
4	CES.R.335	Chemical Reaction Kinetics	2	0	0	2
5	CES.R.337	Heat Transfer I	2	0	1	2
6	CES.R.339	Combustion	2	0	0	2
7	CES.R.3311	Chemicals from Petroleum	2	0	1	2
8	CES.R.3313	Equipment Design	2	0	1	2
		Total	16	6	6	19
		Hours/week	**28**			

Second Semester					
Code Course	Subject	L	P	T	Credits
CES.R.332	Thermodynamics I I	2	0	1	2
CES.R.322	Applied Mathematicsin chemical Engineering	2	0	1	2
CES.R.334	Unit Operation I	2	0	1	2
CES.R.336	Reactor Design	2	0	1	2
CES.R.338	Heat TransferII	2	2	1	3
CES.R.3310	Petroleum and Gas Field Processing	2	0	0	2
CES.R.3312	Petroleum Refinery Eng I	2	2	1	3
CES.R.3314	Equipment, Storage Design Using CAD	2	2	1	3
		16	6	7	19
	Hours/week	**29**			

Universityof Technology
Department of Chemical Engineering

Fourth Year
Oil and Gas Refinery Engineering

No.	*First Semester*					
	Code Course	Subject	L	P	T	Credits
1	CES.R.421	Project I	1	2	0	2
2	CES.R.431	Unit Operations II	2	2	1	3
3	CES. R.433	Process Dynamics	2	0	1	2
4	CES. R.435	PetroleumRefinery Eng II	2	0	1	2
5	CES. R.423	Refinery Management and Ethics	2	0	1	2
6	CES. R.437	Heterogeneous Reactor &Catalyst	2	0	1	2
7	CES. R.438	Environment Pollution & Safety in Petroleum Refineries	2	0	1	2
		Total	13	4	6	15
		Hours/week	**23**			

Second Semester					
Code Course	Subject	L	P	T	Credits
CES. R.422	Project II	1	2	0	2
CES. R.432	Unit Operations I I I	2	0	1	2
CES. R.434	Process Control and Instruments for Petroleum Refinery	2	2	1	3
CES. R.436	Petroleum Refinery Economics	2	0	0	2
CES. R.424	Optimization	2	0	1	2
CES. R.439	Corrosion Eng. In Petroleum Refinery	2	0	0	2
	Total	11	4	3	13
	Hours/week	**18**			

Universityof Technology
Department of Chemical Engineering

First Year

Industrial and Petroleum Pollution Engineering

No.	First Semester					
	Code Course	Subject	L	P	T	Credits
1	CES.E.111	Technical English I	2	0	0	2
2	CES.E.121	Mathematics I	2	0	1	2
3	CES.E.131	Chemical Engineering Principles I	2	0	1	2
4	CES.E.123	Chemistry	2	2	0	3
5	CES.E.125	Physics for Environmental Engineering	2	0	0	2
6	CES.E.127	Engineering Drawing	1	2	0	2
7	CES.E.113	Computer Programming I	1	2	0	2
8	CES.E.129	Workshop I	0	6	0	-
		Total	12	12	2	15
		Hours/week	**26**			

Second Semester					
Code Course	Subject	L	P	T	Credits
CES.E.112	Technical English **II**	2	0	0	2
CES.E.122	Mathematics **II**	2	0	1	2
CES.E.132	Chemical Engineering Principles **II**	2	0	1	2
CES.E.124	Bio-Chemistry	2	2	0	3
CES.E.126	Engineering Mechanics &Strength of Materials	2	0	1	2
CES.E.114	AutoCAD	1	2	0	2
CES.E.128	Electrical Technology	1	0	1	1
CES.E.1210	Workshop**II**	0	6	0	-
CES.E.115	Human Rights	1	0	0	1
	Total	13	10	4	15
	Hours/week	**27**			

University of Technology
Department of Chemical Engineering

Second Year

Industrial and Petroleum Pollution Engineering

No.	First Semester					
	Code Course	Subject	L	P	T	Credits
1	CES.E.221	Engineering Mathematics I	2	0	1	2
2	CES.E.231	Energy Balance	2	0	1	2
3	CES.E.233	Fluid Flow I	2	2	1	3
4	CES.E.235	Physical Chemistryand colloid science	2	2	1	3
5	CES.E.211	Computer Programming II	1	2	1	2
6	CES.E.223	Materials Eng.I	2	0	1	2
7	CES.E.237	Fuel's Technology	2	2	0	3
8	CES.E.213	Democracy	1	0	0	1
		Total	14	8	6	18
		Hours/week	**28**			

No.	Second Semester					
	Code Course	Subject	L	P	T	Credits
1	CES.E.222	Engineering Mathematics II	2	0	1	2
2	CES.E.232	Material &Energy Balance	2	0	1	2
3	CES.E.234	Fluid FlowII	2	2	1	3
4	CES.E.236	Physical Chemistry	2	0	1	2
5	CES.E.212	Computer Programming III	1	2	1	2
6	CES.E.224	Materials Eng.II	2	2	1	3
7	CES.E.238	Fundamentals of Environmental Engineering	2	0	0	2
8	CES.E.225	Eng. Statistics	2	2	1	3
		Total	15	8	7	19
		Hours/week	**30**			

University of Technology
Department of Chemical Engineering

Third Year

Industrial and Petroleum Pollution Engineering

No.	First Semester					
	Code Course	Subject	L	P	T	Credits
1	CES.E.331	Thermodynamics I	2	2	1	3
2	CES.E.321	Numerical Analysis	2	2	1	3
3	CES.E.333	Mass Transfer	2	2	1	3
4	CES.E.335	Chemical Reaction Kinetics	2	0	0	2
5	CES.E.337	Heat Transfer I	2	0	0	2
6	CES.E.339	Air Pollution Control Engineering	2	0	0	2
7	CES.E.3311	Industrial Safety	2	0	0	2
8	CES.E.3313	Equipment Design	2	0	1	2
		Total	16	6	4	19
		Hours/week		**26**		

Second Semester					
Code Course	Subject	L	P	T	Credits
CES.E.332	Thermodynamics I I	2	0	1	2
CES.E.322	Applied Mathematicsin Environmental Engineering	2	0	1	2
CES.E.334	Unit Operation I	2	0	1	2
CES.E.336	Biochemical Reaction Eng.	2	0	0	2
CES.E.338	Heat TransferII	2	2	1	3
CES.E.3310	Solid Waste Treatment	2	0	0	2
CES.E.3312	Environmental Instrumentation and Analysis	2	2	0	3
CES.E.3314	Equipment Design in Environmental Engineering Using CAD	2	2	1	3
	Total	16	6	5	19
	Hours/week		**27**		

University of Technology
Department of Chemical Engineering

Fourth Year

Industrial and Petroleum Pollution Engineering

No.	First Semester					
	Code Course	Subject	L	P	T	Credits
1	CES.E.421	Project I	1	2	0	2
2	CES.E.431	Unit Operations II	2	2	1	3
3	CES.E.433	Process Dynamics	2	0	1	2
4	CES.E.435	Water and Wastewater Treatment Engineering I	2	0	1	2
5	CES.E.423	Industrial & Petroleum Pollution Control	2	0	1	2
6	CES.E.437	Catalysis and Catalytic Eng.	2	0	0	2
7	CES.E.438	Environmental Engineering Managementand Ethics	2	0	1	2
		Total	13	4	5	15
		Hours/week	22			

No.	Second Semester					
	Code Course	Subject	L	P	T	Credits
1	CES.E.422	Project II	1	2	0	2
2	CES.P.432	Unit Operations I I I	2	0	1	2
3	CES.E.434	Process Control and Instruments	2	2	1	3
4	CES.E.436	Water and Wastewater Treatment Engineering II	1	2	1	2
5	CES.E.424	Optimization	2	0	1	2
6	CES.E.439	Corrosion and degradation	2	0	0	2
		Total	10	6	4	13
		Hours/week	20			

Universityof Technology
Department of Chemical Engineering

Program	Chemical Processing Engineering					
Course Code	CES.P.111	Credits hr				Units
Course Title	Technical English "I"					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Basic principles in English language (grammars and vocabularies)	2	-	-	2	2

Course Description

Define a specialknowledge and basic concepts in English language, review of (words, terms and phrases commonly utilized)with practical everyday language that students need, the fundamental principles of grammars used in English language such as question and answer, the negative, the tail questions, the singular and plural, the numbers, nouns, pronouns, the verb (to be, to have, and to do), adjectives, regular and irregular verbs, using so & neither, and adverbs, degrees of comparison, conjunctions and interjections, kinds of letter (S) with general exercises. Also, accurate description of the nature of vocabularies and idioms used by the chemical engineers and that the student needs in his/her academic and/or in his/her professional career by means of applying two reading passages focus mainly on studying the chemical engineer work in the factories as well as equipment, tools and materials used.

Course Text

1- The language of chemical engineering in English, Roy V. Hughson (1979), Regents publishing company, Inc.
2- New headway plus (English Course), Liz & John Soars (2014), Oxford University press.

Other support books :-

1- Life Lines workbook (Pre-intermediate and Intermediate level), Tom Hutchinson (2007), Oxford University press.
2- English in a simplified way, Tahir Al- Bayati (1991), Baghdad.

Course Objectives: at the end of the semester the student should be able to :-

The objective of this course focuses on:

1-in-depth understanding and comprehension of the essential grammars in the English language that usually used in writing and/or speaking with choosing the correct way of speaking and/or listening the vocabulary (phonetics and spelling) by the use of common phrases and words.

2-Also, focus on the use of technical English(reading passages) as a heart of chemical engineer work, such as what chemical engineers do, research and development.

3- The development of the student's ability to apply and arrange knowledge in English language and thus become able to employ them appropriately in his/her daily dealing without the complexity.

4- As well, encourage students to develop their capabilities in the field of English language through participation by the training on the use and improve their language.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Academic Comprehension: (Reading passages related to chemical engineering)** The first reading passage (*What chemical engineers do*) (Special terms or definitions, vocabulary practice - the word and its meaning, paragraphs - read and explanation, review, and discussion)	8 hrs
2	**Academic Comprehension: (Reading passages related to chemical engineering)** The second reading passage (*Research and development*). (Special terms or definitions, vocabulary practice - the word and its meaning, paragraphs - read and explanation, review, and discussion).	8 hrs
3	**English Grammar:** A general introduction to the English language and its importance as a means of communication between different peoples around the world, Review of the words, terms and phrases commonly used, Review of the simple grammars in English language, such as question and answer, the negative, the tail questions, the singular and plural, the numbers, telling the date, and telling the time, Nouns, pronouns, the verb to be, the verb to have, the verb to do, Adjectives and regular and irregular verbs, Reading and writing grammars that include short forms and words with two different meanings, The use of so & neither, and adverbs, Degrees of comparison,Conjunctions and interjections with general exercises, Kinds of letter (S) with general exercises.	14 hrs

University of Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P.121**	Credits hr				Units
Course Title	Mathematics I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematic of secondary school	2	-	1	3	2

Course Description

Introduction to functions, limits, Special functions, Derivatives, Chain rule, and their applications. Introduction to integral calculus, Methods of integration.

Course Text

1- Thomas Calculus, by George B.Thomas,Jr,Elevnth Edition Media Upgrade 2008"

Other support books :-

2- Mathematical methods for science students, Second Edition, by G. Stephenson .

3- Advanced Engineering Mathematics, Fifth Edition, by C.Raywylie,LouisC.Barrett .

Mathematical Methods in chemical Engineering, Second Edition, by V.G.Jenson and G.V. Jeffreys .

Course Objectives : at the end of the semester the student should be able to :-

1.To develop an understanding with the concepts of calculus and analytic geometry and the applications of these concepts to the solution of engineering problems.

2.Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

3. Develop a deep understanding of issues related to the basic principles of calculus, and how to solve problems in chemical engineering

Topics Covered (Syllabus)/ Mathematics I

No.	Contents	Duration
1	**Preliminaries** Absolute value, coordinates of the plane, slope of lines, angle of inclination, functions, graph of the functions, domain and range, identifying functions, sum, differences, products and quotients, composite functions, shifting a graph of a function, scaling and reflecting a graph of a function.	6hr
2	**Limits and Continuity** Properties, limits involving infinity, continuity	4hr
3	**Transcendental functions** Logarithmic and exponential functions, trigonometric functions , inverse trigonometric functions, hyperbolic functions, inverse hyperbolic trigonometric functions.	4hr
4	**Derivatives** Definition, chain rule, derivative of inverse trigonometric functions, of hyperbolic functions, of inverse hyperbolic functions, derivative of exponential and logarithmic functions, L, hopitals rule, partial derivative, function of two or more variables.	6hr
5	**Integration** Indefinite integration, integration of inverse trigonometric functions, integration of hyperbolic functions, integration of inverse hyperbolic functions, integration methods; (substitution, by part, trigonometric substitution, partial fraction) .	10hr

Universityof Technology
Department of Chemical Engineering

Program	**Chemical Processing Engineering**					
Course Code	**CES.P.131**	Credits hr				Units
Course Title	**Chemical Engineering Principles I**					
Term	1^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	**1-Basics Maths** **2-Chemistry Basics**	2	-	1	3	2

Course Description

To teach students fundamental knowledge of chemical engineering and application of this knowledge in the solving of material balances of chemical processes. The course will cover concepts ranging from basics such as units and dimensions, stoichiometry to the simultaneous application of material and energy balances with and without occurrence of chemical reaction. Behavior of ideal gases including the procedures for estimation of vapor pressure and heats of vaporization will be extensively covered.

Course Text

1- Himmelblau, D.M. and J.B.Riggs," Basic principles and calculations in chemical engineering",8[ed] , Prentice-Hall Inc., New Jersey,2013. 2- Sikdar, D.C., Chemical process calculations, PHI Learning private ltd., New Delhi, 2013.

Course Objectives: at the end of the semester the student should be able to :-

1-Identify and understand the unit operations involved in a process, draw flowcharts, and develop relationships between process variables.
2-Perform simple degree-of-freedom analysis to identify the number of unknowns relating to mass, mass flow rate, composition and energy, and develop the linearly independent mass and energy balances needed to determine unknown quantities.
3-Apply ideal gas rule and equations of state for real gases.
4-describe various forms of energy, work, enthalpy, specific properties. state functions. and volumetric properties of pure liquids.
5-Convert from SI unit to British unit system and vice versa.
6-Understand the dimension concept,Understand of conversion coefficient concept andUse conversion coefficient.

Topics Covered (Syllabus))/ Course Title

No.	Contents	Duration
1	**General Knowledge of Chemical Engineering** Definition of chemical engineering, Chemical process industries (CPI), Generalized chemicalprocess,Flow sheet and representationof a chemical process (PFD) The difference betweenthe chemist and the chemical engineer.	4 hr
2	**Mathematical , Physical and Chemical Principles** Dimensions, units, symbols and conversion factors , Precision and significant figures., Density and specific gravity, Temperature, Pressure, The mole unit , Composition and concentration. Basis of calculation, Principles and expressions of stoichiometry.	16 hr
3	**Gases and Vapors** Ideal gas law, Ideal gas mixtures, Real gas relationships, Real gas mixtures, Vapor pressure and saturation.	10 hr

University of Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P.123**	Credits hr				Units
Course Title	Chemistry-I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemistry	2	2	0	4	3

Course Description

Fundamentals of atoms, molecules , Quantitative analysis , Environmental , Transition Metal Chemistry and Spectroscopic Techniques which are mostly used in all other chemical engineering courses

Course Text

1- Skoog, D.A., West D.M., Holler F.J., and Crouch S.R. “Fundamentals of analytical chemistry”,8ed edition ,brooks/Cole Cengage Learning. 2004

Other support books :-

2- Harrison, R.M,” Understanding Our Environment An Introduction to Environmental Chemistry and Pollution”,3ed edition, The Royal Society of Chemistry 1999

3- Atkins, P., de Paula, J."Physical Chemistry"8ed edition, W. H. Freeman and Company. 2006

4- Huheey, J. E. "Inorganic Chemistry: Principles of Structure and Reactivity", 4ed edition ,Prentice Hall. 1997

Course Objectives: at the end of the semester the student should be able to:-

1- Students will learn to use the language of chemistry: symbolic representation, nomenclature, and terminology.
2- Students will learn to think about chemical reactions and chemical and physical properties at the particulate level and will be able to visualize and depict the structure of matter and its reactions at the microscopic (atomic and molecular) level.
3- Students will gain a conceptual understanding of and will be able to perform quantitative problem-solving skills in atomic structure, Stoichiometry, chemical equilibria, and electrochemistry.
4- Students will be able to use their knowledge to analyze and construct solutions by instruments
5- Students will learn to use theories of bonding in coordination compounds

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Atoms and Molecules:** Mechanical picture of atomic structure, Derivation of Schrodinger wave equation, Chemical Bonding- Orbital concepts in bonding, V.B. and M.O. theory, M.O. diagrams, Intermolecular interactions.	3hr
2	**Quantitative analysis:** Atomic weight , Molecular formula, Chemical equations, Mole concept, Chemical, equilibrium, equilibrium constants, Preparation and properties, Molarity, Normality, ppm, pH, pOH, Buffers, Solubility Ksp, Gravimetric Analysis, Precipitation reaction, Potentiometric Titration, Complex titration.	6hr
3	**Electrochemistry:** Arrhenius theory of electrolytic dissociation, Transport number, Kohlrausch's law, Solubility product, Redox reaction, Electrochemical and concentration cells	4hr
4	**Photochemistry and Spectroscopic Techniques:** Photoexcitation of organic molecules, Jablonski diagram, Laws of photochemistry and quantum yield, Some examples of photochemical reactions, Chemistry of vision and other applications of photochemistry. General introduction to UV, IR, NMR and Chromatography	7hr
5	**Transition Metal Chemistry:** Structure of coordination compounds corresponding to coordination number up to 6, Types of ligands, Isomerism [geometrical, optical, ionization, linkage and coordination], Theories of bonding in coordination compounds-crystal field theory, Valence bond theory, Chelation	6hr
6	**Environmental:** Introduction, Water, air, soil pollution	4hr

Practical: (Chem. lab.)

No.	Experiment Name
1.	Introduction and chemical safety basic rules
2.	Equipment and how to use it
3.	Preparation of standard solution (primary and secondary)
4.	Direct Titration
5.	Quantitative determination of a carbonate and hydroxide in mixture
6.	Back titration
7.	Titration Curves
8.	Determination of Chloride Ions in Water
9.	Standardization of $KMnO_4$ and the determination of ferrous sulfate (Redox reaction)
10.	Determination of Hardness of Water
11.	Paper Chromatography
12.	Qualitative analysis silver group

University of Technology
Department of Chemical Engineering

Program	Chemical Processing Engineering					
Course Code	CES.P.125	Credits hr				Units
Course Title	Physics					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physics	2	-	-	2	2

Course Description

Mechanics, Temperature, Heat, Light (Reflection, Refraction, Wave, Nature of light, Dispersion, Colours)

Course Text

- Handbook of Nanostructured Materials and Nanotechnology, San Diego Academic Press, 2000
- Particle Technology Handbook

Course Objectives : at the end of the semester the student should be able to understanding :-

1- Basic physical principle
2- How physical problems can be solved
3- How the scientific method contributes to physics ,and how physics related to every body life
4- Measured physical quantities in appropriate SI unit
5- Work safety in a laboratory and follow the instruction relation between physics and technology

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Mechanics:** Motion, Forces, Energy	5hr
2	**Temperature:** Concept of temperature, Thermometric properties, thermometers	5hr
3	**Heat:** Quantity, Heat transfer	5hr
4	**Waves, Vibration and sound**	5hr
5	**Light** (Reflection, Refraction, Wave, Nature of light, Diffraction and interference, Dispersion, Colours, Electromagnetic spacing.	5hr
6	**Modern Physics**(electron, thermionic , emission, photo electric emission, X-ray, the nucleus, Structure of nucleus and atom, Radioactivity, Nuclear energy, Ionizing radiation and health hazards.	5hr

Program	Chemical Processing Engineering					
Course Code	CES.P.127	Credits hr				Units
Course Title	Engineering drawing					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	None	1	2	---	3	2

Course Description

Introduction inEngineering drawing, engineering drawing applications, engineeringprocess , analysis model to view and study the full and half Sections , conclusion of the third projection ,Draw isometric and Oblique.

Course Text

1. لرسم الهندسي،تاليف (عبد الرسول الخفاف) الطبعة الثانية،١٩٩٣
2. R.P Hoelscher and C.H Springer "Engineering Drawing and Geometry ".2nd edition

Course Objectives: at the end of the semester the student should be able to :-

1.The students can be use Tools Drawing in draw and analyze geometric shapes
2.Enable students to draw devices, equipment & PFD in chemical engineering.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	Introduction	3hr
2	Planning of Drawing paper	3hr
3	Types of line	3hr
4	Engineering operation	3hr
5	Projection Drawing	3hr
6	First angle projection	3hr
7	Third angle projection	3hr
8	Full section	3hr
9	Half section	3hr
10	The finding of third view	3hr
11	Application Example	3hr
12	Pictorial Drawing (Isometric and Oblique)	3hr
13	Application Example	3hr
14	Dimensions	3hr
15	Examples of chemicalengineering drawing and exercises.	3hr

University of Technology
Department of Chemical Engineering

Program	***Chemical Process Engineering***					
Course Code	**CES.P.113**	Credits hr				Units
Course Title	**Computer Programming(I)**					
Term	1stSemester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	None	1	2	---	3	2

Course Description

This course provides an overview of the operating system Windows 10 and the program of Microsoft Office 2010 and the Visual Basic and includes the operation of Visual Basic and describe the elements of the design environment and user interface design and the difference between the project and the program and introduce students to the philosophy of programming using visual Basic and a programming process events Event-Driven Programming and programming objects Object Oriented Programming and gives the student an introduction to object-oriented programming and introduce students to the fundamental differences between the concept of the programming language BASIC visual and languages BASIC traditional and explain the steps to design and program planning.

Course Text

1-“ Visual Basic: Crash Course - The Ultimate Beginner's Course to Learning Visual Basic Programming ”, 3rd Edition, A. Tannenbaum, Prentice-Hall, 1996.
2-"Beginning Visual Basic " by Bryan Newsome Wrox, USL Press , | December 2003 | ISBN-10: 1119092116 |
3- “Course Notes for Learn Visual Basic 6.0 ”, 4th Edition, F. Halsall, Addison-Wesley, 2000.

Course Objectives : at the end of the semester the student should be able to :-

1. start Microsoft Office applications and work with the Microsoft Office interface Create documents in Microsoft Word. Create workbooks in Microsoft Excel.Create presentations in Microsoft PowerPoint
2. Define and modify the the properties and methods associated with an object
3. Load, modify, and save changes made to forms and projects in the Visual Basic environment
4. Define and implement form objects including data arrays, control arrays, text boxes, message boxes, dialog boxes, labels, controls, menus, frames, picture boxes, pull-down menus, and combo boxes

Topics Covered (Syllabus)/ Computer Programming(I)

No.	Contents	Duration
1	**Windows 10 andMicrosoft Office**: the operating system Windows 10 and MicrosoftOffice word, Microsoft excel, Microsoft power point.	3hr
2	**Introduction to Visual Basic Programming :** Menu bar, Tools bar, Project explorer, Tool box, Properties windows, Form, Code, Controls, Command Buttons, Label, Textbox, Pointers, Picture box, frame, Naming Controls, Properties for controls: Height, Width, Left, Top, Font, Forecolor, Backcolor , Name, Caption, Text, and Visible, Events, Saving Visual Basic Project, Examples, Chemical Engineering Applications.	2hr
3	**Mathematics :** Arithmetic Operations: +, , *, /, \, mod, ^. (Using Simple Example for each Operation), Logical Operations. AND, OR, NOT. And the Truth Table for each Operation, (Using Simple Example for each Operation), Relational Operation: >, <, >=, <=, <>, =, String Concatenation (&), Operation Precedence. For all arithmetic, logical, relational operators, Print statement and Formatting. Illustrate (colon, comma, and semicolon), Examples: Chemical Engineering Applications	1hr
4	**Built inFunctions**: Builtin math functions, Abs(x), Int(x), Rnd(x), sgn(x), sqr(x), str(x), val(x), round(x,n),CInt(x),Fix(x),String Functions, InputBox, MsgBox, Examples: Chemical Engineering Applications.	1hr
5	**Selection Structure**: Single Selection: If/Then structure, Double Selection: If/Then/Else structure, Nested If/Then/Else structure, Select Case Multiple Selection Structure, Examples: Chemical Engineering Applications.	2hr
6	**Reputation Structure**: For ... Next Loop, While ... Wend, Do .... While ... Loop, Do ... Loop Until, Exit Do, Exit For Examples: Chemical Engineering Applications.	1hrs

7	**Variables**: Data Types: Boolean, Integer, Long, Single, Double, String, Valid Naming of Variables, Initial Value for each Type of the Variables (Initial Value for each Data Type), Size of each Variable Type in Bytes, How to Declare Variables. (Dim statement), Using: Dim variable name As Data type, Using Suffix: Integer, Long, Single, Double, String, Constant Variable. Examples: Chemical Engineering Applications.	**2hrs**
8	**Arrays**: Introduction: Defining Arrays, Array Declaration Statement, Assigning Values for Arrays (i.e.filling array's element value either by loop or by direct assignment statement), Re Dim Statement, Using Loops with Arrays. (i.e. writing an application on array using loops),Two Dimensional Arrays, Operations on Arrays, Fill Array Elements with Random Numbers using and Function, Sorting, Searching. (i.e. Linear search), Swapping Two Elements. Examples: Chemical Engineering Applications.	**2hr**
9	**Graphics in Visual Basic**: Graphics control, Picture box, Image box, Coordinate system, Pixel, Graphics methods (Line,Circle, pset) Examples: Chemical Engineering Applications.	**1hrs**

University of Technology
Department of Chemical Engineering

Program	***Chemical Processing Engineering***					
Course Code	**CES.P.112**	Credits hr				Units
Course Title	Technical English "II"					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Basic principles in English language (grammars and vocabularies)	2	-	-	2	2

Course Description

Define a specialknowledge and basic concepts in English language, review of phonetics and spellingwith words and sounds that need attention in understanding the meaning and pronunciation, the fundamental principles of grammars utilized in English language such as the use of the prefixes (un, im, in, and dis), the use of since & for, the definite and indefinite articles. As well as simple, continuous and perfect tenses (present, past, and future), the punctuation, active voice and passive voice, direct and indirect speech, finite and non-finite verbs, analyses and kinds of sentences. Also, accurate description of the nature of vocabularies and idioms used by the chemical engineers and that the student needs in his/her academic and/or in his/her professional career by means of applying two reading passages focus mainly on studying the chemical engineer work in the factories as well as equipment, tools and materials used.

Course Text

1- The language of chemical engineering in English, Roy V. Hughson (1979), Regents publishing company, Inc.
2- New headway plus (English Course), Liz & John Soars (2014), Oxford University press.

Other support books :-

1- Life Lines workbook (Pre-intermediate and Intermediate level), Tom Hutchinson (2007), Oxford University press.
2- English in a simplified way, Tahir Al- Bayati (1991), Baghdad.

Course Objectives: at the end of the semester the student should be able to :-

The objective of this course focuses on:

1- Study and conception of the advance grammars in the English language that usually employed in academic writing and also explain the use of grammars correctlyin speaking and/or listening the vocabulary (phonetics and spelling) via increasing the ability to rapid recognize the words that have two different meanings depending on their presence in the context of speech

2- Accurate description of the nature of vocabulary and idioms used by the chemical engineers in dealing with their respective fields in addition to the vocabulary of daily dealing. Also, focus on the use of reading passages such as process design and plant operation, which are related to student competence and his/her profession as an engineer in the chemical companies.

3- Enhancement of student's ability by applying modern information in English language about the characteristics of the chemical engineer job and then try to the simulation that in writing the scientific report, expression, and formulate of simple sentences and complex ones without the difficulty.

4- Finally, promote the qualifications of students in the field of English language by training on the use and the progress of their language in order to allow them to easily use it in his/her future academic study in chemical engineering.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Academic Comprehension: (Reading passages related to chemical engineering):** The third reading passage (*Process design*) (Special terms or definitions, vocabulary practice - the word and its meaning, paragraphs - read and explanation, review, and discussion)	8 hrs
2	**Academic Comprehension: (Reading passages related to chemical engineering):** The fourth reading passage (*Plant operation*). (Special terms or definitions, vocabulary practice - the word and its meaning, paragraphs - read and explanation, review, and discussion).	8 hrs
3	**English Grammar:** Phonetics & Spelling (consonant sounds & vowel sounds), Words and sounds that need attention in understanding the meaning and pronunciation, as well as the use of the prefixes (un, im, in, and dis),The use of since & for, as well as the definite and indefinite articles,Punctuation (such as the use of the capital letter, the question mark, and the comma….etc), Simple tenses (present, past, and future), Continuous and perfect tenses (present, past, and future), Active voice and passive voice,Direct and indirect speech, Finite and non-finite verbs, Analyses of sentences, and kinds of sentences (either according to form or to number of statements).	14 hrs

Universityof Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P.122**	Credits hr				Units
Course Title	Mathematics II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I	2	-	1	3	2

Course Description

Definite integral and applications, Polar coordinates, Vector analysis, Determinant and matrices

Course Text

1- Thomas Calculus, by George B. Thomas, Jr, Elevnth Edition Media Upgrade 2008"

Other support books :-

2- Mathematical methods for science students, Second Edition, by G. Stephenson,
3- Advanced Engineering Mathematics, Fifth Edition, by C. Raywylie, Louis C. Barrett
4- Mathematical Methods in chemical Engineering, Second Edition, by V. G. Jenson and G.V. Jeffreys

Course Objectives : at the end of the semester the student should be able to :-

1. To understand these concepts of applications and how to evaluate volumes, surface area , and to understand analytic geometry.
2. Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.
3. Develop a deep understanding of issues related to the basic principles of polar coordinates, vector analysis, determinants, and how to solve problems in chemical engineering

Topics Covered (Syllabus)/ Mathematics II

1	**Definite integration and Applications:** Double integrals, reverse order of integration, length of curves, surface area, volumes	**10hr**
2	**Polar Coordinates:** Definition, Cartesian versus polar coordinates, graphing in polar coordinate.	**4hr**
3	**Vector Analysis:** Definitions, properties, vector in space, scalar and cross product of vector, product of three vectors.	**8hr**
4	**Determinates and Matrices :** Definition, determinate evaluation, solution of system of linear equation by matrix; (Inverse of matrix, Gauss elimination), Rank of matrix, Eigen value and Eigen vectors.	**8hr**

University of Technology
Department of Chemical Engineering

Program	**Chemical Processing Engineering**					
Course Code	**CES.P.132**	Credits hr				Units
Course Title	**Chemical Engineering Principles II**					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	**1-Basics Maths** **2-Chemistry Basics** **3.Chemical Engineering Principles I**	2	-	1	3	2

Course Description

The objective of this course is to present an introduction to chemical engineering calculations, establish mathematical methodologies for the computation of material balances and to present an overview of industrial chemical processes. It is prerequisite for several junior-level courses in the curriculum, including courses in process fluid dynamics, heat transfer and phase equilibrium.

The course reviews the fundamentals of chemistry and physics as they pertain to chemical problems and applies mathematics to the development of time-dependent equations to describe materials flow through a process. Examples of the processes studied include stoichiometry in combustion and other reactions, materials flow with recycle streams.

Course Text

1- Himmelblau, D.M. and J.B.Riggs," Basic principles and calculations in chemical engineering",8^{ed} , Prentice-Hall Inc., New Jersey,2013.

2- Sikdar, D.C., Chemical process calculations, PHI Learning private ltd., New Delhi, 2013.

Course Objectives: at the end of the semester the student should be able to :-

1-Create representative process flow diagrams and use them to organize systems of equations.
2-Formulate material balances to solve for compositions and flow rates of process streams.
3-Incorporate single and multiple reactions into unit operations within chemical processes.
4-Understanding of the degrees of freedom analysis and its significance.
5-Ability to make material balances on unit operations and processes.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration hr/weeks
1	**Concepts of material balance.**	2 hr
2	**Systematic steps of solving material balance problems.**	2 hr
3	**Material balances without chemical reactions.**	4 hr
4	**Material balances with chemical reactions.**	6 hr
5	**Material balances on combustion processes.**	6 hr
6	**Material balances involving recycle.**	6 hr
7	**Bypass and purge streams.**	4 hr

Universityof Technology
Department of Chemical Engineering

Program	Chemical Processing Engineering					
Course Code	CES.P.124	Credits hr				Units
Course Title	Chemistry II					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemistry	2	2	0	4	3

Course Description

An Introduction to Organic Compounds, preparation, reaction including carbohydrate, polymers and dyes

Course Text

1- Ghatak,k.l,” Textbook of organic chemistry and problem analysis”,PHL Learning.2014.

Other support books :-

2- Morrison, Thornton R.; Boyd, Neilson,R."Organic Chemistry". 6th edition, J. Chem. Educ. 1992

3- Bruice,P.Y. ,J.M “Organic chemistry”,7th edition ,. Books a la Carte Edition, 2014

Course Objectives: at the end of the semester the student should be able to :-

1- Students will learn the basic concepts of organic chemistry
2- understanding the concepts of organic reactions for analysis of unit processes
3- Students will learn the polymeric chemistry
4- Students will learn the basic concepts of dyes
5- Students will learn the basic concepts of carbohydrates

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**An Introduction to Organic Compounds:** Nomenclature, Physical Properties, and Representation of Structure	6hr
2	**Preparation and Reactions:** Alkanes, Alkenes, Dienes, Alkynes, aromatic hydrocarbon	6hr
3	**Preparation and Reactions:** alkanes derivative (RX, ROH, RCOOH, RCOH, RCOR,….etc.Organometalic	9hr
4	**Biomolecules :** Carbohydrates, Amino acid, Vitamins	2hr
5	**Chemistry of polymeric materials:** Polymerization, methods of polymerization - bulk, solution, suspension and emulsion polymerization. Glass transition temperature (Tg), Conducting polymers	4hr

6	**Dyes :** Classification , nomenclature, synthesis	3hr

Practical: (Chem. lab.)

No.	Experiment Name
1.	Boiling point determination
2.	Melting point determination
3.	Simple Distillation
4.	Preparation of aspirin
5.	Preparation of ester
6.	Identification of functional groups-I
7.	Identification of functional groups-II
8.	Saponification reaction
9.	Dyes& Colorants
10.	Polymerization of vinyl monomer

Program	*Chemical ProcessingEngineering*					
Course Code	CES.P.126	Credits hr				Units
Course Title	Engineering Mechanic and Strength of Materials					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physics	2	-	1	3	2

Course Description

Principles of statics, Resultant of a force system, Equilibrium of a force system, Moment of a force, Friction, Centroid and center of gravity, Moment of inertia, Analysis of internal force, Strain, Stress-strain diagram, Hook's law, Shearing deformation, Poisson's ratio, Volumetric strain, Thin-walled cylinders, Thermal stress, Shear and bending moment in beam.

Course Text

1- Engineering Mechanic-Statics and Dynamics volume 1; Higdon, A. and Stiles, W.B., 3ed Edition, Prentice-Hall, India, (1968).
2- Strength of Materials; Singer, F.L. and Pytel, A., 3ed Edition, Harper and Row, London, (1980).

Course Objectives : at the end of the semester the student should be able to :-

1. Designed to study the effects of external forces on a group of solid objects.
2. Resistance of materials and their applications in chemical engineering.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Friction:** Theory of Friction, friction on an inclined plane	3 hr
2	**Centroid and Center of Gravity**	3 hr
3	**Moment of Inertia (Second moment of the axis):** Polar moment of inertia, Transfer formula for moment of inertia	3 hr
4	**Introduction Force in Rigid Bodies:** Definitions of Stress and Strain, Stress-Strain Diagrams	2 hr
5	**Proportional Limits:** Elastic limit, Stiffness elasticity, Plasticity, Hardness and working stress.	4 hr

6	**Hook 's Law**	3 hr
7	**Poisson Ratio, Composite Stresses:** Volumetric Stress, Bulk Modulus, Thin Walled Cylinders	4 hr
8	**Thermal Stress**	4 hr
9	**Shear and Bending Moments in Beam**	4 hr

University of Technology
Department of Chemical Engineering

Program	*Chemical ProcessingEngineering*					
Course Code	**CES.P.114**	Credits hr				Units
Course Title	AutoCAD					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Computer Programming I	1	2	---	3	2

Course Description

introduction , AutoCAD program components and how to use it , knowing AutoCAD commands like point , lines, Rectangle, Polygon, Poly line , Arc with their option to draw 2D engineering drawing, learning Hatching, text, mtext , Dimension creation and editing , Modify command and Layers for 2D engineering drawing.
3D drawing methods: Surfaces, Solids and Composite solid.
Render, background, lights for drawing.

Course Text

1-Terry T. Wohler, applying AutoCAD 2002 fundamentals, Glencoe /McGraw-Hill
2-James A. Leach, AutoCAD 2002 Companion Essentials of AutoCAD plus Solid modeling ,2003 , McGraw-Hill, Boston
3- Terry T. Wohler, applying AutoCAD a step by step approach for AutoCAD release 13, 1996, Glencoe McGraw-Hill
4- James A. Leach, AutoCAD 14 Companion Essentials of AutoCAD plus Solid modeling ,1999,WCB / McGraw-Hill, Boston
Other support books :-
David Byrnes and Mark Middlebrook, AutoCAD® 2007 For Dummies , Wiley Publishing, Inc.

Course Objectives : at the end of the semester the student should be able to :-

1- The students can use AutoCAD program and produce 2D and 3D chemical engineering drawings.
2- Enable students to draw designed equipment in AutoCAD program.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	Introduction, Drawing program screen components, Setting drawing limits, Units, Grid and snap, Zoom, Orthogonal, Osnap, UCS. 2D drafting: Cartesian system coordinate, AutoCAD drawing command: Point, Line: line, multi-line, construction line, drawing line by using: absolute coordinate, polar coordinate, relative coordinate, Example	**3hr**
2	Continuous line drawing: Rectangle, Polygon, Poly line with their options, Example	**3hr**
3	Curves drawing: Arc, Circle, point –SP line, Ellipse with their options,	**3hr**

	Example.	
4	Hatching, text command: text, mtext, Example	**3hr**
5	Dimension creation and editing, Example	**3hr**
6	Region, block, insert block, Example	**3hr**
7	Modify command: 1-coy tool: copy, mirror, offset, array. 2- Erase tool: erase, trim, break .3-move tool: move, rotate .4- Change tool: stretch, Lengthen, Extend, Scale, Chamfer, and Fillet .5-Explode, Example	**3hr**
8	Layers: Create a new layer ,rename layer, active layer, run and extinguishing layers ,Freezing layers, Lock and open layers, the color ,Font type ,Line width, Example	**3hr**
9	3D drawing methods: Surfaces drawing: box, Wedge, Pyramid, Dome, Sphere, Cone, Torus, Dish, Example	**3hr**
10	3D drawing methods: Solids: box, Cylinder, Sphere, Cone, Wedge, Torus, Example	**3hr**
11	Composite solid: Union, Subtraction, Intersection, Example	**3hr**
12	render, background, lights, Example	**3hr**
13	Examples of chemicalengineering drawing and exercises.	**3hr**
14	Examples of chemicalengineering drawing and exercises.	**3hr**
15	Examples of chemicalengineering drawing and exercises.	**3hr**

Universityof Technology
Department of Chemical Engineering

Program	Chemical Processing Engineering					
Course Code	CES.P.128	Credits hr				Units
Course Title	Electrical Technology					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physics	1	-	1	2	1

Course Description

The course cover the basic electric engineering with details and examples in direct current circuits, network calculations, standards and conventions, Ohms law, Resistance and resistivity electromagnetism ,generator ,alternating current,, transformer ,motors and instrumentation ,

Course Text

1- John Bird," Electrical Circuit Theory and Technology",2nd edition, Elsevier Science, 2003
2- John Bird," Electrical and Electronic Principle and Technology", 2nd edition, 2003
3- Giorgio Rizzoni, "Fundamentals of electrical engineering", McGraw-Hill, 2009
4- Alan L. Sheldrake, "Handbook of Electrical Engineering", John Wiley & Sons Ltd,, 2003

Course Objectives : at the end of the semester the student should be able to :-

1- Understanding of the fundamentals principle of electrical technology.
2- Student should be know the basic electric principle, basic D.C. and A.C. circuit, D.C. and A.C. motors, transformer and should be able to work safety in laboratory as in field and follow the instruction relation between electrical and technology and chemical engineering.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction To Dc Circuit:** Material use in electric component, ohms law, temperature Coefficient, Review of Kirchhoff's Laws Series Parallel circuit, equivalent resistance, star / delta Conversion, Node And Mesh Analysis	4hr
2	**Dc And Ac Generator And Motor:** Principle of DC generator and motor, Transformer, Introduction motor(Single phase), Magnetic and electromagnetism, Natural magnetic field, magnetic flux, Feil	2hr
3	Electrochemical,	5hr

4	**Ac Circuit:** Concepts of AC circuit, rms value Average value, from and peak factors, real and Reactive power – power factor.	2hr
5	**Polyphases Circuit :** Introduction to three phase circuits, Introduction to three phase system , Phase and line parameter – relations ,Power measurement , Voltmeter and ammeter method	2hr

Universityof Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P.115**	Credits hr				Units
Course Title	Human rights					
Term	2st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	none	1	-	-	1	1

Course Description

The study of the human rights concept and history and its relationship to religions and the extent of his relationship with globalization and contemporary currents.

Course Text

1-Human rights, development, contents Dr.Riyad Aziz Hadi
٢-مبادئ و قواعد عامة في حقوق الأنسان د. صلاح حسن مطرود
٣- حقوق الأنسان بين الأسلامي و العالمي د. محمد علي الشجيري
٤- حقوق الأنسان و الديمقراطية د. ماهر صالح الجبورى
٥- مشكلة الحرية د. زكريا أبراهيم

Course Objectives : at the end of the semester the student should be able to :-

1-Rooting human rights values in the local culture.
2-leading to the development of the concept.
3-principles of human rights in general.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	Psychological construction and its relationship with human right	1hr
2	Contemporary Arabs currents ,its position on human right	1hr
3	Secular :the early stage of its development ,disadvantages, her features	1hr
4	How can you balance between civil right and social	1hr
5	Capitalist and socialist society with human rights	1hr
6	Close society and an opened society	1hr
7	Theory of the social contract	1hr
8	Thomas Hughes ,Jan-jack Rousseau ,Volter ,AuxtComte,Max WeberMontesquieu	1hr
9	Relationship of right to democracy	1hr
10	Relationship of right to urbanization	1hr
11	Relationship of right with globalization	1hr
12	Human rights between rejection and acceptance	1hr
13	How can rooting the values of human rights in Arab culture and in the great cultures	1hr
14	The relationship between the political culture and ideological	1hr
15	Ideological religion	1hr

Universityof Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P.221**	Credits hr				Units
Course Title	Engineering MathematicsI					
Term	1^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I, Mathematics II	2	-	1	3	2

Course Description

This course describes the evaluation of double, triple integrals, area and volume.Provide knowledge and skills in writing a periodic function in its Fourier series form and on their applications. Develop skills for applying this course in the future on various chemical engineering applications.

Course Text

1- **Text book:**
   1. Higher Engineering Mathematics by Dr.B.S.Grewal, Khanna Publishers, 40^{th} Edition, 2007.

2- **Reference book**:
   1. Advanced Engineering Mathematics by Erwin Kreyszig, 8^{th} edition, 2007.

Course Objectives: at the end of the semester the student should be able to:-

1- Able to evaluate double, triple integrals and the area, volume by double & triple integrals respectively.
2- 2. Understand the concept of Fourier-series representation of periodic functions and their applications.

Topics Covered (Syllabus)/ Engineering MathematicsI

No.	Contents	Duration
1	**Multiple Integrals:** Double Integral, Area, Volume, Double Integral in polar coordinates, Triple Integral in rectangular coordinates, physical application of double and triple integration.	12hr
2	**Function and definite Integrals:** The error function, the gamma function, the beta function, factorial function.	6hr
3	**Infinite Sequences and Series:** Sequences, Convergence, Geometric series, nth partial sum, tests of convergence, alternating series, power and Taylor's series.	6hr
4	**Fourier series:** Periodic functions, Fourier series, Even and odd functions, Half range expansion.	6hr

Universityof Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P.231**	Credits hr				Units
Course Title	Energy Balance					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemical Engineering principle I & II	2	-	1	3	2

Course Description

The aims of the course provide a deep knowledge , wide scope and improved understanding of the mechanisms in heat balance for closed and open system and for steady and unsteady state. The students should gain knowledge to apply the energy balance in engineering problems.

Course Text

1. D.M.Himmelblau and J.B.Riggs ,Basic Principles and Calculations in Chemical Engineering ,7th Edition , 2004 .

Other support books :-

2. R.M.Felder and R.W.Rousseau , Elementary Principles of Chemical Processes ,3rd Edition ,2005.

Course Objectives : at the end of the semester the student should be able to :-

1. The terminology associated with energy balances , concepts , and units .
2. Introduction to energy balances for processes without reaction .
3. Calculation of enthalpy changes .
4. Energy balances : how to account for chemical reaction .

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Energy : Terminology , Concept , and units:** The terminology associated with energy balances , Types of energy : Work , Heat , Kinetic energy , Potential energy , Internal energy , Enthalpy .	4hr
2	**Introduction to Energy Balances for Processes without Reaction:** The concept of the conservation of energy , Energy balances for closed , unsteady-state systems , Energy balances for closed , steady-state systems , Energy balances for open , unsteady-state systems , Energy balances for open, steady-state systems .	6hr
3	**Calculation of Enthalpy Changes:** Phase transitions, Equation to estimate heat of vaporization , Heat	6hr

	capacity equations , Tables and charts to retrieve enthalpy values .	
4	**Application of Energy Balances in the Absence of Chemical Reaction:** Simplifications of the general energy balance , The strategy for solving energy balance problems , Applications of the energy balance to closed systems , Applications of the energy balance to open systems**.**	8hr
5	**Energy Balances : How to Account for Chemical Reaction:** The standard heat of formation , The heat of reaction , Merging the heat of formation with the sensible heat or a compound in making an energy balance , The heat of combustion .	6hr

University of Technology
Department of Chemical Engineering

Program	***Chemical Processing Engineering***					
Course Code	**CES.P.233**	Credits hr				Units
Course Title	Fluid Flow I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Principles of Chem. Eng. & Math	2	2	1	5	3

Course Description

Define fluid properties, stresses in fluids at rest and in motion and types of fluid flows, application of Newton law of viscosity and dimensional analysis methods…

Derive and define the governing equations of fluid flow: continuity, energy and momentum equations from principles of mass, energy and momentum conservation and define the terms of Bernoulli's equation, include major and minor losses and required energy for flow…

Define the types of fluid pumping devices and its characteristics and how to select the appropriate type and size for fluid pumping…

Define the types on Non-Newtonian and two-phase fluids flow and their pressures drop calculations…

Course Text

1- Coulson, J.M. , Richardson, J.F., Backhurst, J.R. and Harker, J.H., “Chemical Engineering” Volume(1) 6th Ed., Butterworth-Heinemann, 1999
2- Holland, F.A. and Bragg, R., “Fluid Flow for Chemical Engineers”, 2nd Ed., Edward Arnold, 1995.

Other support books :-

3- DARBY. R. , Dekker M. “Chemical Engineering Fluid Mechanics”, 2nd Ed. Marcell Dekker, 2001
4- Wilkes J. O.,“Fluid Mechanics for Chemical Engineers”, 2nd Ed. Prentice Hall PTR, 1999.
5- De Nevers, N. “Fluid Mechanics for Chemical Engineers” , 2nd Ed. McGraw-Hill 1991.
6- McCabe, W. L., Smith, J. and Harriot, P., "Unit Operations of Chemical Engineering", 6th Ed., McGraw – Hill, International Edition, 2001.
7- Christi J. Geankoplis "Transport Processes and Unit Operations" 3rd Ed. Printice Hall International Editions, 1993.

Course Objectives : at the end of the semester the student should be able to :-

1- Demonstrate knowledge of incompressible fluid flows, two phase flow, fluid statics, kinematics of flows and essential basic hydrodynamics.
2-Define and solve problems in fluid dynamics in various engineering applications. Provide the ability to describe energy variation and its application in flow and pressure measurement and frictional energy losses calculations.
3-Provide the ability to estimate the required energy for fluid pumping (selection the size and type of appropriate pumping for liquid and gas) and to design the liquid mixing equipment.
4-Predict necessary fluid parameters of full scale projects by performing simple model experiments.
5-Share ideas and work in a team in an efficient and effective manner under controlled supervision or independently.

Topics Covered (Syllabus)Fluid Flow I

No.	Contents	Duration
1	**INTRODUCTION:** Definition of a fluid, fluid mechanics; Physical properties of fluids: Density, specific gravity, viscosity, kinematic viscosity, surface tension and capillarity, bulk modulus of elasticity, Pressure and shear stress; Types of Fluids: Newtonian, non-Newtonian fluids ideal and real fluids, Newton's law of viscosity.	4 hrs
2	**Dimensional Analysis:** Units and dimensions; Fundamental dimensions; Dimensional homogeneity; Dimensionless number Methods of dimensional analysis, 1- Rayleigh's method (power series) 2- Buckingham's Π- method / Theorem	4 hrs
3	**Fluid Statics :** Basic consideration of fluid statics; Pressure head of liquid; Pressure force on surfaces; Buoyancy; Measurement of pressure: (Piezometer, Manometers, types of Manometers, Mechanical Gauges)	4 hrs
4	**Fluid Dynamics, Newtonian's Incompressible Fluid:** Fluid kinematics: Types of fluid flow (steady and unsteady flows, uniform and non-uniform flows, one, two, and three dimensional flows, Rotational and irrotational flows, laminar and turbulent, compressible and	8 hrs

	incompressible flows), velocity distribution in laminar and turbulent flow Boundary layer, Continuity equation, Momentum equation, Bernoulli's equation, Euler's equation of motion, modified Bernoulli's equation, pipe size selection; Two-Phase Flow, Horizontal and vertical flow regime, calculation of pressure drop of two-phase flow by Lockhart and Martinelli method.	
5	**Pumping of Liquids:** Total heads, NPSH, Horse Power and cost consumption, Pumping Efficiencies Characteristics curves Types of the pumps, Selection of Pumps. Centrifugal pump relations, homologous centrifugal pump, centrifugal pumps in series and in parallel.	6 hrs
6	**Non-Newtonian Fluids in Pipes:** Definition, types of non-Newtonian fluids, flow characteristics, apparent viscosity, shear rate and description of time-independed fluid, calculation of friction and pressure drop for general time independent in laminar and turbulent flow	4 hrs

Practical Fluid Flow I

No.	Experiment Name.
1	**Calibration of Bourdon Tube Pressure Gauge**
2	**Reynolds Experiment**
3	**Energy Loss in Pipes**
4	**Centrifugal Pump Characteristics**
5	**Bernoulli's Theorem Demonstration**
6	**Friction Losses in Piping Systems**
7	**Gear Pump**
8	**Flow Visualization**

Universityof Technology
Department of Chemical Engineering

Program	Chemical Processing Engineering					
Course Code	CES.P.235	Credits hr				Units
Course Title	Physical ChemistryI					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	1-chemical engineering principles 2-chemistry	2	2	-	4	3

Course Description

Physical chemistry is the application of the methods of physical to chemical problems. It includes the qualitative and quantitative study. Both experimental and theoretical of the general principles determining the behavior of matter.

Course Text

1. J. Laidler, physical chemistry, Bosten; Houghton M, ffl.n company, 1999.
2. G. Mortimer, physical chemistry, San Francisco; Altarcourt science and technology company, 2000.

Course Objectives : at the end of the semester the student should be able to :-

1- 1. Be able to solve problems involving ideal mixture and dilute solutions.

2- 2. Understand the principles govering phase diagrams and be able to interpret phase diagrams for various kinds of systems.

3- 3. Be able to solve problems involving surface tension.

4- 4. Be able to solve several simple rate laws and to solve a variety of problems related to these solutions.

5- 5. Be able to apply experimental techniques to the determination of rate law and rate constant.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Phase Equilibria:** Equilibrium between phases, one component systems, binary systems involving vapor, liquid vapor equilibria of two component system, liquid vapor equilibrium in system not obeying Raoults law, temperature composition diagram (boiling point curves), distillation, azeotropes, solubility of gases in liquids.	12 hr
2	**Chemical Kinetics 1:** Rate of consumption and formation, rate of reaction, empirical rate equation, order of reaction, reactions having no order, rate constants and rate coefficients, analysis of kinetic results.	6 hr
3	**Surface chemistry :** Adsorption, adsorption isotherms, surface tension and capillary rise, pressure difference across curved surface tension, liquid- films on surfaces, solid- liquid interfaces.	12hr

Practical Physical Chemistry I

No.	Experiment Name.
1	**Refractive index.**
2	**Viscosity.**
3	**Saponfication of acetate ethyl.**
4	**Three component system(water, ethanol and ethyl acetate)**
5	**Molecular weight determination by victor meyers method.**
6	**Calorimeter Constant.**
7	**Heat of solution**
8	**Surface tension.**
9	**Surface chemistry. Adsorption by solid from solution.**
10	**Spectrophotometer analysis of $k_2Cr_2O_7$.**

<table>
<tr><td>Program</td><td colspan="6">Chemical Processing Engineering</td></tr>
<tr><td>Course Code</td><td>CES.P.211</td><td colspan="4" rowspan="2">Credits hr</td><td rowspan="3">Units</td></tr>
<tr><td>Course Title</td><td>Computer Programming II</td></tr>
<tr><td>Term</td><td>1st Semester</td><td>Theoretical</td><td>Practical</td><td>Tutorial</td><td>Total</td></tr>
<tr><td>Prerequisite(s)</td><td>1. Basic Principles of chemical engineering I.
2. Mathematics I.
3. Computer programming I</td><td>1</td><td>2</td><td>1</td><td>4</td><td>2</td></tr>
</table>

Course Description

To introduce chemical engineering students to modern calculating tool used in the practice of engineering by being able to construct plots, fit data, and use built-in functions in MATLAB.

Course Text

1- RudraPratap: Getting started with MATLAB 7, Oxford Press (Indian edition),2006.
2- Desmond J. Higham and Nicolas J. Higham: Matlab Guide, SIAM, 2000.

Other support books :-

1- Duane Hanselman and Bruce Littlefield: Mastering Matlab-6: A Comprehensive Tutorial and Reference, Prentice Hall, 2001.
2- Schilling R. J., Harries S.L., Applied Numerical Methods for Engineers using MATLAB & C, Thomson Books, 2002.

Course Objectives: at the end of the semester the student should be able to :-

1- Develop the confidence necessary to successfully solve Mathematical problems with a computer.
2- Formulate and write structured code in MATLAB.
3- Understand the foundation behind the basic numerical methods for Matrix manipulations.

University of Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Starting With Matlab:** MATLAB windows , Menus and the toolbar , Working in the command window , Arithmetic operations with scalars , Display formats , Elementary math built-in functions, Useful commands for managing variables, Script files and the Editor Debugger, Matlab Help System	2hr
2	**Symbolic Math :** Symbolic objects, and symbolic expressions, Changing the form of an existing symbolic expression, Solving algebraic equations, Differentiation, Integration, Solving an ordinary differential equation.	3 hr
3	**Creating Arrays:** Creating a one-dimensional array (vector) , Creating a two-dimensional array (matrix) , The transpose operator , Array addressing , Using a colon: in addressing arrays, Adding elements to existing variables, Deleting elements, Built-in functions for handling arrays, Strings and strings as variables.	2 hr
4	**Mathematics With Array:** Addition and subtraction , Array multiplication, Array division , Element-by-element operations , Using arrays in MATLAB built-in math functions, Built-in functions for analyzing arrays, Generation of random numbers, Solving Algebraic Equations.	3 hr
5	**Polynomials, Curve Fitting, And Interpolation :** Polynomials, Curve fitting , Interpolation , Extrapolation.	2 hr
6	**Programming In Matlab:** Relational and logical operators, Conditional statements, The switch case statement, Loops, Program Design and Development.	3 hr

Program	***Chemical Processing Engineering***					
Course Code	**CES.P.223**	Credits hr				Units
Course Title	Material Eng. (I)					
Term	1^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Strength of material+ General chemistry	2	-	1	3	2

Course Description

Introduction to classification of materials and the atomic structure of it, Study the mechanical, thermal and electrical properties of materials and Crystal structure and imperfection in solid materials.

Course Text

1-Donaled R. Askeland, The science and engineering of materials, international student edition, 2006 .
2-William D. Callister, Jr. , Materials science and engineering, Fifth edition, 2000.
3-Lawrence H. Vanvlack , Elements of materials science and engineering, Fifth edition, 1987.

Course Objectives : at the end of the semester the student should be able to :-

1- Describe and solve problems on atomic arrangement and geometry of imperfections.

2- Describe and solve problems on mechanical, thermal and electrical properties of materials.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Classification of Materials:** Classification of materials, classification of materials based on structure, advanced materials	4hr
2	**Mechanical Properties of Materials:** Stress-strain behavior, ductility, brittleness, toughness, modulus of resilience, poison's ratio, hardness, effect of temperature.	6hr
3	**Atomic structure:** The structure of atom, atomic bonding, bonding energy and inter-atomic spacing	6hr
4	**Atomic order in solids :** Types of atomic or ionic arrangements, crystal structure, lattice, unit cells, metallic crystal structure, crystal systems, crystal direction and crystal planes , diffraction techniques for crystal structure analysis	8hr
5	**Thermal and electrical properties of materials :** Heat capacity, thermal expansion, thermal conductivity, thermal stresses, Glass transition temperature, Creep resistance, electrical conductivity, electron mobility, electrical resistivity of metals	6hr

Universityof Technology
Department of Chemical Engineering

Program	Chemical Processing Engineering					
Course Code	**CES.P.237**	Credits hr				Units
Course Title	Fuel Technology					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	chemistry	2	2	0	4	3

Course Description

Introduction to fuels technology (solid, liquid, and gases). Procedure and characterization in terms of physic-chemical properties.

Course Text

1- Modern petroleum Technology, vol. 1, upstream, ed. By Richard A. Dave, 1P, 6th ed., Jhonwiley and sons. Ltd.
2- Modern Petroleum Technology, vol.2, Downstream, ed. By Alan G. Lucas, 1P, 6thed , ., Jhonwiley and sons. Ltd.
3- Fuels combustion and furnaces, Jhon Griswold, Mc-Graw Hill Book company.
4- Petroleum Refinery Engineering, Nelson, 4th ed. Mc-Graw, Hill Book Company.

Course Objectives: at the end of the semester the student should be able to :-

1- Introduces basic knowledge about solid, liquid and gases fuels, their origin, classification.
2- Knowledge of preparation, procedure and characterization in terms of physic-chemical properties
3- Knowledge in liquid fuel section. Petroleum is the liquid fuel which is elaborated in terms of distillation and secondary processing. Different important gaseous fuels are included in gaseous fuel section.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction**: History of fuels, history of solid fuel, history of liquid fuels and gases fuels, fundamental definition, properties of liquid and gaseous fuels, various measurement.	4hr
2	**Coal :** classification,Composition and basis, coal preparation and washing, combustion of coal and coke and making, coal tar distillation coal liquefaction, coal gasification.	4hr
3	**Crude Petroleum:** Exploration of crude Petroleum, Evaluation of crude, distillation cracking, thermal cracking catalytic cracking, reforming of naphtha, hydrotreatment, dewaxingdeasphalting, refinery equipment.	10hr
4	**Natural gas and LPG:** Producer gas, water gas, other fuel gases.	4hr
5	**Combustion air Calculation:** Calculation of calorific value of fuels, flame properties, combustion burners, combustion furnaces .	8hr

Practical Fuel Technology

No.	Experiment Name.
1	ASTM distillation exp.
2	Density and specific gravity exp
3	Viscosity& viscosity index exp.
4	Salt content in crude oil
5	Gum and gum stability
6	Flash & fire point
7	Ash content for petroleum products
8	Conrad Son Carbon residue of petroleum

<table>
<tr><td>Program</td><td colspan="6">Chemical Processing Engineering</td></tr>
<tr><td>Course Code</td><td>CES.P.213</td><td colspan="4">Credits hr</td><td rowspan="3">Units</td></tr>
<tr><td>Course Title</td><td>Democracy</td><td colspan="4"></td></tr>
<tr><td>Term</td><td>1st Semester</td><td>Theoretical</td><td>Practical</td><td>Tutorial</td><td>Total</td></tr>
<tr><td>Prerequisite(s)</td><td>none</td><td>1</td><td>-</td><td>-</td><td>1</td><td>1</td></tr>
</table>

Course Description

The study of the Democracy concept and history and its relationship to religions and relations with Development , also the advantages and the disadvantages of democracy

Course Text

1-Human rights, development, contents Dr.Riyad Aziz Hadi
٢-مبادئ و قواعد عامة في حقوق الأنسان د. صلاح حسن مطرود
٣- حقوق الأنسان بين الأسلامي و العالمي د. محمد علي الشجيري
٤- حقوق الأنسان و الديمقراطية د. ماهر صالح الجبورى
٥- مشكلة الحرية د. زكريا أبراهيم

Course Objectives : at the end of the semester the student should be able to :-

1- To know the democracy and how can adapt our culture with the principles of democracy in general.
2-Lock of student to their own cultural inventories in the concepts of democratization and it has be shining in the emergence of a democratic culture in university community with the intimate and external community .

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Democracy:** definition, a brief history, characteristics advantages of democracy and its disadvantages	1hr
2	The most important problem facing the implementation of democracy in arab-muslim world	1hr
3	Relationship awareness in the application of democracy	1hr
4	How can adapt our culture with the principles of democracy	1hr
5	Democracy between changes and external pressures	1hr
6	A pressure group the difference between them and the political parties	1hr
7	The advantages of democracy and the disadvantages	1hr
8	The theory of social determinism in state-building	1hr
9	Relationship between democracy and globalization	1hr
10	Development and democracy	1hr
11	Religion and democracy	1hr
12	The third way between socialism and capitalism	1hr

13	Reasons for the spread of financial and administrative corruption and how to confront it	**1hr**
14	The reasons for the collapse of democracy	**1hr**
15	The relationship between the intellectual and power Democracy and modernity Democracy and alienation	**1hr**

University of Technology
Department of Chemical Engineering

Program	***Chemical Processing Engineering***					
Course Code	**CES.P.222**	Credits hr				Units
Course Title	Engineering MathematicsII					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Engineering Mathematics I	2	-	1	3	2

Course Description

This course describe the providing of knowledge on solving ordinary differential equations and applications of first order ordinary differential equations and chemical engineering applications of the theory portion covered will be emphasized.

Course Text

Text book:

1. Higher Engineering Mathematics by Dr.B.S.Grewal, Khanna Publishers, 40th Edition, 2007.

Reference book:

1. Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, 2007.

Course Objectives: at the end of the semester the student should be able to:-

1- Understand methods of solving First order and Higher order ordinary differential equations along with some physical applications.
2- 2. Demonstrate the relevance of the mathematical methods learnt to chemical engineering.

Topics Covered (Syllabus)/ Engineering MathematicsII

No.	Contents	Duration
1	**Solution by Series:** Infinite series by Taylor theorem, Method of Frobenius (Case I, II, IIIa, and IIIb), Bessels's and Modified Bessel's Equation, Properties of Bessel Functions, Applications in chemical engineering ,Tubular Gas Preheater, Reaction in axisymmetric Spherical and Cylindrical pellets.	15hr
2	**Ordinary Differential Equations:** Introduction, Linear equation, Bernoulli's equation, Exact differential equations, Equations reducible to exact equations, Orthogonal trajectories, Newton's law of cooling. Linear differential equations with constant coefficients: Definition, Theorem, Operator D, Rules for finding the complementary function, Inverse operator, Rules for finding the particular integral, working procedure to solve the equation.	10hr
3	**Application of Ordinary Differential Equations:** Representation problems of 1^{st} and 2^{nd} ordinary differential equations (linear and nonlinear, homogeneous …etc.).	5hr

Universityof Technology
Department of Chemical Engineering

Program	Chemical Processing Engineering					
Course Code	**CES.P.**232	Credits hr				Units
Course Title	Material and Energy Balance					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Energy Balance	2	-	1	3	2

Course Description

The aims of the course provide a deep knowledge , wide scope and improved understanding the heat balance that include the effects of chemical reaction as well as unsteady state material and energy balances . The students should gain knowledge to apply the material and energy balance in engineering problems .

Course Text

1. D.M.Himmelblau and J.B.Riggs ,Basic Principles and Calculations in Chemical Engineering ,7th Edition , 2004 .

Other support books :-

2. R.M.Felder and R.W.Rousseau ,Elementary Principles of Chemical Processes ,3rd Edition ,2005 .

Course Objectives : at the end of the semester the student should be able to :-

1. Energy balances that include the effects of chemical reaction .
2. Ideal process , efficiency , and the mechanical energy balance .
3. Heat of solution and mixing .
4. Humidity (psychrometric) charts and their use .
5. Unsteady state material and energy balances .

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Energy Balances that Include the Effects of Chemical Reaction:** Applications of energy balances in processes that include reactions , Calculation of an adiabatic reaction temperature , General energy balance in a process in which more than one reaction occurs , Energy balance to a process composed of multiple units .	8hr
2	**Ideal Processes , Efficiency , and the Mechanical Energy Balances :** Ideal reversible processes , Calculation of the work done during evaporation of a liquid , Calculation of the work in a batch process , efficiency , the mechanical energy balances , Comparison of the reversible work for a batch process with that of a flow process operating under the same conditions , the mechanical energy balance to the pumping of water .	4hr
3	**Heat of Solution and Mixing:** Heat of solution , Heat of dissolution , Heat of mixing , Introducing the effects of mixing into the energy balance .	4hr
4	**Humidity (Psychometric) Charts and their Use :** The humid heat , The humid volume , The dry-bulb temperature , The wet-bulb temperature , The humidity (psychometric) chart , Wet-bulb line , Adiabatic cooling line , Applications of the humidity chart .	6hr
5	**Unsteady state Material and Energy Balances :** Unsteady-state material balance without generation , Material balance on batch distillation , Unsteady-state chemical reaction , Unsteady-state energy balance .	8hr

Program	Chemical Processing Engineering					
Course Code	**CES.P.234**	Credits hr				Units
Course Title	Fluid Flow II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Fluid Flow I	2	2	1	5	3

Course Description

Application of Bernoulli's equation and derive the flow rate equations and explain the principles of flow measuring devices in open and closed channels…

Derive and define the governing equations of compressible fluid flow: continuity, energy and momentum equations from principles of mass, energy and momentum conservation with various gas flow conditions, Mach Number and flow through conversion-diversion nozzle with application for subsonic, sonic, supersonic flow, types of gas pumping devices, Compressors types with ideal and actual gas compression cycle and calculation of compressor work …

Define and description for liquid mixing equipment and its design calculations with the energy consumption by this equipment...

Derive the terminal falling velocity and description drag coefficient for flow through packed columns and pressure drop calculation for fixed and fluidized beds and transport of particles...

Course Text

1- Coulson, J.M. , Richardson, J.F., Backhurst, J.R. and Harker, J.H., "Chemical Engineering" Volume(1) 6th Ed., Butterworth-Heinemann, 1999
2- Coulson, J.M. , Richardson, J.F., Backhurst, J.R. andHarker, J.H., "Chemical Engineering" Volume (2) 5th Ed., Butterworth-Heinemann, 2002
3- Holland, F.A. and Bragg, R., "Fluid Flow for Chemical Engineers", 2nd Ed., Edward Arnold, 1995.

Other support books :-

1- McCabe, W. L., Smith, J. and Harriot, P., "Unit Operations of Chemical Engineering", 6th Ed., McGraw – Hill, International Edition, 2001.
2- Christi J. Geankoplis "Transport Processes and Unit Operations" 3rd Ed. Printice Hall International Editions, 1993.

Course Objectives: at the end of the semester the student should be able to :-

1- Define the operation principles of the different types flow measurement, solve problems in fluid flow through flow measurement devices with applications for steady and unsteady flow.
2- Demonstrate knowledge of compressible fluid flows, with differences of equations using depending on compressible flow conditions, sonic (sub)(super)sonic flow,

conversion*diversion nozzle, types of gas pumping devices.

3- Provide the ability to estimate the energy (power) consumption for liquid mixing equipment and to design it by predict necessary fluid parameters of full scale projects by performing simple model experiments.

4- Provide the ability to estimate the terminal falling velocity and description drag coefficient for flow through packed columns and pressure drop calculation for fixed and fluidized beds and transport of particles...

5- Share ideas and work in a team in an efficient and effective manner under controlled supervision or independently.

Topics Covered (Syllabus)/Fluid Flow II

No.	Contents	Duration
1	**Flow Measurement:** Pitot tubes, orifice meter, venturi meter, nozzle meter, Rotameters other types of flow meters, flow in open channels and weirs with steady and unsteady applications	6 hrs
2	**Flow of Compressible Fluid:** General equation, equation of state, sonic velocity in fluids, Mach No. Isothermal, Non-isothermal and Adiabatic flow of an ideal gas in horizontal pipes, Converging-diverging nozzle for gas flow. Types of gas pumping devices (fans, blowers compressors) compressors types and gas compression cycle and calculations of work and efficiency of compressor	10 hrs
3	**Liquid Mixing :** Stirring and mixing and rotational force, effective forces and dimensionless numbers for rotational fluid flow. Stirred vessels (power consumption, power curve, scaled-up), equipment	6 hrs
4	**Flow of Fluid through Granular Bed and Packed Columns:** Motion of particles in a fluid, Drag force on a particle, terminal falling velocities, Sedimentation of fine and coarse particles, Pressure drop in granular beds, packed columns: packing types, Pressure drop estimation (Kozeny and Carmen equations), Fluidization Minimum fluidization velocity, Pressure, Pressure drop, Ergun equation, bed expansion and transport of particles.	8 hrs

Practical Fluid Flow II

No.	Experiment Name
1	Discharge through an orifice
2	Open Channel Flow over Weir
3	Flow through a Venturi Meter
4	Fluidization
5	Forced Vortex
6	Flow of Compressible Fluid
7	Impact of Jet
8	Non-Newtonian Fluids Behavior

Universityof Technology
Department of Chemical Engineering

Program	Chemical Processing Engineering					
Course Code	**CES.P.236**	Credits hr				Units
Course Title	Physical Chemistry II					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	1-chemical engineering principles 2-chemistry	2	-	-	2	2

Course Description

In this semester deals with the various transformation that can be brought about an ideal gases have played a very important part in the development of thermodynamics. It is include properties of solutions of electrolytes and with processes that occur at electrodes. It concerned with galvanic cells, in which a chemical reaction produce an electric potential difference between two electrodes.

Course Text

1. J. Laidler, physical chemistry, Bosten; Houghton M, ffl.n company, 1999.
2. G. Mortimer, physical chemistry , San Francisco; Altarcourt science and technology company, 2000.

Course Objectives : at the end of the semester the student should be able to :-

1- 1. Be able to solve problems related to the macroscopic equilibrium properties of gases and liquid.
2- 2. Understand how the thermodynamics of non simple system is applied to electrochemical cells.
3- 3. Be able to calculate cell voltages for standard conditions and other conditions using standard reduction potentials and the nerst equation.
4- 4. Be able to solve problems relating equilibrium constants and Gibbs energy changes to electrochemically measured quantities.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Applications of the equations of ideal gases:** The PVT behavior of pure substances, the ideal gas, the constant volume process, the constant pressure process, the adiabatic process, the polytropic process.	10 hr
2	**Solutions of electrolytes :** Electrical units, Faradays laws of electrolysis, molar conductivity, weak electrolytes, strong electrolytes, activity and ionic strength, determination of activity coefficient from solubility, the Debye-Hackle theory, acid- base catalysis and their dissociation constant.	10 hr
3	**Electrochemical cells:** Electromotive force (EMF) of a cell, measurements of EMF- the potentiometer, the polarity of electrodes, the cell reactions and reversible cells, free energy and reversible cells, typical of half cells classification EMF, standard electrode potentials, standard free energy and energy of aqueous ions, calculation of EMF of cell, oxidation-reduction reactions, concentrations cells,electrolysis.	10 hr

University of Technology
Department of Chemical Engineering

<table>
<tr><td>Program</td><td colspan="6">Chemical Processing Engineering</td></tr>
<tr><td>Course Code</td><td>CES.P.212</td><td colspan="4" rowspan="2">Credits hr</td><td rowspan="3">Units</td></tr>
<tr><td>Course Title</td><td>Computer Programming III</td></tr>
<tr><td>Term</td><td>2nd Semester</td><td>Theoretical</td><td>Practical</td><td>Tutorial</td><td>Total</td></tr>
<tr><td>Prerequisite(s)</td><td>4. Basic Principles of chemical engineering I.
5. Mathematics I.
6. Computer programming II</td><td>1</td><td>2</td><td>1</td><td>4</td><td>2</td></tr>
</table>

Course Description

To introduce chemical engineering students to modern calculating tool used in the practice of engineering by demonstrating an ability to create small structured programs in a MATLAB programming environment and understanding how user written functions interact with numerical methodsroutines.

Course Text

1. RudraPratap: Getting started with MATLAB 7, Oxford Press (Indian edition),2006.
2. Desmond J. Higham and Nicolas J. Higham: Matlab Guide, SIAM, 2000.

Other support books :-

1. Duane Hanselman and Bruce Littlefield: Mastering Matlab-6: A Comprehensive Tutorial and Reference, Prentice Hall, 2001.
2. Schilling R. J., Harries S.L., Applied Numerical Methods for Engineers using MATLAB & C, Thomson Books, 2002.

Course Objectives: at the end of the semester the student should be able to:-

1- Solve sets of linear and nonlinear equations using numerical methods as well as in-built MATLAB functions.

2- Apply numerical methods and MATLAB functions to differentiate and integrate a function or a set of discrete points.

3- 3. Apply explicit and implicit numerical methods and MATLAB functions to integrate single and multiple sets of initial value problems

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Two-Dimensional Plots :** The plot command , The f-plot command , Plotting multiple graphs in the same plot , Formatting a plot, Plots with logarithmic axes, Plots with error bars, Plots with special graphics , Histograms, Plotting multiple plots on the same page , Multiple figure windows Graphics.	4 hr
2	**Three-Dimensional Plots :** Line plots, Mesh and surface plots, Plots with special graphics, The view command.	2hr
3	**Using Script Files :** The MATLAB workspace and the workspace window, Input to a script file, Output commands, The save and load commands, Importing and exporting data.	1 hr
4	**Functions And Function Files:** Creating a function file, Structure of a function file, Local and global variables , Saving a function file, Using a user-defined function, Examples of simple user-defined functions, Comparison between script files and function files , Function functions, Sub-functions	4 hr
5	**Numerical Analysis:** Solving an equation with one variable, Finding a minimum or a maximum of a function, Numerical integration, Ordinary differential equations.	4 hr

Universityof Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P.224**	Credits hr				Units
Course Title	Material Eng. (II)					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	general chemistry	2	2	1	5	3

Course Description

Imperfection in solid. diffusion and atomic movement in solid. Solid solution and phase diagram for different alloys. Ceramic materials and composite materials.

Course Text

1-Donaled R. Askeland, The science and engineering of materials, international student edition, 2006 .
2-William D. Callister, Jr. , Materials science and engineering, Fifth edition, 2000.
3-Lawrence H. Vanvlack , Elements of materials science and engineering, Fifth edition, 1987.

Course Objectives : at the end of the semester the student should be able to :-

1- Describe the geometry of imperfections
2- Calculate the extent of diffusion- driving composition changes based upon composition, time and temperature.
3- Predict the equilibrium microstructure of a material given the binary phase diagram, thermal history of the materials.
4- Describe the types and properties of ceramic and composite materials.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Imperfections in solids:** Point defects, line defects, interfacial imperfections, Macroscopic defects	6hr
2	**Atomic and ion movements in materials:** Stability of atoms and ions, mechanisms for diffusion, rate of diffusion (Fick's first law), factors affecting diffusion, non-steady state diffusion (Fick's second law) .	6hr
3	**Solid solutions and phase diagrams:** Basic concepts, solubility and solid solution, phase and phase diagram, unary phase diagram, binary Iso-morphous system, binary eutectic system.	6hr
4	**The Iron-Carbon system:** The Iron-Iron carbide phase diagram, development of microstructures in Iron-carbon alloys	6hr

5	**Ceramic materials :** Crystal structure, mechanical properties of ceramic, classification of ceramic materials on the basis of its application	**2hr**
6	**Composites**: Material combination, Reinforced composites, structural composites.	**4hr**

Practical Material Eng. (II)

Exp. No.	Exp. Name.
1	*Tension test*
2	*Hardness Testing*
3	*Bending Test*
4	*Creep Test*
5	*Abrasion Test*
6	*Impact Test*
7	*Moisture Measurement in Engineering Materials*
8	*Determination of Linear Thermal Expansion for a Solid*
9	*Microstructure Examination of pb-Sn alloys using the metallurgical microscope*

Universityof Technology
Department of Chemical Engineering

Program	*Chemical ProcessingEngineering*					
Course Code	**CES.P.238**	Credits hr				Units
Course Title	Renewable Energy					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	------	2	0	0	2	2

Course Description

Theory, Classification of energy resources, Solar thermal energy, Solar, Bioenergy- Biomass and biogas, photovoltaics, Wind energy, Geothermal energy, Energy storage
Energy Management system.

Course Text

1- S. H. Saeed and D.K. Sharma, Non-Conventional energy resources, 3rd edition, S.K. Kataria& Sons, New Delhi (2013)

Other support books :-

1- J. B. Galvez and S. M. Rodriguez, Solar detoxification, United Nations Educational, Scientific and Cultural Organization (2003)

Course Objectives : at the end of the semester the student should be able to :-

1- The expected outcomes for this course include:
2- Learning renewable energy (RE) issues in the context of science, technology, economics, policy and society
3- Nurturing the ability to develop RE systems considering sustainable development
4- Developing the ability to relate RE to climate change and other global contemporary issues
5- Understanding the professional ethics of RE

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Classification of energy resources**	1 hr
2	**Solar thermal energy:** Solar radiation, solar collectors, performance and applications of collectors, solar thermal power plant, solar water disinfection, solar cooling	8hr
3	**Solar photovoltaics:** Photovoltaic basics, Types of photovoltaic cells, solar photovoltaic (SPV) module, Applications and efficiency of solar photovoltaic systems, Limitations of SPV systems	4 hr
4	**Bioenergy- Biomass and biogas:** Biomass conversion processes, Factors affecting generation of biogas, various types of biogas plants, Community biogas plants	4 hr
5	**Geothermal energy**: Resources of geothermal energy, dominated power plants of vapor or liquid, applications of geothermal energy, environmental effects of geothermal energy, advanced concepts of geothermal energy.	6 hr
6	**Energy storage :** Solar energy storage system, types of solar energy storage systems	3 hr
7	**Energy Management system:** Types of energy Management system, energy audit, energy planning, energy demand management.	4 hr

Universityof Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P.225**	Credits hr				Units
Course Title	Eng. Statistics					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I, Mathematics II	2	2	1	5	3

Course Description

Theory, applications, deferent methods calculation, sample descriptive statistics and graphical representation of data.

Course Text

1- Murry R. Spiegel, Statistics, Mc Grow-Hill international book company 1st addition.
2- Michael Sullivan III, Statistics informed decision using data 3rd addition, pearson education international 2010.
3- Jones' instrument technology.
4- Butterworth and co. (publishers) 2nd addition 1987.

Course Objectives: at the end of the semester the student should be able to :-

Use all the methods of statistical calculations to solve problems in chemical engineering and others applications.

Topics Covered (Syllabus)/ Eng. Statistics

No.	Contents	Duration
1	Introduction: Statistics, population and sample descriptive and inductive statistics and graphical representation of datas	**2hr**
2	Frequency distribution table, raw data, arrays, types of frequencies.	**2hr**
3	Graphical representation of frequency distribution table..	**2hr**
4	Measures of central tendency.	**2hr**
5	Measures of dispersion	**2hr**
6	Curve fitting, Least squares method, Straight line forms, polynomial regression, variance and correlation coefficient.	**4hr**
7	Multiple and partial correlation: regression equation, normal equations for the least square regression, the coefficient for multiple correlation, relationship between multiple and partial correlation.	**4hr**
8	Probability distribution, continuous and discrete probability distribution, normal distribution.	**2hr**
9	The binomial distribution, the poisson probability distribution, approximation of standard distributions.	**2hr**
10	The chi-square test, confidence intervals, degree of significant, test of	**4hr**

	hypothesis, test for goodness of fit of probability distributions test of independence.	
11	Companing three or more means (one-way analysis of variance (ANOVA), requirements of ANOVA test, ANOVA F-test, decision rule in ANOVA test.	**4hr**

PracticalEng. Statistics

No.	Contents
1	The concept of statistical analysis, the important statistics to life, about the most important statistical programmes
2	Install Statistical ,About statistical analysis software, interfaces and quibbles
3	Working environment and Statistical data entry program
4	Using Statistica in statistical analysis with examples
5	Regression And Correlation (Curve Fitting)with Examples
6	How to finds With examples 1. Find minimum and maximum and variance. 2. Find standard deviation, mean, mode. 3. Find second max frequency. 4. Find max class mark and its frequency? 5. Find max frequency. 6. Find second class mark and its frequency.
7	Ways to validate the equation imposed with examples
8	Line (45) Method with examples
9	Correlation Coefficient Method with examples
10	Residual Plot Method with examples
11	Multiple Linear Regression liner model with examples
12	Multiple Linear Regression Non liner model with examples

University of Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P.331**	Credits hr				Units
Course Title	Thermodynamics I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Material &Energy Balance, Physical Chemistry,Fluid Flow	2	2	1	5	3

Course Description

The course of chemical engineering thermodynamics I comprises the study of volumetric properties of pure fluids; Entropy and second law analysis of engineering systems; Thermodynamic properties of fluids; Applications of thermodynamics to flow processes.

Course Text

1- J. M. Smith,H.C.Van Ness, Introduction to chemical engineering thermodynamics, 6th edition (International Edition), Mc-Graw Hall, 2008.

Other support books :-

1-K.V.Narayanan, Atext book of chemical engineering thermodynamics, prentice Hall of India, New Delhi, 2011.

2- B.G.Kyle, Chemical and process thermodynamics ,(3rd Edition), prentice Hall Inc.New Jersey, 1984.

3-J. Rayner, Basic engineering thermodynamics inSI units, printed in great Britain,1971

Course Objectives : at the end of the semester the student should be able to :-

6-To familiarize the students with basic concepts of the first and second laws of thermodynamics and their applications in engineering problems.
7-Develop a practical ability to solve energy balance problems , minimum work.
3.Students will demonstrate basic understanding of basics and definitions of thermodynamics and properties of pure substances.
4.Describe the reversible and irreversible processes (macroscopic description of an ideal and real processes).

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Volumetric properties of pure fluids** Review on virile equation of state, cubic equation of state, generalized correlations for gases and for liquids.	6 hr
2	**The 2nd law of thermodynamics** Review on the 2nd law and Carnot heat engine, entropy balance for open system, calculation of ideal work, lost work.	9 hr
3	**Thermodynamic properties of fluids** Review on the property relations ($\Delta H, \Delta S, \Delta U and \Delta G$) residual properties, two phase systems, thermodynamic diagrams and tables, generalized property correlations for gases.	6 hr
4	**Applications of thermodynamics to flow processes** Duct flow of compressible fluids, pipe flow, nozzles, throttling process, turbines, compression processes compressors, ejectors.	9 hr

Practical Thermodynamics I

No.	Exp. Name.
1	**Measurement of the solar irradiation**
2	**Alternating current solar installation**
3	**Refrigeration**
4	**Hydrolysis of methyl acetate**
5	**Pressure and Temperature relationship for steam**
6	**Liquid -vapor equilibrium Isotropic Mixtures**
7	**Boyles' law**
8	**Regulating and charging battery**
9	**Measurement of the solar irradiation**

Universityof Technology
Department of Chemical Engineering

Program	Chemical Processing Engineering					
Course Code	CES.P.321	Credits hr				Units
Course Title	Numerical Analysis					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Computer Programming II , III	2	2	1	5	3

Course Description

This course introduces students to: Error analysis; Finding roots of a non-linear function; Approximation and interpolation; Numerical integration and differentiation; direct and indirect solution of systems of linear equations; Solution of systems of nonlinear equation; solving ordinary differential equations and partial differential equations. All examples within the course concerning with principles of chemical engineering.

Course Text

1. "Numerical Methods for Engineers", Steven C. Chapra, Raymond P. Canale, McGraw Hill, 6th edition, 2010.
2. "Numerical Methods for Engineers and Scientists", Joe Hoffman, McGraw-Hill Book Company,1993.
3. "Applied Numerical Analysis", Gerald,C.F. and Wheatley, P.O., 6th Edition, Pearson Education, 2006.
4. "Numerical Methods for Chemical Engineers with MATLAB Applications", AlkisConstantinides, NavidMostoufi, Prentice Hall, 1999.

Course Objectives: at the end of the semester the student should be able to:-

To solve chemical engineering problems with numerical analysis techniques.

Topics Covered (Syllabus)/Numerical Analysis

No.	Contents	Duration
1	**Introduction to Numerical Analysis:** Numerical Solution, type of errors; relative error, absolute error, percentage error, truncation error, round off error. Floating point.	2hr
2	**Root Finding:** Roots of polynomials, Bisection method, Secant method, Newton-Raphson method.	4hr
3	**Interpolation and Polynomials Approximation:** Lagrangian Polynomials, Divided differences, Cubic spline interpolating polynomials, Newton's forward and backward difference formulas.	4hr
4	**Numerical Differentiation and Numerical Integration :**	6hr

	Forward, backward and central difference approximation. Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules. Double integrals using trapezoidal and Simpson's rules.	
5	**Solving System of Equations:** Solution of linear system of equations by direct methods (Gaussian elimination and Gauss-Jordon). Solution of linear system of equations by Iterative methods (Jacobi and Gauss-Seidel). Solution of non-linear system of equations by Newton-raphson.	**4hr**
6	**Solution of ordinary Differential Equations:** Initial value problems. Solution of first-order ordinary differential equations using Taylor', Eular, Runge-Kutta and Predictor-corrector methods. Solution of simultaneous ordinary differential equations.	**4hr**
7	**Solution of Partial Differential Equations:** Types of Partial Differential Equations: Elliptic (Poisson) equation, Parabolic (heat) equation, Hyperbolic (wave) equation. Finite difference solution of Partial Differential Equations. Numerical solution of partial differential equations using explicit, implicit and Crank-Nicolson methods elliptic (Laplace) equation.	**6hr**

Practical Numerical Analysis

No.	Contents
1	**Review of properties of Matlab programming language.**
2	**Bisection method and Secant method.**
3	**Newton-raphson method.**
4	**Lagrange interpolation.**
5	**Newton's forward and backward difference formulas.**
6	**Trapezoidal rule.**
7	**Simpson's 1/3 and 3/8 rules.**
8	**Solution of linear system of equations by direct methods (Gaussian elimination and Gauss-Jordon).**
9	**Solution of linear system of equations by Iterative methods (Gauss-Seidel and Jacobi).**
10	**Solution of differential equation using Euler's method.**
11	**Solution of differential equation using Runge-Kutta method.**
12	**Solution of partial differential equations using explicit and implicit methods.**
13	**Solution of partial differential equations using Crank-Nicolson method.**
14	**Solution of steady state diffusion through catalyst**
15	**Solution of un-steady state diffusion through catalyst**

Universityof Technology
Department of Chemical Engineering

Program	*Chemical Processes Engineering*					
Course Code	**CES.P.333**	Credits hr				Units
Course Title	Mass Transfer					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemical engineering principles, thermodynamics, fluid flow	2	2	1	5	3

Course Description

This course covers diffusion and mass transfer in binary& multi-components, molecular diffusion in fluids, convective mass transfer, mass transfer coefficients, mass transfer correlations, interphase mass transfer, mass transfer theories.

Course Text

1- Coulson, J. M & Richardson J. F. (2006). "Chemical engineering, Volume 1", 3rd Edition, Robert Maxwell. M. C.
2- Dutta Binary K. (2007), "Principles of Mass Transfer & Separation Process", Bvt. Ltd. Prentice Hall, ISPN 8-1203-2990-2.

Other support books:-

1- Treybal Robert E. (1975), "Mass transfer Operation" 2ed Edition, Mc-Graw-Hill Book.
2- McCabe, W., Smith, J., Harriott, P. (2004), "Unit Operations of Chemical Engineering", Mc-Graw-Hill Co., 7th Edition, ISBN0072848235.

Course Objectives: at the end of the semester the student should be able to:-

1- Understand the basics of diffusion as applicable to mass transfer phenomena.
2- Estimate Molar fluxes in convective and inter phase mass transfer.
3- Explain the concept of diffusion theories.
4- Applying the convective mass transfer correlations to calculate mass transfer rates in many units operation.

Topics Covered (Syllabus)/ Mass transfer

No.	Contents	Duration
1	**Introduction :** Fundamentals of mass transfer processes, concentrations, velocities, mass & molar fluxes.	2 hrs
2	**Diffusion in binary gaseous :** Fick's first law of diffusion. Diffusion in gas mixtures, Equimolecular diffusion, diffusion in stationary layer. Correlations to calculate diffusivity, correcting diffusivity	6 hrs
3	**Diffusion in multi component mixtures:** Multi-component gas phase systems, effective diffusivity. Maxwell's law of diffusion	4 hrs
4	**Diffusion in liquids.**	2 hrs
5	**Diffusion in solids.**	2 hrs
6	**Diffusion theories**: Diffusion across phase boundary, Film theory, two film theory, Mass transfer coefficients (individual & overall) in laminar and turbulent flow.	4 hrs
7	**Diffusion resistances:** Calculating the resistance to mass transfer in both phases. Calculating intermediate concentrations.	4 hrs
8	**Unsteady state mass transfer:** Introduction to unsteady state mass transfer, mass transfer accompanied by a chemical reaction.	6 hrs

University of Technology
Department of Chemical Engineering

Practical Mass Transfer

No.	Experiment Name
1	Liquid-Liquid diffusion
2	Absorption
3	Batch Distillation Column
4	Fluid Mechanics of Packed Bed
5	Sieve Analysis
6	Gas Solid Fluidization

Universityof Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P.335**	Credits hr				Units
Course Title	Chemical reaction kinetics					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physical chemistry	2	-	-	2	2

Course Description

Theory,Kinetic parameters and rate law, multiple reactions, yield and selectivity, stoichiometric considerationsand collection and analysis of rate data
.

Course Text

1-Octave Levenspiel (1999),*CHEMICAL REACTOR ENGINEERING*, 3rd edition, John Wiley & Sons Inc., USA ISBN: 9780471254249.

2-J.M. Smith (1987), *CHEMICAL ENGINEERING KINETICS*, 3rd edition, McGraw-Hill International Editions, Singapore. ISBN: 9780070587106

Other support books :-

1- Ronald W. Missen; Charles A. Mims; Bradley A. Saville (1999), *INTRODUCTION TO CHEMICAL REACTION ENGINEERING AND KINETICS*,1stedition, John Wiley & Sons Inc.,USA.

Course Objectives : at the end of the semester the student should be able to :-

This course aims to establish fundamental knowledge for the students in chemical reaction kinetics. At the end of this course, students should be able to:

(i) interpret and analysechemical reaction kinetics data.
(ii) apply reaction kinetics principles in chemical reaction.
(iii) identify and formulate problems in chemical reaction kinetics and find appropriate solutions**.**

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Kinetic parameters and rate law:** L1: Definition in terms of reacting compounds and reaction extent; irreversible and reversible reactions, homogeneous catalyticreactions L2: Symbols and relationships between concentration and conversion L3: Introduction to rate laws, stoichiometry. L4: Reaction order and elementary reactions. L5: Reaction rate constants, Arrhenius equation, Van't Hoff equation L6: Temperature and pressure effects on reaction rates. L7: Thermal effects due to heat of reaction.	10hr
2	**Multiple reactions, yield and selectivity:** L8: Types of multiple reactions. L9: Definitions of yield and selectivity. L10: Analysis of parallel, series, consecutive reactions. L11: Effect of pressure and temperature on multiple reactions L12: The Denbigh reaction and its special cases	10hr
3	**Stoichiometric considerations :** L13: Stoichiometric considerations in batch systems (constant and variable density). L14: Stoichiometric considerations in flow systems (constant and variable density). L15: Examples: batch, semi-batch reactors, flow reactors, and Industrial reactors.	6hr
4	**Collection and Analysis of rate data:** L16: Differential and integral methods. L17: Initial rate and half-life methods.	4hr

Universityof Technology
Department of Chemical Engineering

Program	***Chemical ProcessingEngineering***					
Course Code	**CES.P.337**	Credits hr				Units
Course Title	Heat transfer I					
Term	1^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Fluid flow &Math	2	0	1	3	2

Course Description

To introduce and develop an understanding the modes of heat Transfer (conduction, convection and radiation).Derive and discusses all types of equation in these modes of heat transfer. Analyze heat transfer rate data in different modes. Derive the necessary equations for hydrodynamics and thermal boundary layer. Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

Course Text

1- J.P.Holman, Heat Transfer, Ninth edition.
2- Frank P. Incropera& David P. Dewitt, Fundamentals of Heat and Mass Transfer, Fifth Edition.

Other support books :-

1- Coulson ,J.M and Richardson J.F. “Chemical Engineering , volume 1”,3rd edition.

Course Objectives: at the end of the semester the student should be able to:-

1- Develop a deep understanding of issues related to the heat and energy balance for different chemical process
2- 2. Define and solve problems in heat transfer mechanism in various engineering applications.
3- 3. Explain and derive heat equations for the conduction and convection heat transfer.
4- 4. Apply the analytical equations and correlations in convection heat transfer problems.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Modes of Heat Transfer:** Conduction, Convection and Radiation**.**	4 hrs
2	**Steady State Heat Conduction in One Dimension:** General heat conduction equation in different coordinates, Plane wall, Radial systems, heat source systems, Boundary surrounded by fluids, Overall heat transfer coefficient, Conduction convection systems and fins.	10 hrs
3	**Unsteady State Heat Transfer:** Temperature as a function of time, lumped capacity system, quenching of small bodies and heating of tank.	4 hrs
3	**Principles of Convection:** Transport equations, Fluid mechanism aspect of convection, laminar boundary layer, The turbulent portion of boundary layer, The laminar sub-layer. Thermal boundary layer, Empirical and practical relations for pipe and tube flow and flow normal to single and tube banks. Reynolds analogy.	12 hrs

University of Technology
Department of Chemical Engineering

Program	***Chemical ProcessingEngineering***					
Course Code	**CES.P.339**	Credits hr				Units
Course Title	Chemical Process Industries I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemistry, Material Eng.	2	0	0	2	2

Course Description

The syllabus deals with Industrial Chemistry. Which includes manufacture of sulfuric acid, nitricacid, ammonia, nitrogenous fertilizers, phosphoric acid, phosphate fertilizers, electrolytic industries, and industrial salts.

Course Text

1.Shreves chemical process industries, Austin , G. T. , 5thed , McGraw- Hill ,1984
2.N. Naderpour ,Petrochemical production process,1st reprint, sbspublication,New Delhi,2009
3. Hydrocarbon processing ,Petrochemical processes,2005

Course Objectives : at the end of the semester the student should be able to :-

1- Chemical process definition and its applications on an industrial scale.
2- Introduction to natural or primary raw materials and their potential use.
3- Introduction to the use of chemical agents in industry.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Chemical processing:** Process classification, Process types, Operating conditions , Flow charts, Industrial stoichiometry, control system ,research and development	2hr
2	**Sulfur and Sulfuric acid:** Raw materials, Mining and manufacture of sulfur , Manufacture of sulfuric acid , Manufacture of oleum	6hr
3	**Ammonia and Nitric acid:** Raw materials, manufacture procedure of ammonia, Nitric acid production,	6hr
4	**Nitrogenous fertilizers:** Types of chemical fertilizers, Manufacture processes of $(NH_4)So_4$, Manufacture process of NH_4NO_3, Manufacture process of Urea	4hr

5	**Phosphate fertilizers:** Raw materials, Manufacture process of super phosphate, Manufacture process of triple super phosphate, Phosphorous, Phosphoric acid manufacture process, Nitrophosphate	**4hr**
6	**Electrolytic industries:** Chloro- Alkali industries	**4hr**
7	**Industrial salts**	**4hr**

University of Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P.3311**	Credits hr				Units
Course Title	Biochemical Engineering					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	None	2	0	0	2	2

Course Description

General definitions, Enzymes, Bioreactors (batch and continuous), Models of enzymes kinetics, inhibition of enzyme, Mass transfer in biological reactors, classical growth curve, Fermenters, Heat transfer in biological reactors, wastewater treatment, Aerobic fermentation process.

Course Text

1-Rajiv Dutta , "Fundamentals of Biochemical Engineering",India,2007
2-Nukesh Double, "Biochemical Engineering" ,India 2007
3- James E.Bailey , David F. Oils, "Biochemical Engineering Fundamentals",2nd ,1986.

Course Objectives : at the end of the semester the student should be able to :-

1.Introduce and understanding of microorganisms.
2.Introduce the types of biochemical reactors and fermenters.
3. Introduce biochemical wastewater treatment.
4. Introduce biochemical industries.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Definitions:** Principles definitions to know the principles of bioscience	2hr
2	**Classification of enzymes:** Types of enzymes and the role in bio reactors	2hr
3	**Michaelies model:** Know how to calculate the reaction rate	2hr
4	**Briggs model:** Know how to calculate the reaction rate	2hr
5	**Calculate the parameters:** How calculate the parameters of this models	2hr
6	**Mods of bioreactors:** Understand the types of bioreactors	2hr
7	**Batch reactor:**	2hr

	Know how to calculate the reaction time	
8	**Continuous reactor:** Know how to calculate the volume of reactor	2hr
9	**Immobilized of enzymes:** Know the advantages and disadvantages	2hr
10	**Fermenters:** General explanation	2hr
11	**Types of fermenters:** Know the types and choose the best depending the process	2hr
12	**The division rate:** Know how to calculate the division rate	2hr
13	**Heat transfer in bioreactors:** Know the basic principles of heat transfer in bioreactor	2hr
14	**Wastewater treatment:** Know the main biological wastewater treatment	2hr
15	**Biological industries:** Explain some biological processes	2hr

Universityof Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P.3313**	Credits hr				Units
Course Title	Equipment Design					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Basic Principles of chemical ,fluid flow,	2	---	1	3	2

Course Description

.The course content process planning, piping and pumps network , gas-gad separation ,solid handling, hear and mass transfer equipments

Course Text

.Sinnott R. and Towler C; 2013 " chemical Engineering Design" 5th edition Butterworth-Heinemann Coke,A.K ;2007"Ludwig s Applied Process Design of Chemical and petrochemical Plant" vol. 1 4th edition Gulf professional Publisher

Course Objectives : at the end of the semester the student should be able to :-

The ability to apply the design equation and equipments specifications as practical To prepare students to be able to read and understand chemical engineering plants drawing

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Process planning:** Introduction, Nature of design ,the organization of a chemical engineering projects Scheduling .Standards and codes. Flow sheet design, flow sheet types and designation .Block diagram .Process flow sheet .Piping and instrumentation diagram .Utilities, Computer aided drafting ,process simulation programs .Layout and plot plan .Project evaluation and cost estimation	6hr
2	**Piping network and Pumps:** Valves selection . Piping design standards and codes . Pipe size selection .Mechanical design of piping system. Pump type, pump specifications, and pump data sheet	4hr
3	**Vessels and tanks:** Types of vessels. Criteria in vessel design ,stress considerations . Materials of construction commonly used in vessels tanks. Design of tall vertical vessels . Pressure vessels Design. Vessels supports and foundations	4hr

4	**Solid Handling**: Screening Classification with Streams of Air or Water Air Classifiers . Size Reduction. Equipment for Size Reduction Particle Size Enlargement Extrusion Processes	**4hr**
5	**Heat Transfer Equipments:** Heat exchanger types and applications. Basic design procedure and theory. Overall heat transfer coefficient. Heat exchanger data sheet. Furnaces convection and radiation zone. Steam boilers	**6hr**
6	**Mass Transfer Equipments**: Columns types . Plate Types. Packing types . Pressure drops in columns . Column data sheets	**6hr**

University of Technology
Department of Chemical Engineering

Program	***Chemical Processing Engineering***					
Course Code	**CES.P.332**	Credits hr				Units
Course Title	Thermodynamics II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mass Transfer,Unit Operation I ,Equipment Design	2	-	1	3	2

Course Description

The course discuss the study of Power cycles; Refrigeration and liquefaction process; Theory and application of solution thermodynamics ;Vapor/liquid equilibrium in both: binary and multi-components; Ideal and non-ideal solutions are discussed using Raoult's and modified Raoult's law; Fugacity and fugacity coefficient definitions; Chemical reaction equilibriumandThermodynamic analysis of processes.

Course Text

1- J. M.Smith,H.C.Van Ness, Introduction to chemical engineering thermodynamics, 6th edition (International Edition), Mc-Graw Hall, 2008.

Other support books :-

1-K.V.Narayanan, Atext book of chemical engineering thermodynamics, prentice Hall of India, New Delhi, 2011.
2- B.G.Kyle, Chemical and process thermodynamics ,(3rd Edition), prentice Hall Inc.New Jersey, 1984.
3-J. Rayner, Basic engineering thermodynamicsinSI units, printed in great Britain,1971.

Course Objectives : at the end of the semester the student should be able to :-

1-Apply the laws of thermodynamics to power, refrigeration and liquefaction cycle.

2-Establish thermodynamic constraint that apply to VLE, and explain qualitatively the VLE diagram.

3. Apply thermodynamics to VLE of pure components and solutions in terms of fugacity and fugacity coefficients.

4. Apply equilibrium criteria to chemical reactions and evaluate the effect of temperature.

5. Revision for thermodynamic analysis of processes.

University of Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Production of power from heat**: The steam power plant, Rankin cycle, the regenerative cycle, internal combustion engines Otto engine, diesel engine, gas turbine engine.	4 hr
2	**Refrigeration and liquefaction:** The Carnot refrigerator, the vapor compression cycle, the choice of refrigerant, absorption refrigeration, the heat pump, liquefaction processes.	6 hr
3	**Vapor\liquid equilibrium; introduction :** The nature of equilibrium, the phase rule, Duhem,s theorem, diagrams for vapor liquid equilibrium, simple models for VL equilibrium: Rault,s law, dew point and bubble point calculations, Henrys law, VLE by modified Raults law, VLE from K value correlations, flash calculations.	9 hr
4	**Solution thermodynamics: theory** Fundamental property relations, the chemical potential and phase equilibrium, ideal gas mixtures, fugacity and fugacity coefficient, the fundamental residual property relations, the ideal solutions.	2 hr
5	**Chemical Reaction equilibrium:** The reaction coordinate, standard Gibbs energy change and equilibrium constant, effect of temperature on equilibrium constant, evaluation of equilibrium constant, liquid phase reactions, equilibrium conversion for single reactions.	6 hr
6	**Thermodynamic analysis of processes:** Second law relation for steady state flow processes, calculation of ideal work, thermodynamic analysis of steady state flow processes.	3 hr

University of Technology
Department of Chemical Engineering

Program	Chemical Processing Engineering					
Course Code	**CES.P.322**	Credits hr				Units
Course Title	Applied Mathematicsin chemical Engineering					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I, II	2	-	1	3	2

Course Description

This course introduces students to: Solve ordinary differential equations: apply Laplace transform to solve various systems of ordinary differential equations: Solve different types of partial differential equations. At the end of the course students should be able to apply these methods to tackle all kinds of problems that appear in chemical engineering.

Course Text

1. "Mathematical Methods in Chemical Engineering", Jenson. V.J. and Jeffereys, G.V, 2nd Edition, Academic Press New York, 1977.
2. "Applied Mathematics and Modeling for Chemical Engineers",Rice R G. and. Do, D. D., John Wiley and Sons, New York, 1995.
3. "Applied Mathematical Methods for Chemical Engineers",Loney, Norman W., 2^{nd} edition, CRC Press – Taylor & Francis Group, Boca Raton, 2007.

Course Objectives: at the end of the semester the student should be able to:-

Apply different analytical methods to solve chemical engineering problems.

Topics Covered (Syllabus)/ Applied Mathematics in chemical Engineering

No.	Contents	Duration
1	**Ordinary Differential Equations :** First-order differential equations, Linear and nonlinear first-order equations, Formation of differential equations, Solutions of linear differential equations, Initial and Boundary value problems, Separable first-order ode's, Exact differential equations, Differential operator, Integrating factors, Solutions of second order linear homogenous equations, Coupled first order equations, Method of reduction of higher order differential equations, Solutions of higher order homogenous linear equations. Chemical engineering applications: Application of the law of	**10hr**

	conservation of mass, First-order chemical reaction in a batch reactor, Heating a closed kettle, Cooling of a hot object, Dilution of a salt solution in a stirred tank, Consecutive reaction system in a batch reactor, Radial heat transfer through a cylindrical conductor, Reaction in a spherical and cylindrical catalyst, Flow of heat from fin. Simultaneous diffusion and chemical reaction in a tubular reactor, Solvent extraction in N stages.	
2	**Laplace transform**: Laplace transforms, Laplace transform of the derivatives, Laplace transform of Integral, Laplace Transform of t.f (t) (multiplication by t), Properties of Laplace transform, Laplace transform of special functions (step, pulse, Impulse, ramp and periodic functions), Convolution theorem, Initial value problems (multiplication by s), Final value problems (division of s), First shifting properties, second shifting properties, Inverse of Laplace transform, Inverse Laplace transform of derivatives, Inverse Laplace Transform of Integrals, Partial Fraction, Solution of differential equations, Solution of simultaneous ordinary differential equations, Application of Laplace transform to solve chemical engineering problems.	**10hr**
3	**Partial differential equations:** Classification of partial differential equations, Formulation of partial differential equations, Continuity equation, Unsteady-state component mass transfer with axial symmetry, Unsteady-state heat conduction with axial symmetry, Boundary conditions, Solution of partial differential equation by direct Integration, General and particular solutions, superposition of solutions, Complementary solution, Particular solution, Solution using separation of variables method, Solution using Laplace transforms method, Solution using combination of variables method. Chemical engineering applications: i. Heat conduction in a semi-infinite slab. ii. Unsteady conduction/diffusion in one dimension. iii. Steady-state heat conduction in two-dimensions.	**10hr**

University of Technology
Department of Chemical Engineering

Program	Chemical Processes Engineering					
Course Code	CES.P.334	Credits hr				Units
Course Title	Unit Operations I					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mass transfer	2	0	1	3	2

Course Description

This course covers two main operations, gas absorption, stripping and distillation for binary and multi component mixtures. Concepts to design mass transfer equipment.

Course Text

1- Coulson, J. M & Richardson J. F. (2006). “Chemical engineering”, Volume 2, 3^{rd} Edition, Robert Maxwell. M. C.
2- Dutta Binary K. (2007), “Principles of Mass Transfer & Separation Process”, Bvt. Ltd. Prentice Hall, ISPN 8-1203-2990-2.

Other support books:-

1- Treybal Robert E. (1975), “Mass transfer Operation” 2^{nd} Edition, Mc-Graw-Hill Book.
2- McCabe, W., Smith, J., Harriott, P. (2004), “Unit Operations of Chemical Engineering”,Mc-Graw-Hill Co., 7^{th} Edition, ISBN0072848235.

Course Objectives: at the end of the semester the student should be able to:-

1- Understand the basics of gas absorption, stripping and distillation.
2- Design absorbers, strippers and distillation columns.
3- Find Operating lines, feed line and No. of trays or amounts of packing required.
4- Calculate columns efficiency.

Topics Covered (Syllabus)/ Unit Operation I

No.	Contents	Duration
1	**Introduction to separation processes:** General separation techniques. The mechanism of absorption and stripping processes. Flow regimes.	4 hrs
2	**Absorption in packed bed columns**: Constructions, mass transfer coefficients & specific area, capacity, height of columns based on gas film, liquid film, and based on overall conditions, operating line, the transfer units, the importance of gas and liquid flow rates.	4 hrs
3	**Absorption in Tray towers :** Types of trays, number of trays analytically and graphically. How to calculate the tray and column efficiency.	4 hrs
4	**Introduction to distillation process:** Partial pressure, Dalton's, Raoult's& Henry's laws. Relative volatility, non ideal systems. Method of diffusion, binary mixtures, batch distillation, flash distillation, steam distillation. Fractionating column.	3 hrs
5	**Fractionating process**: Number of plates required importance of reflux ratio, location of feed point, multiple feeds and side streams.	3 hrs
6	**Multi-component Distillation :** Key components. Components distributions, equilibrium data, feed & product compositions, minimum reflux ratio, calculation number of trays required, relation between reflux ratio & number of plates.	4 hrs
7	**Plate & packed distillation columns:** General designed methods, column efficiency	4 hrs
8	**Reynolds Analogy**: Mass transfer with bulk flow, flow over a plane surface, flow in a pipe.	4 hrs

University of Technology
Department of Chemical Engineering

Course Code	CES.P.336	Credits hr				Units
Course Title	Reactor Design					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemical Reaction Kinetics	2	-	-	2	2

Course Description

Theory,design fundamentals and mass conservation equations for ideal reactors, isothermal reactors for homogeneous reactions, non-isothermal reactors, multiple reactor System.

Course Text

1- Octave Levenspiel (1999),*CHEMICAL REACTOR ENGINEERING*, 3^{rd} edition, John Wiley & Sons Inc., USA ISBN: 9780471254249.

2- J.M. Smith (1987), *CHEMICAL ENGINEERING KINETICS*, 3^{rd} edition, McGraw-Hill International Editions, Singapore. ISBN: 9780070587106

Other support books :-

2- Ronald W. Missen; Charles A. Mims; Bradley A. Saville (1999), *INTRODUCTION TO CHEMICAL REACTION ENGINEERING AND KINETICS*,1stedition, John Wiley & Sons Inc.,USA.

3- . H. S. Fogler, Elements of Chemical Reaction Engineering, 4th Ed (2006), Prentice Hall,NewYorK.

Course Objectives : at the end of the semester the student should be able to :-

This course aims to establish fundamental knowledge for the students in chemical reactor engineering. At the end of this course, students should be able to:

(i) apply reaction kinetics principles in chemical reactor engineering.

(ii) identify and formulate problems in chemical reactor engineering and find appropriate solutions.

(iii) specify and size the most common industrial chemical reactors to achieve production goals for processes involving homogeneous reaction systems.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction to reactor design:** L1: Interpretation of rate data, scale-up, and design L2: Classification of reactors.	2hr
2	**Design fundamentals and mass conservation equations for ideal reactors:** L1: Conservation of mass in reactors. L2: The ideal stirred-tank reactor (Batch and steady-state flow) L3: The ideal tubular flow reactor (PFR) L4: Space time and space velocity	4hr
3	**Isothermal reactors for homogeneous reactions:** L5: Design procedure: Batch reactor (constant volume and constant pressure) L6: Design procedure: Continuous stirred-tank reactors (Single and multiple reactions) L7: Design procedure: Tubular-flow reactors L8: Comparison of stirred-tank and tubular-flow reactors. L9: Flow recycle reactors L10: Non-steady flow (semi-batch) reactors	8hr
4	**Non-isothermal reactors:** L11: Energy conservation equations L12: Batch stirred-tank reactors L13: Continuous stirred-tank reactors	8hr
5	**Multiple reactor System:** L14: Plug flow reactors in series and/or parallel L15: Equal- size mixed flow reactors in series (first order and second order reactions) L16: Mixed Flow Reactors of different sizes in series. L17: Best arrangement of a set of ideal reactors	8hr

Universityof Technology
Department of Chemical Engineering

Course Title	Heat transfer II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Heat transfer I	2	2	1	5	3

Course Description

Characterization the design procedures for different heat transfer equipments as heat exchanger. Discuss the heat transfer in boiling and condensation processes .Characterization the design procedures for furnace. Give a new knowledge in renewable energy systems. Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

Course Text

- J.P.Holman ,Heat Transfer, Ninth edition.
- Frank P. Incropera& David P. Dewitt, Fundamentals of Heat and Mass Transfer, Fifth Edition.

Other support books :-

- Coulson, J.M. , Richardson, J.F., Backhurst, J.R.andHarker, J.H., “Chemical Engineering” Volume(1) 6th Edition.

Course Objectives: at the end of the semester the student should be able to:-

1. Design heat exchanger equipments.
2. Define and solve problems in boiling and condensation heat transfer.
3. Design the furnace and understand the radiation heat transfer.
4. Solve problems in heat transfer applications.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Heat Exchangers:** Various types and their general characteristics, Overall heat transfer coefficient, fouling factor, Heat exchangers mean temperature differences and Co-current and counter current flow.	10 hrs
2	**Shell and Tube Exchanger:** Types and various specifications, design calculations by conventional and by effectiveness (NTU) methods and optimum design calculation.	6 hrs
3	**Condensation and Boiling Heat Transfer:** Condensation of single vapors, Laminar film condensation Design calculations for condenser, Pool and flow boiling, Boiling regime, General aspects, Boiling correlations.	6 hrs
4	**Radiation and Furnace design:** Radiation properties, shape factor, heat exchange for non black bodies, parallel planes, shields, gas tradition.	4 hrs
5	**Renewable Energy:** Solar radiation, Solar water heater, Solar air heaters, Heat exchangers for ocean thermal energy, Heat storage and transmits.	4 hrs

University of Technology
Department of Chemical Engineering

Practical Heat Transfer II

No.	Experiment Name
1	**Conductive Heat Transfer in Steady State.**
2	**Coil Heat Exchanger.**
3	**Determination of Overall Heat Transfer Coefficient on Air Velocity**
4	**Performance of Cooling Tower**
5	**Graphite Heat Exchanger**
6	**Extended Surface Heat Transfer**

University of Technology
Department of Chemical Engineering

Program	*Chemical ProcessingEngineering*					
Course Code	CES.P.3310	Credits hr				Units
Course Title	Chemical Process Industries II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemistry, Material Eng.	2	3	0	5	3

Course Description

The syllabus deals with Industrial Chemistry,which includes manufacture of ceramic,cement, glass, oil and fats, soap and detergents, sugar, and production of liquid biofuels from renewable resources.

Course Text

1.Shreves chemical process industries, Austin , G. T. , 5th ed , McGraw- Hill ,1984
2.N. Naderpour ,Petrochemical production process,1st reprint, sbspublication,New Delhi,2009
3.Hydrocarbon processing ,Petrochemical processes,2005

Course Objectives : at the end of the semester the student should be able to :-

To provide an understanding of the synthesis, industrial manufacture, flow diagram, properties and uses of important chemical industries such as ceramic, oil and fats, soap and detergents.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Ceramic industries:** Raw materials, Classification of ceramic products, White ware, Refractories	6hr
2	**Cement industries:** Raw materials, Classification of cement, Manufacture of Portland cement	4hr
3	**Glass industries:** Raw materials, Glass fabrication, Types of Glass	4hr
4	**Oil and fats:** Oil and fats sources and properties, Chemical compositions, Manufacture steps of oil	4hr
5	**Soap and detergents:** Detergent groups, Manufacture of fatty acids, Manufacture of fatty alcohols, Manufacture of detergents, Manufacture of soap	4hr

6	**Sugar industries:** Cane sugar, Beet sugar	4hr
7	**Production of liquid biofuels from renewable resources**	4hr

Practical Chemical Process Industries II

No.	Experiment Name
1	Water treatment by ionic exchange
2	Extraction of vegetable oils
3	Production of fatty acid
4	Production of soap
5	Sulfonation of detergent –Alkylates
6	Production of Urea Formaldehyde
7	Biodiesel production
8	Chloroform production
9	Ethanol production
10	Ethyl acetate production

University of Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	CES.P.3312	Credits hr				Units
Course Title	Particles& Nanotechnology					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemistry &Physics	2	-	-	2	2

Course Description

Particle technology, particle size and properties, size reduction particle size reduction, Nanotechnology, synthesis of nanomaterial, investigation methods and application.

Course Text

1- Hiroaki, Mosuda, “ Powder Technology Handbook” 2006

Course Objectives : at the end of the semester the student should be able to :-

1-The student an understanding of the fundamental principle of particle and nanotechnology

2-Particle size measurements methods, particle reduction size, particle distribution, Nanotechnology, nanoparticles, Synthesis methods, nano particles and measurement techniques, application of nanotechnology in different fields.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Particle Technology** Particle, particle shape, measurement of particle size	5hr
2	**Size reduction** Methods of size reduction, energy required for size reduction, particle size distribution, crystal structure and crystalin structure of materials	5hr
3	**Nanotechnology** Nanotechnology, nanoscience, nanomaterials	5hr
4	**Synthesis of nanomaterial** Mechanical, physical, chemical, sol-gel, CVD, Carbon nanotubes properties and production	5hr
5	Nanoparticals investigation methods, XRD, FTIR, SEM, TEM, AFM	5hr
6	Application of Nanotechnology	5hr

Universityof Technology
Department of Chemical Engineering

Program	*Chemical ProcessingEngineering*					
Course Code	**CES.P.3314**	Credits hr				Units
Course Title	Equipment DesignUsing CAD					
Term	2 nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Thermodynamics, heat and mass transfer	2	2	1	5	3

Course Description

.The aim of the subject is to engaged students with chemical plants by explain to them the main items of plant design and teach them procedures to design different equipments with computer programs

Course Text

.Sinnott R. and Towler C; 2013 " chemical Engineering Design" 5^{th} edition Butterworth-Heinemann
Coke,A.K ;2007"Ludwig s Applied Process Design of Chemical and petrochemical Plant" vol. 1 4^{th} edition Gulf professional Publisher

Course Objectives : at the end of the semester the student should be able to :-

1-Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.
2- The student be able to use computer software packages to perform design activity beside the conventional methods

3- The student should have the necessary skills to design equipments

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	Applied Design for Pressure vessels ,pumps and compressors flash drum, gas-liquid separator, liquid-liquid separator, gas movers and compressors manually and with computer aided	**12 hr**
2	Applied Design for heat equipments (shell And tube heat exchanger, plate heat exchanger , coil type exchanger, condenser, vaporizer, air cooler …….etc) manually and with computer aided	**12 hr**
3	Applied Design for mass transfer equipments (distillation column, absorber column, leaching equipment, scrubber…………..etc) manually and with computer aided	**6 hr**

Universityof Technology
Department of Chemical Engineering

Practical Equipment designusing CAD

No.	Contents
1	**Introduction**
2	**Equation of state & stream**
3	**Rotating Equipment (3.1 Compressor, 3.2 Expander, 3.3 pump)**
4	**Separation Operations (Separator , 3-Phases Separator , 4.3 Tank)**
5	**Heat Transfer Equipment (Heater & Cooler, Heat Exchanger, LNG,Air Cooler)**
6	**Column distillation** **(Column Installation, Column Property View, Column-Specific Operations and Running the Column)**
7	**Reactors(CSTR, General Reactor, Gibbs, Equilibrium, conversion)**
8	**Logical Operations (Adjust, Balance, Recycle, Set)**
9	**process plant involving reaction and separation**
10	**Examination lab**

<table>
<tr><td>Program</td><td colspan="6">Chemical Processing Engineering</td></tr>
<tr><td>Course Code</td><td>CES.P.421</td><td colspan="4">Credits hr</td><td rowspan="3">Units</td></tr>
<tr><td>Course Title</td><td>Project I</td><td colspan="4"></td></tr>
<tr><td>Term</td><td>1st Semester</td><td>Theoretical</td><td>Practical</td><td>Tutorial</td><td>Total</td></tr>
<tr><td>Prerequisite(s)</td><td>1. Basic Principles of chemical engineering I
2. Basic Principles of chemical engineering II
3. Material &Energy Balance.
4. Thermodynamics I & II</td><td>1</td><td>2</td><td>---</td><td>3</td><td>2</td></tr>
</table>

Course Description

The course includes the design aspects and design considerations for plant of chemical industry.

Course Text

Sinnott R.K. "Chemical Engineering Design", Coulson and Richardson's. Chemical Engineering, Volume 6, Fourth edition, (2005).

Other support books :-

1. Peters M. S.,Timmerhaus K.D. and West R.E. Plant Design and Economics for Chemical Engineering, Fifth edition, (2003).

Course Objectives: at the end of the semester the student should be able to:-

To learn the students the basic information's of designing the chemical plants and the economic and engineering aspects

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction to Design:** The anatomy of chemical manufacturing process, general overall design considerations, development of design data base, process creation, types of process design.	**5 hr**
2	**Design Information and Data :** Source of information of physical properties , predication of physical properties (density, viscosity, thermal conductivity , etc)	**5 hr**
3	**Material and Energy Balance**: Review of material and energy balance, flow sheet symbols, PFD information in flow diagram	**5 hr**

Project Requirements

No.	Contents	Duration
1	**Chapter One:** Introduction, Historical Profile, Physical and Chemical Properties, Applications for chemical material production.	4 hr
2	**Chapter Two:** Production Methods, Comparison between Processes, Selected the optimum Process, Physical properties of raw materials and by products, Production Capacity.	4 hr
3	**Chapter Three:** Material balance for the plant process.	10 hr
4	**Chapter Four:** Energy balance for the plant process, Process flow diagram (PFD).	10 hr
5	**Poster and Oral Presentation**	2 hr

University of Technology
Department of Chemical Engineering

Program	*Chemical Process Engineering*					
Course Code-	**CES.P. 431**	Credits hr				Units
Course title	Unit Operation II					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics II, Engineering Mathematics I , II, Numerical Analysis, Energy Balance, Material &Energy Balance, Fluid FlowI, II, Thermodynamics I, II, Mass Transfer, unit operation I , II, Heat treansfear I, II,	2	2	1	5	3

Course Description

Theory, applications and design of unit operations which are mostly employed in the chemical industry, drying of solid, humidification, dehumidification and cooling tower and liquid evaporation and crystallization.

Course Text

- Coulson ,J.M and Richardson J.F. "Chemical Engineering , Volume 1, 3rd edition ,Robert Maxwell.M.C.
- Coulson J.M, and Richardson J.F. "Chemical Engineering, Volume 2, 3rd edition, Robert Maxwell.M.C.

Other support books :-

- Perry,J.H, "Chemical engineering handbook ",Mc-Graw –Hill Bookcom.1975.
- Binay.K.Dutta "Mass transfer and separation process" 2007.
- Trebal Robert E., "Mass transfer operation"2nd edition, Mc-Graw –Hill Book com.1975.

Course Objectives: at the end of the semester the student should be able to:-

1-To provide an understanding of the general principles of separation processes to allow students to make sensible options given a separation task (Humidification, Dehumidification and Cooling tower, Evaporation, crystallization, and Wet Solid Drying).
2-A comprehensive understanding of the transport processes related to chemical engineering operations, with focus on both theory and applications.
3-Ability to select of appropriate equipment for the separation of materials in process plant.
4-Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

Topics Covered (Syllabus)

No.	Contents	Duration
1	**Drying of Solids:** Introduction Drying of Solids....General Principles. Wet Solid Group.Terminology and Definitions. Humidity Measurement. Humidity Data for Air – Water system. Temperature –Humidity Chart (Psychometric Chart). Uses of Humidity Chart. Rate of Drying. Calculation method of Drying Rate and Time. Drying Rate. Drying Time. Mechanism of Moisture Movement in Wet Solid. Material and Heat Balance for Continuous Dryers. Rate of Drying for continuous Direct Heat Driers. Drying at High Temperature. Drying at Low Temperature. Drying Equipment.	6 hrs
2	**Humidification, dehumidification and Cooling towers:** Introduction. Humidification Operations. Adiabatic Operations. Non-Adiabatic Operations. Mixing of Humid Streams. Mixing of Two Stream of Humid Gas. Addition of Liquid or Vapor to a Gas. Humidification Processes Theory. Cooling Tower Principles and Operations. Cooling Tower Classification. Design Cooling Tower. Adiabatic Humidification — Cooling. Dehumidification Tower	9 hrs
3	**Evaporation:** Introduction, Types of Evaporations, Evaporation Equipment, Heat transfer in Evaporation Process, single, double and Multi effect Evaporators, Design of evaporators, Comparison of Forward, backward and Parallel effect evaporators, boiling Point rise.	9 hrs
4	**Crystallization :** Crystallization fundamentals, cooling crystallizer, Evaporating crystallizer, Batch and continuous crystallization Crystallizer selection.	6 hrs

Practical Unit Operation II

No.	Experiment Name
1	**Tray Dryer**
2	**Plate and Frame Filtration**
3	**Rotary Drum Filtration**
4	**Design of Cooling Tower**
5	**Sedimentation**
6	**Liquid - Liquid Extraction**

University of Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P. 433**	Credits hr				Units
Course Title	Process Dynamic					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	1.Heat and Material balance 2.Applied Mathematics	2	-	1	3	2

Course Description

Study of dynamics characteristics of open-loop Chemical Engineering processes to formulate transfer function and analysis response of the system to design and select closed-loop controlscheme.

Course Text

1. D.R. Coughanowr and S. LeBlanc, Process Systems Analysis and Control, McGraw-Hill, 3rd edition, 2008.
2. Stephanopoulos G., “Chemical Process Control-An Introduction to Theory and Practice, ”Prentice -Hall, New Jersey, 1984.

Other support books :-

1-Luyben W. L., “Process Modeling, Simulation and Control for Chemical Engineers,” McGraw-Hill, New York, 2nd Ed., 1990 .

2-Process Dynamics: Modeling, Analysis and Simulation, by Wayne Bequette.

Course Objectives : at the end of the semester the student should be able to :-

1- Study of dynamic analysis of chemical processes to allow students to identify the system under different operating conditions.

2- Understanding of formulate transfer function of the system.

3- Testing and selecting of critical process variables.

4- Developing of skills, solving open ended problems and to work in teams.

Topics Covered (Syllabus)/ Process Dynamic

No.	Contents	Duration
1	Linear Open-Loop Systems: Transfer function, Transient Response,Forcing Functions:Step Response ,Impulse Response Ramp Response Sinusoidal Response.	10hr
2	Applications of First Order Systems: Liquid –level system, heating system, Mass transfer system, Reactors, absorber, pressure vessel, Linearization.	8hr
3	Response of First-Order Systems in Series Non-interacting System, Interacting System.	4hr
4	Higher-Order Systems: Second-Order: Under-damped, Critical and over-damped, Transportation Lag	8hr

Universityof Technology
Department of Chemical Engineering

Program	***Chemical Processing Engineering***					
Course Code	**CES.P. 435**	Credits hr				Units
Course Title	Petroleum refinery processing					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Cat. Chemistry	2	0	1	3	2

Course Description

An introduction to petroleum feedstocks, refining processes, and how refined products are made. Design of atmospheric and vacuum columns for petroleum fractionation will be explained. Refinery processes will be explained in terms of their objectives, feedstocks, products and catalysts.

Course Text

1. W.L..Nelson" Petroleum Refining Engineering " 4th Edition. McGraw Hill, New York, 1985
2. M.A. Fahim, T.A. Al-Sahhaf, and A.S. Elkilani," Fundamentals of Petroleum Refining", Elsevier, 2010.
3. J.H. Gary and G. E. Handwerk and M.J. Kaiser, "Petroleum Refining Technology and Economics", 5th Ed. CRC Press, 2007.

Course Objectives : at the end of the semester the student should be able to :-

1. Become knowledgeable in composition, properties and classification of crude oil or petroleum.
2. Become familiar with the overall refinery processes including physical separation operations and chemical conversion processes.
3. Become knowledgeable about impurities in crude oil and how to remove them from products.

University of Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Petroleum Processing Overview :** History of Petroleum Production, What is Petroleum, History of Petroleum Processing, Modern Petroleum Processing. Refinery Feed-stocks and Products.	2hr
2	**Thermo-physical Properties of Petroleum Fractions and Crude Oils:** Specific Gravity, Boiling Point Curves, Breakup of TBP Curve into Pseudo-components, Thermo-physical Properties Calculation.	4hr
3	**Heating of Crude oil :** Types of pipe still heaters , calculations of radiant absorption rates	4hr
4	**Crude Distillation :** Desalting Crude Oils, Atmospheric distillation tower: types of refluxes. Energy balance in a topping tower and calculations involve estimation of top, side, bottom draw tray temperatures	6hr
5	**Thermal and Catalytic Cracking :** Coking, Visbreaking, Fluid Catalytic Cracking, Hydrotreating and Hydrocracking.	4 hr
6	**Catalytic Reforming:** Objectives, process, Reactions, catalysts and effect of process variables.	2hr
7	**Isomerization, Alkylation and Polymerization:** Objectives, process, Reactions, catalysts and effect of process variables.	2 hr
8	**Products blending :** Reid Vapor Pressure, Octane Blending.	4 hr
9	**Supporting Processes:** Hydrogen Production, Gas Processing Unit, Acid Gas Removal, Sulfur Recovery Processes.	2 hr

Universityof Technology
Department of Chemical Engineering

Program	***Chemical Processing Engineering***					
Course Code	**CES.P. 437**	Credits hr				Units
Course Title	Heterogeneous Reactor and catalyst					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physical chemistry ,mass- and heat- transfer, fluid and thermo-dynamics	2	-	1	3	2

Course Description

Definition, classification of catalysts, properties of heterogeneous catalysts (activity, acidity, selectivity, and porosity), effectiveness of presence the catalysts on kinetic and thermodynamic properties, mechanism of chemical interactions occurring within the catalysts, applications of catalysts in catalytic processes, movement of the reactant molecules around and throughout the body of a catalyst in different types of reactors (fixed-, fluidized-, slurry-, and trickle-bed), intra-particle and diffusivities inside porous catalysts, and modern characterization techniques.

Course Text

1-J. M. Smith (1981), Chemical Engineering Kinetics, 3rd edition, Mc Grow – Hill, Singapore.

2-H. V. Bekkum, E. M. Flanigen, P. A. Jacobs, and J. C. Jansen (2001), Introduction to zeolite science and practice, 2nd edition, Amsterdam: Elsevier.

Other support books :-

1-J.F. Lepage, J. Cosyns&P.Couty, (1987), Applied heterogeneous catalysis. Paris: Editions Technip.

2-R. W. Missen, C. A. Mims, and B. A. Saville (1999), Chemical reaction engineering and kinetics, John Wiley & sons.

3-Daniel Decroocq (1984), Catalytic cracking of heavy petroleum fractions, Paris: Editions Technip.

Course Objectives: at the end of the semester the student should be able to :-

1-The objective of this course focuses on:
in-depth understanding of the catalyst and its impact on either chemical reactionskinetics or thermodynamics.

2-comprehension the principle of diffusion on the internal and external surfaces of the porous catalyst particles with their impact on the nature of reaction products in terms of increasing the quantity and quality and reducing the operating cost.

3-As well as the utilize of the operating equations and design for various kinds of reactors containing the catalyst particles as a key parameter in their work.

4-also to discover the theoretical knowledge about the equipments and characterization techniques used in catalyst and catalysisscience.

5-In addition, identify scientific and engineering information about the performance of a catalyst in enhancing the reaction mechanisms, problem solving, and other related issues.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction:** Definition, classification of catalysts, mechanisms of catalysis, properties of porous catalysts (i.e. mechanical strength, stability, activity, and selectivity), morphology, pore size, solid density and porosity calculations, pore volume distribution, developing the support, promoters and inhibitors, coke formation on the catalyst surface, catalyst deactivation and reactivation.	6 hrs
2	**Applications of catalysts in catalytic processes:** History of the catalysts in catalytic processes, direct oxidation of methanol to formaldehyde, hydrogenation of acetone in a packed bubble column.	4 hrs
3	**Surface area and kinetic parameters determinations:** Determination the surface area of catalyst, calculations of pressure drop and void fraction in a solid catalyst within a packed bed, calculations both the reaction rate and the activation energy over a solid catalyst, operating condition (i.e. temperature, pressure, residence time; *W/F*) and catalyst performance.	4 hrs
4	**Diffusion of bulk fluid over a solid catalyst within a packed bed and reactor design** Fixed-bed reactors: mass and heat-transfer coefficients (fluid-particle), fluidized-bed reactors: particle-fluid mass and heat transfer, slurry-bed reactors:mass-transfer coefficients: gas bubble to liquid (k_L), and liquid to catalyst particle (k_c), trickle-bed reactors: mass-transfer coefficients: gas to liquid ($k_L a_g$), and liquid to particle ($k_c a_c$) with calculation of global rate.	10 hrs
5	**Intra-particle and diffusivities estimation inside porous catalysts:** Diffusion coefficient of Knudsen and Bulk diffusion, Gaseous diffusion in the micro- and macro- cylindrical pores, Diffusion in liquids, Diffusion within porous catalysts (effective diffusivity), pore models (parallel-pore model and random-pore model), surface diffusion, effectiveness factors.	6 hrs

University of Technology
Department of Chemical Engineering

Program	***Chemical Processing Engineering***					
Course Code	**CES.P. 423**	Credits hr.				Units
Course Title	**Industrial Management &Ethics**					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Equipment Design Heat transfer Mass transfer	2	---	---	2	2

Course Description

Theory and applications, of Industrial Engineering Management which are mostly employed in The chemical industryIndustrialEngineeringManagement; ,Industrial organization, Maintenance Work Measurement Techniques, Costing, Quality Control, ISO and Engineering Ethics.

Course Text

T.R. Banga and S.C. Sharma "Industrial Engineering Management" including Production Management, Eleventh Edition:2008.
M.S. Peters, K.D. Timmerhaus and R.E. West "Plant Design and Economics for Chemical Engineers" Fifth Edition: 2003.

Course Objectives: at the end of the semester the student should be able to:-

To helps and learn in the optimum use of plant, equipment, efforts towards productivity improvement, establishing the most efficient and effective utilization of human effort and synchronizing various resources like men, machine and material as well as Engineering Ethics.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Management:** Principle of management, types and classifications, management responsibility, organization responsibility.	**4hr**
2	**Industrial organization**: Site, Feasibility study, Development of efficient work method (plant layout, flow of material, material handling), Workstations, Inputs and Outputs, Production planning (types of Productions).	**3hr**
3	**Maintenance**: Classification, Cost, Machine replacements, Case studies and examples.	**3hr**
4	**Network Analysis:** Principles and applications, Critical path method (CMP), Gant Chart, Pert techniques (examples and case studies).	**3hr**

5	**Work Measurement Techniques:** Time and Motion study.	3hr
6	**Costing:** Framework of management, Cost of production (row material cost, labor cost, machinery cost).	3hr
7	**Quality Control:** Standardization, Specification, Sampling techniques, Inspection- analysis of results. Quality costs (preventive cost, appraisal cost and failure cost). Application of quality control chart-examples, Reliability.	4hr
8	**ISO:** Requirements, applications, ISO series, Quality management system (QMS), Total Quality management (TQM), Requirements and applications.	3hr
9	**Engineering Ethics:** Engineering has a direct and vital impact on the quality of life for all people. Engineering is an important and learned job. Engineers are expected to exhibit the highest standards of honesty and integrity. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct.	4hr

University of Technology
Department of Chemical Engineering

Program	Chemical Processing Engineering					
Course Code	**CES.P. 438**	Credits hr				Units
Course Title	Environmental Eng. & Industrial Safety					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Environmental Eng. & Industrial Safety	2	0	1	3	2

Course Description

Environment; Environmental Engineering: Pollution; Classification of air pollutants, Sources and type of air pollution, Particulate and air born particulate. Air pollution control equipment: types of equipment, its operation and its advantages and disadvantages. Design of settling chamber and cyclones. Source of water, Utilization, and classification. Type of water pollutants and its effect, Wastewater treatment. Oxygen demanding wastewater: Dissolved Oxygen DO, BOD, Oxygen sage curve and the related equations.

Industrial safety

Course Text

1- C.S.Rao, “Environmental Pollution Control Engineering”, 2nd Edition , New Age International(P) Limited, Published, 2006, Reprint 2007.
2- M. Grawford, “Air Pollution Control Theory”, McGraw-Hill, New York, 1976.
3- S.C.Bhatia, ”Environmental Pollution and Control in Chemical Process Industries” 2nd Edition, 2009, KHANNA PUBLISHERS,New Delhi.

Course Objectives: at the end of the semester the student should be able to:-

1- Understand the concept of the environment and environmental pollution.
2- Provide solutions to environmental problems.
3- Concerned with local and worldwide environmental issues.
4- Design devices that are used in the control of air pollution.
5- Environmental engineers conduct hazardous-waste management studies in which they evaluate the significance of the hazard, offer analysis on treatment and containment.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction:** Definition: Environment, Environmental engineering, Pollution and Pollutants.	2hr
2	**Water and Waste Water Treatment:** Source of water, Utilization of water. Types of water pollutants and their effects. Classification of wastewater. Wastewater treatment process.	10hr
3	**Air Pollution Control:** Classification of air pollution. Source of air pollutants. Air pollutants and their effects. Case study treatment of gaseous effluent in typical industry.	8hr
4	**Solid and Hazardous Wastes Law:** Solid Wastes Characterization, Nonhazardous and Hazardous solid waste, Solid wastes treatment.	4hr
5	**Industrial Safety**: Hazards: Toxicity, Flammability, Explosions, Sources of ignition, Ionizing radiation, Pressure, Temperature deviations and Noise. Dow fire and explosion index. Fire and protection, Biological effects. Designing for safety, Personal protective equipment.	6hr

University of Technology
Department of Chemical Engineering

Program	***Chemical Processing Engineering***					
Course Code	**CES.P. 422**	Credits hr				Units
Course Title	Project II					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	5. Mass Transfer 6. Unit OperationI and II 7. Heat Transfer I and II 8. Equipment Design 9. Catalysis Eng. AndReactor Design	1	2	---	3	2

Course Description

The course includes the design aspects and design considerations for plant of chemical industry.

Course Text

Sinnott R.K. "Chemical Engineering Design", Coulson and Richardson's. Chemical Engineering, Volume 6, Fourth edition, (2005).

Other support books :-

2. Peters M. S.,Timmerhaus K.D. and West R.E. Plant Design and Economics for Chemical Engineering, Fifth edition, (2003).

Course Objectives: at the end of the semester the student should be able to:-

To learn the students the basic information's of designing the chemical plants and the economic and engineering aspects

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Choice of Plant Location and Layout Standard**	**3 hr**
2	**Piping and Instrumentation:** Pipes, valves, Pumps, Mechanical design and control	**4hr**
3	**Cost and Project Evaluation**	**3hr**
4	**Safety and Loss Prevention**	**2 hr**
5	**Design with Computer Aided**	**3 hr**

Project Requirements

No.	Contents	Duration
1	**Chapter Five:** Design main equipment by design equation with mechanical design, cost evaluation, control andcomputeraided using Hysyssoftware	14hr
2	Design supported equipment with mechanical design, cost evaluation and control.	6 hr
3	**Chapter Six:** Environmental effect for raw materials, products and by products	6hr
4	**Poster and Oral Presentation**	4hr

University of Technology
Department of Chemical Engineering

Program	*Chemical Process Engineering*					
Course Code-	**CES.P. 432**	Credits hr				Units
Course title	Unit Operation III					
Term	2 nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I**I,** Engineering Mathematics I , II, Numerical Analysis, Energy Balance, Material &Energy Balance, Fluid FlowI, II, Thermodynamics I, II, Mass Transfer, unit operation I , II, Heat treansfearI, II,	2	0	1	3	2

Course Description

A comprehensive understanding of the transport processes related to chemical engineering operations with focus on theory, design and applications ofSolid–liquid filtration, Sedimentation, liquid - liquid extraction, Leaching and Washing.

Course Text

1- Coulson ,J.M and Richardson J.F. “Chemical Engineering” , Volume 1, 3rd edition, Robert Maxwell.M.C.
2- Coulson,J.M and Richardson J.F. “Chemical Engineering” , Volume 2, 3rd edition , Robert Maxwell.M.C.

Other support books :-

1- De Sinha and Parameswar De “Mass Transfer: Principles and Operations”, Parameswar De , New Delhi, 2012
2- Binay.K.Dutta “Mass transfer and separation process” 2007.
3- Trebal Robert E., “Mass transfer operation”2nd edition, Mc-Graw –Hill Book com.1975.

Course Objectives: at the end of the semester the student should be able to :-

1- Basic information, concepts and terminology of the general principles of separation processes of Solid –liquid filtration, Sedimentation, liquid - liquid extraction, Leaching and Washing.
2- Demonstrating a broad and integrated knowledge and a deep understanding of issues related to separation processes in a chemical process and important role it plays in the success of the process both economically and environmentally.
3- Ability to select of appropriate equipment for the separation of materials in process plant.
4- An ability to apply effective, creative and innovative solutions, both independently and cooperatively, to current and future problems in separation processes and transport phenomena.

Topics Covered (Syllabus)

No.	Contents	Duration
1	**Filtration:** Type of Filters, Filtration theory, Plate and frame filter press, leaf filter, filtration at Constant ΔP, Filtration at Constant rate, washing Time, centrifugal filtration	9 hrs
2	**Sedimentation:** Introduction, Settling and Sedimentation in particle fluid separation, Sedimentation and thickening design, equipment for settling and Sedimentation.	6 hrs
3	**Liquid - Liquid Extraction:** Definition, Extraction process, Equilateral Triangular coordinates (Ternary Diagram), system of three liquid _ one pair partially soluble, choice of solvent, Equipment in extraction cross _ current extraction, multi stage Cross Current extracting cross current for insoluble Liquid , Continuous Counter current extraction , Continuous Counter Current in Soluble , Liquid , Minimum Solvent .	12 hrs
4	**Leaching :** General principles, Equipment for leaching, Mass transfer in leaching, continuous operation, Equilibrium-stage model for leaching and washing.	3 hrs

Universityof Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	**CES.P. 434**	Credits hr				Units
Course Title	Process Control and Instruments					
Term	2st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Process Dynamic	2	2	1	5	3

Course Description

Analysis ofclosed-loop Chemical Engineering processes system to design and select closed-loop controlscheme that will operate the plant with stable conditions.

Course Text

1. D.R. Coughanowr and S. LeBlanc, Process Systems Analysis and Control, McGraw-Hill, 3nd edition, 2008.

2. Stephanopoulos G., “Chemical Process Control-An Introduction to Theory and Practice, ”Prentice -Hall, New Jersey, 1984.

Other support books :-

1. Luyben W. L., “Process Modeling, Simulation and Control for Chemical Engineers,” McGraw-Hill, New York, 2nd Ed., 1990 .

2. *Process Dynamics: Modeling*, *Analysis and Simulation*, *by Wayne Bequette*.

Course Objectives : at the end of the semester the student should be able to :-

1. To enhancement the ability of students for the analysis of closed-loop system and response of controlled system under different operating conditions.
2. Construction of transfer function of the closed system for different schemes.
3. Provide practice of tuning of controller parameters and limiting of stable operating conditions.
4. Motivation and encourage the students for solving open ended problems.

Universityof Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Process Control and Instrumentation

No.	Contents	Duration
1	Instrumentation Sensors: pressure, temperature, level, flow and concentration. Control valve. Dynamics characteristics of Instruments.	6hr
2	Linear Closed-Loop Systems The Control System, Controllers and Final Control Elements, Block Diagram of Controlled System, Overall Closed-Loop Transfer Functions.	4hr
3	Characteristics of the Closed Loop System Transient Response of Simple Control Systems, Stability	7hr
4	Frequency Response Methods Introduction to Frequency Response Bode Diagrams, Control System Design by Frequency Response, Ziegler-Nichols Controller Settings.	7hr
5	Computer Control of Chemical process Analog Computer, Digital Computer, Computer Control Loops.	3hr
6	Control of Complex Processes Distillation Column, Absorber, Chemical Reactor.	3hr

Practical Process Control and Instrumentation

No.	Experiment Name
1	**Feedback Control**
2	**Dynamic Behavior of Second order under Damped System (Orifice)**
3	**Flow rate Control**
4	**Level Control in the Tank**
5	**Pressure Control**
6	**Dynamic Behavior of Second order over Damped System (Stirred Tanks)**
7	**Dynamic Behavior of Second order over Damped System (Stirred Tanks Heater)**
8	**Temperature Control**
9	**PH Control**
10	**Control of Water Treatment Unit**

University of Technology
Department of Chemical Engineering

Program	*Chemical ProcessingEngineering*					
Course Code	**CES.P. 436**	Credits hr				Units
Course Title	Petrochemical Industries					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Organic chemistry,unit operation	2		1	3	2

Course Description

Basic PCs(1^{st}PCsgeneration)raw materials,processes and uses,Intermediate:of most basic PCs(2^{nd} generation) ,Final products:involvepolymers.In addition to PC complexes

Course Text

1.Hydrocarbon processing: petrochemical processing,2005.

Other support books :-

1-Shreve's Chemical Process Industries, 5th edition,1988.
2-List,H.L."Petrochemical Technology, 1986
3-Jamaly,J.S."Petrochemical processes,1984:Arabic.

Course Objectives : at the end of the semester the student should be able to :-

1. To introduce and develop an understanding of raw materials of petrochemicals . petrochemical.

2.To introduce petrochemical generation first :Basic petrochemicals,second: Intermediates and third:finalproducts:polymers

3. Give the learner the skills necessary to accomdate considered what has been studied.

4-Provide the student with confidence and study the skills to enable them to progress.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction:** Raw material, characterization	2hr
2	**Basic Petrochemical Materials :** a-low Olefins: Ethylene production by steam Cracking processes b-butylenes: conversion process for production of olefins, Isobutylene production. c-Diolefin:, Butadiene Separation.d- Higher Olefins: production methods.e-. Linear: Alkyl benzene Complex (LAB), f-Aromatics: Sources, Separation of benzene Toluene Xylene.g- Syntheses gas:H_2 production: Steam reforming, Partial Oxidation	11hr
3	**Intermediate Petrochemicals:** Methanol, , Acetic acid, Vinyl chloride M, Ethylene Oxide Ethanolamine, , Ethylene glycol , Acrylonitrile, Adipic Acid, Methyl Tetra butyl ether, Ethyl benzene, Styrene, Phenol, Nitrobenzene, Cyclohexane, Benzoic acid, Terephthalic acid.	9hr
4	**Polymers:** LDPE, HDPE, PP, PVC,PP Synthetic Fibers	6hr
5	**Petrochemical Complexes :** Ethylene ,Propylene ,Benzen , C4 ,BTX	2hr

Universityof Technology
Department of Chemical Engineering

Program	***Chemical Processing Engineering***					
Course Code	**CES.P. 424**	Credits hr				Units
Course Title	Optimization					
Term	2^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Eng.Mathematics1,2 ,Unit Operation.	2	-	1	3	2

Course Description

The subject is to be given in one semester. studying the formulation of objective the theory of optimization of single variable using analytical and numerical methods. Determination in the solution of multi variables problems .studying and solving the linear programming problems(LP).

Course Text

1) Optimization, Greirg D.M. Longmangroup limited London.
2) Optimization, converse A.O ,Holt, Reinhart, and Winston.

Other support books :-

1) Numerical methods for unconstrained optimization, Murrayw. Academic press.
2) Constrained optimization by direct search Swann, W.H. Gill and Murray.

Course Objectives : at the end of the semester the student should be able to :-

1. To formulate many problems arising in widely different situations.
2. Ability for finding optimum. Minimum, or maximum in unconstrained or constrained single or multi variables functions..
3. Deals with the special case of linear programming (functions and constraints are linear).
4. Provide practice to deal with industrial optimization problems.

Topics Covered (Syllabus)/ Optimization

No.	Contents	Duration
1	**Introduction to optimization.**	**2hr**
2	Recognizing an optimization problems and their solution. - Formulation of optimization problems. - Unconstrained and constrained problems.	**6hr**
3	**Optimization methods for single variable problems.** - Analytical methods; constrained and unconstrained. - Graphical method. - Numerical methods. - a- Unconstrained functions; fixed step method, DSC method, Newton method. b- Constrained functions; sequential search, Dichotomous search; Fibonacci search, Golden ratio search.	**12hr**

4	**Determining the solution to multivariable optimization problems.** a- Unconstrained minimization and maximization strategy. - Solving linear and non linear equations using matrices. - Optimality conditions for unconstrained problems. - Lagrangian criteria. - Simplex method direction step length calculation. b- Solution of constrained multivariable problems. - Analytical solution. - Lagrangian duality. - Linearization of nonlinear optimization problems. - Simplex method. - Pivot table formulation. c- Linear programming (LP) formulation. - Solving linear system. - Basic solution of an (LP) problems. - Graphical interpretation.	10hr

University of Technology
Department of Chemical Engineering

Program	*Chemical Processing Engineering*					
Course Code	CES.P. 439	Credits hr				Units
Course Title	Corrosion Engineering					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Material Engineering	2	-	-	2	2

Course Description

Introduction, Classification of Corrosion, Kinetics of aqueous corrosion, Thermodynamics, Determining Passivity, Reference Electrode, Corrosion prevention, Protection methods.

Course Text

1- Zaki Ahmed, "Principle of Corrosion Engineering and Corrosion Control″,1ST Edition, ,IChemE,ELSEVIER, 2006.
2- Denny A. Jones, "Principle and Prevention of Corrosion″, 2nd Edition, Prentice Hall, 1996.
3- Herbert H. UHLIG, ″ Corrosion and Corrosion Control″ John WILEY, 2008.
4- Fontana, M.G and Greene, N.D, "Corrosion Engineering", 3rd Edition, McGraw-HILL, 1986.

Course Objectives : at the end of the semester the student should be able to :-

1- Understanding the concept of corrosion. The form of corrosion, How the material destroyed by corrosion.
2- Determine the corrosion rates and electrochemical behavior of the metals and the thermodynamics of corrosion reactions.
3- Applying the corrosion prevention technology.
4- Selection of materials involved in applying the corrosion prevention technology.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction :** Definitions, Corrosive environment, Consequences of corrosion, Cost of corrosion, Why metals corrode, Basic concepts on corrosion, Anodic and Cathodic reactions, Types of cells.	2 hr
2	**Classification of corrosion:** Wet corrosion, Dry corrosion, Forms of corrosion	4 hr
3	**Kinetics of aqueous corrosion:** Faraday's laws of electrolysis and its application in determining the	4 hr

	corrosion rate, reversibility and exchange current density, polarization, Activation polarization, Concentration polarization, Resistance Polarization, Combined polarization.	
4	**Thermodynamics and its application on corrosion:** Free energy, Cell potential, Reversible electrode potential, Nernst equation	**4 hr**
5	**Determining the corrosion rate** Corrosion rate measurement units, methods determining corrosion rate: 1- Immersion test 2- Electrochemical technique a) Tafel extrapolation b) Linear polarization	**4 hr**
6	**Passivity:** Active passive metal and conditions for passivity, Kinetics of passivity table passivity, Unstable Passivity	**2 hr**
7	**Reference electrodes:** Hydrogen electrode, Ag/AgCl electrode, Zn/$ZnCl_2$ electrode, Pb/$PbCl_2$ electrode	**2 hr**
8	**Corrosion prevention in Oil Industry:** Materials selection, Alteration of Environment, Design, Coating, Anodic protection, Inhibitors	**2 hr**
9	**Pourbaix diagram:** Equilibrium Diagram, Advantage and Disadvantage of Pourbaix Diagram	**2hr**
10	**Cathodic Protection:** Sacrificial anode corrosion protection, Impressed current anode corrosion protection, Major impressed current anodes, Galvanic systems anode, Design parameters in cathodic protection, Stray current corrosion	**4 hr**

University of Technology
Department of Chemical Engineering

Program	Oil and Gas Refinery Engineering					
Course Code	CES.R.111	Credits hr				Units
Course Title	Technical English "I"					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Basic principles in English language (grammars and vocabularies)	2	-	-	2	2

Course Description

Define a specialknowledge and basic concepts in English language, review of (words, terms and phrases commonly utilized)with practical everyday language that students need, the fundamental principles of grammars used in English language such as question and answer, the negative, the tail questions, the singular and plural, the numbers, nouns, pronouns, the verb (to be, to have, and to do), adjectives, regular and irregular verbs, using so & neither, and adverbs, degrees of comparison, conjunctions and interjections, kinds of letter (S) with general exercises. Also, accurate description of the nature of vocabularies and idioms used by the chemical engineers and that the student needs in his/her academic and/or in his/her professional career by means of applying two reading passages focus mainly on studying the chemical engineer work in the factories as well as equipment, tools and materials used.

Course Text

1- The language of chemical engineering in English, Roy V. Hughson (1979), Regents publishing company, Inc.
2- New headway plus (English Course), Liz & John Soars (2014), Oxford University press.

Other support books :-

1- Life Lines workbook (Pre-intermediate and Intermediate level), Tom Hutchinson (2007), Oxford University press.
2- English in a simplified way, Tahir Al- Bayati (1991), Baghdad.

Course Objectives: at the end of the semester the student should be able to :-

The objective of this course focuses on:

1-in-depth understanding and comprehension of the essential grammars in the English language that usually used in writing and/or speaking with choosing the correct way of speaking and/or listening the vocabulary (phonetics and spelling) by the use of common phrases and words.

2-Also, focus on the use of technical English(reading passages) as a heart of chemical engineer work, such as what chemical engineers do, research and development.

3- The development of the student's ability to apply and arrange knowledge in English language and thus become able to employ them appropriately in his/her daily dealing without the complexity.

4- As well, encourage students to develop their capabilities in the field of English language through participation by the training on the use and improve their language.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Academic Comprehension: (Reading passages related to chemical engineering):** The first reading passage (*What chemical engineers do*) (Special terms or definitions, vocabulary practice - the word and its meaning, paragraphs - read and explanation, review, and discussion)	8 hrs
2	**Academic Comprehension: (Reading passages related to chemical engineering):** The second reading passage (*Research and development*). (Special terms or definitions, vocabulary practice - the word and its meaning, paragraphs - read and explanation, review, and discussion).	8 hrs
3	**English Grammar:** A general introduction to the English language and its importance as a means of communication between different peoples around the world,Review of the words, terms and phrases commonly used,Review of the simple grammars in English language, such as question and answer, the negative, the tail questions, the singular and plural, the numbers, telling the date, and telling the time, Nouns, pronouns, the verb to be, the verb to have, the verb to do, Adjectives and regular and irregular verbs, Reading and writing grammars that include short forms and words with two different meanings, The use of so & neither, and adverbs, Degrees of comparison,Conjunctions and interjections with general exercises, Kinds of letter (S) with general exercises.	14 hrs

Universityof Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.121**	Credits hr				Units
Course Title	Mathematics I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematic of secondary school	2	-	1	3	2

Course Description

Introduction to functions, limits, Special functions, Derivatives, Chain rule, and their applications. Introduction to integral calculus, Methods of integration.

Course Text

1- Thomas Calculus, by George B.Thomas,Jr,Elevnth Edition Media Upgrade 2008"

Other support books :-

1- Mathematical methods for science students, Second Edition, by G. Stephenson .
2- Advanced Engineering Mathematics, Fifth Edition, by C.Raywylie,LouisC.Barrett .
Mathematical Methods in chemical Engineering, Second Edition, by V.G.Jenson and G.V. Jeffreys .

Course Objectives : at the end of the semester the student should be able to :-

1.To develop an understanding with the concepts of calculus and analytic geometry and the applications of these concepts to the solution of engineering problems.
2.Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.
3. Develop a deep understanding of issues related to the basic principles of calculus, and how to solve problems in chemical engineering

Topics Covered (Syllabus)/ Mathematics I

No.	Contents	Duration
1	**Preliminaries:** Absolute value, coordinates of the plane, slope of lines, angle of inclination, functions, graph of the functions, domain and range, identifying functions, sum, differences, products and quotients, composite functions, shifting a graph of a function, scaling and reflecting a graph of a function.	6hr
2	**Limits and Continuity:** Properties, limits involving infinity, continuity	4hr
3	**Transcendental functions:** Logarithmic and exponential functions, trigonometric functions , inverse trigonometric functions, hyperbolic functions, inverse hyperbolic trigonometric functions.	4hr
4	**Derivatives:** Definition, chain rule, derivative of inverse trigonometric functions, of hyperbolic functions, of inverse hyperbolic functions, derivative of exponential and logarithmic functions, L, hopitals rule, partial derivative, function of two or more variables.	6hr
5	**Integration:** Indefinite integration, integration of inverse trigonometric functions, integration of hyperbolic functions, integration of inverse hyperbolic functions, integration methods; (substitution, by part, trigonometric substitution, partial fraction) .	10hr

Universityof Technology
Department of Chemical Engineering

Program	***Oil and Gas Refinery Engineering***					
Course Code	**CES.R.131**	Credits hr				Units
Course Title	**Chemical Engineering Principles I**					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	**1-Basics Maths** **2-Chemistry Basics**	2	-	1	3	2

Course Description

To teach students fundamental knowledge of chemical engineering and application of this knowledge in the solving of material balances of chemical processes.

The course will cover concepts ranging from basics such as units and dimensions, stoichiometry to the simultaneous application of material and energy balances with and without occurrence of chemical reaction.

Behavior of ideal gases including the procedures for estimation of vapor pressure and heats of vaporization will be extensively covered.

Course Text

1- Himmelblau, D.M. and J.B.Riggs," Basic principles and calculations in chemical engineering",8ed , Prentice-Hall Inc., New Jersey,2013.
2- Sikdar, D.C., Chemical process calculations, PHI Learning private ltd., New Delhi, 2013.

Course Objectives: at the end of the semester the student should be able to :-

1-Identify and understand the unit operations involved in a process, draw flowcharts, and develop relationships between process variables.
2-Perform simple degree-of-freedom analysis to identify the number of unknowns relating to mass, mass flow rate, composition and energy, and develop the linearly independent mass and energy balances needed to determine unknown quantities.
3-Apply ideal gas rule and equations of state for real gases.
4-describe various forms of energy, work, enthalpy, specific properties. state functions. and volumetric properties of pure liquids.
5-Convert from SI unit to British unit system and vice versa.
6-Understand the dimension concept,Understand of conversion coefficient concept andUse conversion coefficient.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**General Knowledge of Chemical Engineering:** Definition of chemical engineering, Chemical process industries (CPI), Generalized chemicalprocess,Flow sheet and representationof a chemical process (PFD) The difference betweenthe chemist and the chemical engineer**.**	4 hr
2	**Mathematical , Physical and Chemical Principles:** Dimensions, units, symbols and conversion factors , Precision and significant figures., Density and specific gravity, Temperature, Pressure, The mole unit , Composition and concentration. Basis of calculation, Principles and expressions of stoichiometry**.**	16 hr
3	**Gases and Vapors:** Ideal gas law, Ideal gas mixtures, Real gas relationships, Real gas mixtures, Vapor pressure and saturation**.**	10 hr

Universityof Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.123**	Credits hr				Units
Course Title	Chemistry					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemistry	2	2	0	4	3

Course Description

Fundamentals of atoms, molecules , Quantitative analysis , Environmental , Transition Metal Chemistry and Spectroscopic Techniques which are mostly used in all other chemical engineering courses

Course Text

1- Skoog, D.A., West D.M., Holler F.J., and Crouch S.R. “Fundamentals of analytical chemistry”,8ed edition ,brooks/Cole Cengage Learning. 2004

Other support books :-

1- Harrison, R.M,” Understanding Our Environment An Introduction to Environmental Chemistry and Pollution”,3ed edition, The Royal Society of Chemistry 1999

2- Atkins, P., de Paula, J."Physical Chemistry"8ed edition, W. H. Freeman and Company. 2006

3- Huheey, J. E. "Inorganic Chemistry: Principles of Structure and Reactivity", 4ed edition ,Prentice Hall. 1997

Course Objectives: at the end of the semester the student should be able to:-

1- Students will learn to use the language of chemistry: symbolic representation, nomenclature, and terminology.
2- Students will learn to think about chemical reactions and chemical and physical properties at the particulate level and will be able to visualize and depict the structure of matter and its reactions at the microscopic (atomic and molecular) level.
3- Students will gain a conceptual understanding of and will be able to perform quantitative problem-solving skills in atomic structure, Stoichiometry, chemical equilibria, and electrochemistry.
4- Students will be able to use their knowledge to analyze and construct solutions by instruments
5- Students will learn to use theories of bonding in coordination compounds

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Atoms and Molecules:** Mechanical picture of atomic structure, Derivation of Schrodinger wave equation, Chemical Bonding- Orbital concepts in bonding, V.B. and M.O. theory, M.O. diagrams, Intermolecular interactions.	3hr
2	**Quantitative analysis :** Atomic weight , Molecular formula, Chemical equations, Mole concept, Chemical, equilibrium, equilibrium constants, Preparation and properties, Molarity, Normality, ppm, pH, pOH, Buffers, Solubility Ksp, Gravimetric Analysis, Precipitation reaction, Potentiometric Titration, Complex titration.	6hr
3	**Electrochemistry:** Arrhenius theory of electrolytic dissociation, Transport number, Kohlrausch's law, Solubility product, Redox reaction, Electrochemical and concentration cells	4hr
4	**Photochemistry and Spectroscopic Techniques:** Photoexcitation of organic molecules, Jablonski diagram, Laws of photochemistry and quantum yield, Some examples of photochemical reactions, Chemistry of vision and other applications of photochemistry. General introduction to UV, IR, NMR and Chromatography	7hr
5	**Transition Metal Chemistry:** Structure of coordination compounds corresponding to coordination number up to 6, Types of ligands, Isomerism [geometrical, optical, ionization, linkage and coordination], Theories of bonding in coordination compounds- crystal field theory, Valence bond theory, Chelation	6hr
6	**Environmental :** Introduction, Water, air, soil pollution	4hr

Practical: (Chem. lab.)

No.	Experiment Name
1	Introduction and chemical safety basic rules
2	Equipment and how to use it
3	Preparation of standard solution (primary and secondary)
4	Direct Titration
5	Quantitative determination of a carbonate and hydroxide in mixture
6	Back titration
7	Titration Curves
8	Determination of Chloride Ions in Water
9	Standardization of $KMnO_4$ and the determination of ferrous sulfate (Redox reaction)
10	Determination of Hardness of Water
11	Paper Chromatography
12	Qualitative analysis silver group

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.125**	Credits hr				Units
Course Title	Physics					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physics	2	-	-	2	2

Course Description

Mechanics, Temperature, Heat, Light (Reflection, Refraction, Wave, Nature of light, Dispersion, Colours)

Course Text

- Handbook of Nanostructured Materials and Nanotechnology, San Diego Academic Press, 2000
- Particle Technology Handbook

Course Objectives : at the end of the semester the student should be able to understanding :-

1- Basic physical principle
2- How physical problems can be solved
3- How the scientific method contributes to physics ,and how physics related to every body life
4- Measured physical quantities in appropriate SI unit
5- Work safety in a laboratory and follow the instruction relation between physics and technology

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Mechanics** Motion, Forces, Energy	5hr
2	**Temperature** Concept of temperature, Thermometric properties, thermometers	5hr
3	**Heat** Quantity, Heat transfer	5hr
4	**Waves, Vibration and sound**	5hr
5	**Light** (Reflection, Refraction, Wave, Nature of light, Diffraction and interference, Dispersion, Colours, Electromagnetic spacing.	5hr
6	**Modern Physics**(electron, thermionic , emission, photo electric emission, X-ray, the nucleus, Structure of nucleus and atom, Radioactivity, Nuclear energy, Ionizing radiation and health hazards.	5hr

Universityof Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	CES.R.127	Credits hr				Units
Course Title	Engineering drawing					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	None	1	2	---	3	2

Course Description

Introduction inEngineering drawing, engineering drawing applications, engineering process , analysis model to view and study the full and half Sections , conclusion of the third projection ,Draw isometric and Oblique.

Course Text

1. لرسم الهندسي،تاليف (عبد الرسول الخفاف) الطبعة الثانية،١٩٩٣
2. R.P Hoelscher and C.H Springer "Engineering Drawing and Geometry ".2nd edition

Course Objectives: at the end of the semester the student should be able to :-

1.The students can be use Tools Drawing in draw and analyze geometric shapes
2.Enable students to draw devices, equipment & PFD in chemical engineering.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	Introduction	3hr
2	Planning of Drawing paper	3hr
3	Types of line	3hr
4	Engineering operation	3hr
5	Projection Drawing	3hr
6	First angle projection	3hr
7	Third angle projection	3hr
8	Full section	3hr
9	Half section	3hr
10	The finding of third view	3hr
11	Application Example	3hr
12	Pictorial Drawing (Isometric and Oblique)	3hr
13	Application Example	3hr
14	Dimensions	3hr
15	Examples of chemicalengineering drawing and exercises.	3hr

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.113**	Credits hr				Units
Course Title	**Computer Programming(I)**					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	None	1	2	---	3	2

Course Description

This course provides an overview of the operating system Windows 10 and the program of Microsoft Office 2010 and the Visual Basic and includes the operation of Visual Basic and describe the elements of the design environment and user interface design and the difference between the project and the program and introduce students to the philosophy of programming using visual Basic and a programming process events Event-Driven Programming and programming objects Object Oriented Programming and gives the student an introduction to object-oriented programming and introduce students to the fundamental differences between the concept of the programming language BASIC visual and languages BASIC traditional and explain the steps to design and program planning.

Course Text

1-“ Visual Basic: Crash Course - The Ultimate Beginner's Course to Learning Visual Basic Programming ”, 3rd Edition, A. Tannenbaum, Prentice-Hall, 1996.
2-"Beginning Visual Basic " by Bryan Newsome Wrox, USL Press , | December 2003 | ISBN-10: 1119092116 |
3- “Course Notes for Learn Visual Basic 6.0 ”, 4th Edition, F. Halsall, Addison-Wesley, 2000.

Course Objectives : at the end of the semester the student should be able to :-

1. start Microsoft Office applications and work with the Microsoft Office interface Create documents in Microsoft Word. Create workbooks in Microsoft Excel.Create presentations in Microsoft PowerPoint
2. Define and modify the the properties and methods associated with an object
3. Load, modify, and save changes made to forms and projects in the Visual Basic environment
4. Define and implement form objects including data arrays, control arrays, text boxes, message boxes, dialog boxes, labels, controls, menus, frames, picture boxes, pull-down menus, and combo boxes

Topics Covered (Syllabus)/ Computer Programming(I)

No.	Contents	Duration
1	**Windows 10 andMicrosoft Office**: the operating system Windows 10 and MicrosoftOffice word, Microsoft excel, Microsoft power point.	**3hr**
2	**Introduction to Visual Basic Programming:** Menu bar, Tools bar, Project explorer, Tool box, Properties windows, Form, Code, Controls, Command Buttons, Label, Textbox, Pointers, Picture box, frame, Naming Controls, Properties for controls: Height, Width, Left, Top, Font, Forecolor, Backcolor , Name, Caption, Text, and Visible, Events, Saving Visual Basic Project, Examples, Chemical Engineering Applications.	**2hr**
3	**Mathematics**: Arithmetic Operations: +, , *, /, \, mod, ^. (Using Simple Example for each Operation), Logical Operations. AND, OR, NOT. And the Truth Table for each Operation, (Using Simple Example for each Operation), Relational Operation: >, <, >=, <=, <>, =, String Concatenation (&), Operation Precedence. For all arithmetic, logical, relational operators, Print statement and Formatting. Illustrate (colon, comma, and semicolon), Examples: Chemical Engineering Applications	**1hr**
4	**Built inFunctions**: Builtin math functions, Abs(x), Int(x), Rnd(x), sgn(x), sqr(x), str(x), val(x), round(x,n),CInt(x),Fix(x),String Functions, InputBox, MsgBox, Examples: Chemical Engineering Applications.	**1hr**
5	**Selection Structure**: Single Selection: If/Then structure, Double Selection: If/Then/Else structure, Nested If/Then/Else structure, Select Case Multiple Selection Structure, Examples: Chemical Engineering Applications.	**2hr**
6	**Reputation Structure**: For ... Next Loop, While ... Wend, Do .... While ... Loop, Do ... Loop Until, Exit Do, Exit For Examples: Chemical Engineering Applications.	**1hrs**

7	**Variables**: Data Types: Boolean, Integer, Long, Single, Double, String, Valid Naming of Variables, Initial Value for each Type of the Variables (Initial Value for each Data Type), Size of each Variable Type in Bytes, How to Declare Variables. (Dim statement), Using: Dim variable name As Data type, Using Suffix: Integer, Long, Single, Double, String, Constant Variable. Examples: Chemical Engineering Applications.	**2hrs**
8	**Arrays**: Introduction: Defining Arrays, Array Declaration Statement, Assigning Values for Arrays (i.e.filling array's element value either by loop or by direct assignment statement), Re Dim Statement, Using Loops with Arrays. (i.e. writing an application on array using loops),Two Dimensional Arrays, Operations on Arrays, Fill Array Elements with Random Numbers using and Function, Sorting, Searching. (i.e. Linear search), Swapping Two Elements. Examples: Chemical Engineering Applications.	**2hr**
9	**Graphics in Visual Basic**: Graphics control, Picture box, Image box, Coordinate system, Pixel, Graphics methods (Line,Circle, pset) Examples: Chemical Engineering Applications.	**1hrs**

Laboratories

No.	Contents
1	**Windows 10 and Microsoft Office:** The operating system Windows 10 and MicrosoftOffice word, Microsoft excel, Microsoft power point.
2	**Introduction to Visual Basic Programming**: Menu bar, Tools bar, Project explorer, Tool box, Properties windows, Form, Code, Controls, Command Buttons, Label, Textbox, Pointers, Picture box, frame, Naming Controls, Properties for controls: Height, Width, Left, Top, Font, Forecolor, Backcolor , Name, Caption, Text, and Visible, Events, Saving Visual Basic Project, Examples, Chemical Engineering Applications.
3	**Mathematics**: Arithmetic Operations: +, , *, /, \, mod, ^. (Using Simple Example for each Operation), Logical Operations. AND, OR, NOT. And the Truth Table for each Operation, (Using Simple Example for each Operation), Relational Operation: >, <, >=, <=, <>, =, String Concatenation (&), Operation Precedence. For all arithmetic, logical, relational operators, Print statement and Formatting. Illustrate (colon, comma, and semicolon), Examples: Chemical Engineering Applications
4	**Built in Functions**: Builtin math functions, Abs(x), Int(x), Rnd(x), sgn(x), sqr(x), str(x), val(x), round(x,n),CInt(x),Fix(x),String Functions, InputBox, MsgBox, Examples: Chemical Engineering Applications.
5	**Selection Structure**: Single Selection: If/Then structure, Double Selection: If/Then/Else structure, Nested If/Then/Else structure, Select Case Multiple Selection Structure, Examples: Chemical Engineering Applications.
6	**Reputation Structure**: For ... Next Loop, While ... Wend, Do .... While ... Loop, Do ... Loop Until, Exit Do, Exit For Examples: Chemical Engineering Applications.

7	**Variables**: Data Types: Boolean, Integer, Long, Single, Double, String, Valid Naming of Variables, Initial Value for each Type of the Variables (Initial Value for each Data Type), Size of each Variable Type in Bytes, How to Declare Variables. (Dim statement), Using: Dim variable name As Data type, Using Suffix: Integer, Long, Single, Double,String,ConstantVariable. Examples: Chemical Engineering Applications.
8	**Arrays**: Introduction: Defining Arrays, Array Declaration Statement, Assigning Values for Arrays (i.e.filling array's element value either by loop or by direct assignment statement), Re Dim Statement, Using Loops with Arrays. (i.e. writing an application on array using loops),Two Dimensional Arrays, Operations on Arrays, Fill Array Elements with Random Numbers usingand Function, Sorting, Searching. (i.e. Linear search), Swapping TwoElements. Examples: Chemical Engineering Applications.
9	**Graphics in Visual Basic**: Graphics control, Picture box, Image box, Coordinate system, Pixel, Graphics methods (Line,Circle, pset) Examples: Chemical Engineering Applications.

<table>
<tr><td rowspan="1">Program</td><td colspan="6">Oil and Gas Refinery Engineering</td></tr>
<tr><td>Course Code</td><td>CES.R.112</td><td colspan="4" rowspan="2">Credits hr</td><td rowspan="3">Units</td></tr>
<tr><td>Course Title</td><td>Technical English "II"</td></tr>
<tr><td>Term</td><td>2nd Semester</td><td>Theoretical</td><td>Practical</td><td>Tutorial</td><td>Total</td></tr>
<tr><td>Prerequisite(s)</td><td>Basic principles in English language (grammars and vocabularies)</td><td>2</td><td>-</td><td>-</td><td>2</td><td>2</td></tr>
</table>

Course Description

Define a specialknowledge and basic concepts in English language, review of phonetics and spellingwith words and sounds that need attention in understanding the meaning and pronunciation, the fundamental principles of grammars utilized in English language such as the use of the prefixes (un, im, in, and dis), the use of since & for, the definite and indefinite articles. As well as simple, continuous and perfect tenses (present, past, and future), the punctuation, active voice and passive voice, direct and indirect speech, finite and non-finite verbs, analyses and kinds of sentences. Also, accurate description of the nature of vocabularies and idioms used by the chemical engineers and that the student needs in his/her academic and/or in his/her professional career by means of applying two reading passages focus mainly on studying the chemical engineer work in the factories as well as equipment, tools and materials used.

Course Text

1- The language of chemical engineering in English, Roy V. Hughson (1979), Regents publishing company, Inc.
2- New headway plus (English Course), Liz & John Soars (2014), Oxford University press.

Other support books :-

1- Life Lines workbook (Pre-intermediate and Intermediate level), Tom Hutchinson (2007), Oxford University press.
2- English in a simplified way, Tahir Al- Bayati (1991), Baghdad.

Course Objectives: at the end of the semester the student should be able to :-

The objective of this course focuses on:

1- Study and conception of the advance grammars in the English language that usually employed in academic writing and also explain the use of grammars correctlyin speaking and/or listening the vocabulary (phonetics and spelling) via increasing the ability to rapid recognize the words that have two different meanings depending on their presence in the context of speech

2- Accurate description of the nature of vocabulary and idioms used by the chemical engineers in dealing with their respective fields in addition to the vocabulary of daily dealing. Also, focus on the use of reading passages such as process design and plant operation, which are related to student competence and his/her profession as an engineer in the chemical companies.

3- Enhancement of student's ability by applying modern information in English language about the characteristics of the chemical engineer job and then try to the simulation that in writing the scientific report, expression, and formulate of simple sentences and complex ones without the difficulty.

4- Finally, promote the qualifications of students in the field of English language by training on the use and the progress of their language in order to allow them to easily use it in his/her future academic study in chemical engineering.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Academic Comprehension: (Reading passages related to chemical engineering):** The third reading passage (*Process design*) (Special terms or definitions, vocabulary practice - the word and its meaning, paragraphs - read and explanation, review, and discussion)	8 hrs
2	**Academic Comprehension: (Reading passages related to chemical engineering):** The fourth reading passage (*Plant operation*). (Special terms or definitions, vocabulary practice - the word and its meaning, paragraphs - read and explanation, review, and discussion).	8 hrs
3	**English Grammar:** Phonetics & Spelling (consonant sounds & vowel sounds), Words and sounds that need attention in understanding the meaning and pronunciation, as well as the use of the prefixes (un, im, in, and dis),The use of since & for, as well as the definite and indefinite articles,Punctuation (such as the use of the capital letter, the question mark, and the comma….etc), Simple tenses (present, past, and future), Continuous and perfect tenses (present, past, and future), Active voice and passive voice,Direct and indirect speech, Finite and non-finite verbs, Analyses of sentences, and kinds of sentences (either according to form or to number of statements).	14 hrs

Universityof Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.122**	Credits hr				Units
Course Title	Mathematics II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I	2	-	1	3	2

Course Description

Definite integral and applications, Polar coordinates, Vector analysis, Determinant and matrices

Course Text

1- Thomas Calculus, by George B. Thomas, Jr, Elevnth Edition Media Upgrade 2008"

Other support books :-

1- Mathematical methods for science students, Second Edition, by G. Stephenson,
2- Advanced Engineering Mathematics, Fifth Edition, by C. Raywylie, Louis C. Barrett
3- Mathematical Methods in chemical Engineering, Second Edition, by V. G. Jenson and G.V. Jeffreys

Course Objectives : at the end of the semester the student should be able to :-

1- To understand these concepts of applications and how to evaluate volumes, surface area , and to understand analytic geometry.

2- Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

3- Develop a deep understanding of issues related to the basic principles of polar coordinates, vector analysis, determinants, and how to solve problems in chemical engineering

Topics Covered (Syllabus)/ Mathematics II

1	**Definite integration and Applications:** Double integrals, reverse order of integration, length of curves, surface area, volumes	**10hr**
2	**Polar Coordinates:** Definition, Cartesian versus polar coordinates, graphing in polar coordinate.	**4hr**
3	**Vector Analysis:** Definitions, properties, vector in space, scalar and cross product of vector, product of three vectors.	**8hr**
4	**Determinates and Matrices :** Definition, determinate evaluation, solution of system of linear equation by matrix; (Inverse of matrix, Gauss elimination), Rank of matrix, Eigen value and Eigen vectors.	**8hr**

University of Technology
Department of Chemical Engineering

Program	***Oil and Gas Refinery Engineering***					
Course Code	**CES.R.132**	**Credits hr**				**Units**
Course Title	**Chemical Engineering Principles II**					
Term	**2nd Semester**	**Theoretical**	**Practical**	**Tutorial**	**Total**	
Prerequisite(s)	**1-Basics Maths 2-Chemistry Basics 3.Chemical Engineering Principles I**	**2**	**-**	**1**	**3**	**2**

Course Description

The objective of this course is to present an introduction to chemical engineering calculations, establish mathematical methodologies for the computation of material balances and to present an overview of industrial chemical processes. It is prerequisite for several junior-level courses in the curriculum, including courses in process fluid dynamics, heat transfer and phase equilibrium.

The course reviews the fundamentals of chemistry and physics as they pertain to chemical problems and applies mathematics to the development of time-dependent equations to describe materials flow through a process. Examples of the processes studied include stoichiometry in combustion and other reactions, materials flow with recycle streams.

Course Text

1- Himmelblau, D.M. and J.B.Riggs," Basic principles and calculations in chemical engineering",8ed , Prentice-Hall Inc., New Jersey,2013.
2- Sikdar, D.C., Chemical process calculations, PHI Learning private ltd., New Delhi, 2013.

Course Objectives: at the end of the semester the student should be able to :-

1-Create representative process flow diagrams and use them to organize systems of equations.
2-Formulate material balances to solve for compositions and flow rates of process streams.
3-Incorporate single and multiple reactions into unit operations within chemical processes.
4-Understanding of the degrees of freedom analysis and its significance.
5-Ability to make material balances on unit operations and processes.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Concepts of material balance.**	2 hr
2	**Systematic steps of solving material balance problems.**	2 hr
3	**Material balances without chemical reactions.**	4 hr
4	**Material balances with chemical reactions.**	6 hr
5	**Material balances on combustion processes.**	6 hr
6	**Material balances involving recycle.**	6 hr
7	**Bypass and purge streams.**	4 hr

University of Technology
Department of Chemical Engineering

Program	***Oil and Gas Refinery Engineering***					
Course Code	**CES.R.124**	Credits hr				Units
Course Title	Chemistry of Petroleum					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemistry	2	2	0	4	3

Course Description

An Introduction to Organic Compounds, preparation, reaction including petroleum and heterocyclic compound

Course Text

1- Ghatak,k.l,” textbook of organic chemistry and problem analysis”,PHL Learning.2014.

Other support books :-

1- Morrison, Thornton R.; Boyd, Neilson, R."Organic Chemistry" 6th edition, J. Chem. Educ. 1992
2- Bruice,P.Y. ,J.M “organic chemistry”,7th edition ,. Books a la Carte Edition, 2014

Course Objectives: at the end of the semester the student should be able to :-

1- Students will learn the basic concepts of organic chemistry
2- understanding the concepts of organic reactions for analysis of unit processes
3- Students will learn the Petroleum chemistry and refining

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**An Introduction to Organic Compounds:** Nomenclature, Physical Properties, and Representation of Structure	6hr
2	**Preparation and Reactions :** Alkanes, Alkenes, Dienes, Alkynes, aromatic hydrocarbon	6hr
3	**Preparation and Reactions :** alkanes derivative (RX, ROH, RCOOH, RCOH, RCOR,….etc. Organometalic	9hr
4	**Mechanisms of organic reactions:** (elimination, substation, addition)	2hr
5	**Petroleum :** Origin of petroleum, Composition, Refining, Kerosene, Naphtha	4hr
6	**Heterocyclic compounds :** Isolation and reactions of furan, pyrrole, pyridine Terpenes	3hr

Practical: (Chem. lab.)

No.	Experiment Name
1	Boiling point determination
2	Melting point determination
3	Simple Distillation
4	Preparation of aspirin
5	Preparation of ester
6	Identification of functional groups-I
7	Identification of functional groups-II
8	Saponification reaction
9	Preparation of phenolphthalein
10	Synthesis of adipic acid
11	Synthesis of furan

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.126**	Credits hr				Units
Course Title	Engineering Mechanic and Strength of Materials					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physics	2	-	1	3	2

Course Description

Principles of statics, Resultant of a force system, Equilibrium of a force system, Moment of a force, Friction, Centroid and center of gravity, Moment of inertia, Analysis of internal force, Strain, Stress-strain diagram, Hook's law, Shearing deformation, Poisson's ratio, Volumetric strain, Thin-walled cylinders, Thermal stress, Shear and bending moment in beam.

Course Text

1- Engineering Mechanic-Statics and Dynamics volume 1; Higdon, A. and Stiles, W.B., 3ed Edition, Prentice-Hall, India, (1968).
2- Strength of Materials; Singer, F.L. and Pytel, A., 3ed Edition, Harper and Row, London, (1980).

Course Objectives : at the end of the semester the student should be able to :-

Designed to study the effects of external forces on a group of solid objects, Resistance of materials and their applications in chemical engineering.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Friction:** Theory of Friction, friction on an inclined plane	3 hr
2	**Centroid and Center of Gravity:**	3 hr
3	**Moment of Inertia (Second moment of the axis):** Polar moment of inertia, Transfer formula for moment of inertia	3 hr
4	**Introduction Force in Rigid Bodies:** Definitions of Stress and Strain, Stress-Strain Diagrams	2 hr
5	**Proportional Limits:** Elastic limit, Stiffness elasticity, Plasticity, Hardness and working stress.	4 hr

6	**Hook 's Law**	**3 hr**
7	**Poisson Ratio, Composite Stresses:** Volumetric Stress, Bulk Modulus, Thin Walled Cylinders	**4 hr**
8	**Thermal Stress**	**4 hr**
9	**Shear and Bending Moments in Beam**	**4 hr**

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.114**	Credits hr				Units
Course Title	AutoCAD					
Term	2st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Computer Programming I	1	2	---	3	2

Course Description

introduction , AutoCAD program components and how to use it , knowing AutoCAD commands like point , lines, Rectangle, Polygon, Poly line , Arc with their option to draw 2D engineering drawing, learning Hatching, text, mtext , Dimension creation and editing , Modify command and Layers for 2D engineering drawing.
3D drawing methods: Surfaces, Solids and Composite solid.
Render, background, lights for drawing.

Course Text

1-Terry T. Wohler, applying AutoCAD 2002 fundamentals, Glencoe /McGraw-Hill
2-James A. Leach, AutoCAD 2002 Companion Essentials of AutoCAD plus Solid modeling ,2003 , McGraw-Hill, Boston
3- Terry T. Wohler, applying AutoCAD a step by step approach for AutoCAD release 13, 1996, Glencoe McGraw-Hill
4- James A. Leach, AutoCAD 14 Companion Essentials of AutoCAD plus Solid modeling ,1999,WCB / McGraw-Hill, Boston
Other support books :-
David Byrnes and Mark Middlebrook, AutoCAD® 2007 For Dummies , Wiley Publishing, Inc.

Course Objectives : at the end of the semester the student should be able to :-

1- The students can use AutoCAD program and produce 2D and 3D chemical engineering drawings.
2- Enable students to draw designed equipment in AutoCAD program.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	Introduction, Drawing program screen components, Setting drawing limits, Units, Grid and snap, Zoom, Orthogonal, Osnap, UCS. 2D drafting: Cartesian system coordinate, AutoCAD drawing command: Point, Line: line, multi-line, construction line, drawing line by using: absolute coordinate, polar coordinate, relative coordinate, Example	3hr
2	Continuous line drawing: Rectangle, Polygon, Poly line with their options, Example	3hr

3	Curves drawing: Arc, Circle, point –SP line, Ellipse with their options, Example.	**3hr**
4	Hatching, text command: text, mtext, Example	**3hr**
5	Dimension creation and editing, Example	**3hr**
6	Region, block, insert block, Example	**3hr**
7	**Modify command:** 1-coy tool: copy, mirror, offset, array. 2- Erase tool: erase, trim, break .3- move tool: move, rotate .4- Change tool: stretch, Lengthen, Extend, Scale, Chamfer, and Fillet .5-Explode, Example	**3hr**
8	Layers: Create a new layer ,rename layer, active layer, run and extinguishing layers ,Freezing layers, Lock and open layers, the color ,Font type ,Line width, Example	**3hr**
9	**3D drawing methods:** Surfaces drawing: box, Wedge, Pyramid, Dome, Sphere, Cone, Torus, Dish, Example	**3hr**
10	3D drawing methods: Solids: box, Cylinder, Sphere, Cone, Wedge, Torus, Example	**3hr**
11	Composite solid: Union, Subtraction, Intersection, Example	**3hr**
12	render, background, lights, Example	**3hr**
13	Examples of chemical engineering drawing and exercises.	**3hr**
14	Examples of chemical engineering drawing and exercises.	**3hr**
15	Examples of chemical engineering drawing and exercises.	**3hr**

Practical Topics Covered (Syllabus)

No.	Experiment Name
1	introduction to AutoCAD program , drawing rectangular using lines in absolute coordinate, polar coordinate, relative coordinate
2	Continuous line drawing: drawingrectangular,Polygonwith their options
3	Curves drawing:Arc, Circle, point –SP line, Ellipse with using their options
4	Hatching, text :sectionDrawingofgeometryshapeand applied Hatching, text command
5	Dimensions: Drawing a simple chemical flow chart and add Dimension.
6	drawing 2D drawing and applying Region, block, insert block
7	Modify command: Drawing simple 2D shape and applying Modify commands such as copy, mirror, offset, array , trim, move, rotate , stretch, Lengthen, Extend, Scale, Chamfer, and Fillet .
8	Layers:Drawing a simple 2D chemical engineering drawing and applied layers.
9	3D drawing methods: Surfaces,Drawingbox, Wedge, Pyramid, Dome, Sphere, Cone, Torus, Dish3D
10	3D drawing methods: Surfaces,DrawingSolids shapes: box, Cylinder, Sphere, Cone, Wedge, Torus,
11	Composite solid: Drawing Solids shapes and applying Union, Subtraction, Intersection.
12	Drawing simple chemical engineering drawing and applying render, background, lights.
13	Drawing process flow diagram of chemical engineering unit
14	Drawing chemical engineering Applications
15	Drawing chemical engineering Applications

University of Technology
Department of Chemical Engineering

Program	***Oil and Gas Refinery Engineering***					
Course Code	**CES.R.128**	Credits hr				Units
Course Title	Electrical Technology					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physics	1	-	1	2	1

Course Description

The course cover the basic electric engineering with details and examples in direct current circuits, network calculations, standards and conventions, Ohms law, Resistance and resistivity electromagnetism ,generator ,alternating current,, transformer ,motors and instrumentation ,

Course Text

1- John Bird," Electrical Circuit Theory and Technology",2nd edition, Elsevier Science, 2003
2- John Bird," Electrical and Electronic Principle and Technology", 2nd edition, 2003
3- Giorgio Rizzoni, "Fundamentals of electrical engineering", McGraw-Hill, 2009
4- Alan L. Sheldrake, "Handbook of Electrical Engineering", John Wiley & Sons Ltd,, 2003

Course Objectives : at the end of the semester the student should be able to :-

3- Understanding of the fundamentals principle of electrical technology.
4- Student should be know the basic electric principle, basic D.C. and A.C. circuit, D.C. and A.C. motors, transformer and should be able to work safety in laboratory as in field and follow the instruction relation between electrical and technology and chemical engineering.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction To Dc Circuit:** Material use in electric component, ohms law, temperature Coefficient, Review of Kirchhoff's Laws Series Parallel circuit, equivalent resistance, star / delta Conversion, Node And Mesh Analysis	4hr
2	**Dc And Ac Generator And Motor:** Principle of DC generator and motor, Transformer, Introduction motor(Single phase), Magnetic and electromagnetism, Natural magnetic field, magnetic flux, Feil	2hr
3	Electrochemical,	5hr
4	**Ac Circuit:** Concepts of AC circuit, rms value Average value, from and peak factors, real and Reactive power – power factor.	2hr
5	**Polyphases Circuit :** Introduction to three phase circuits, Introduction to three phase system , Phase and line parameter – relations ,Power measurement , Voltmeter and ammeter method	2hr

University of Technology
Department of Chemical Engineering

Program	Oil and Gas Refinery Engineering					
Course Code	CES.R.115	Credits hr				Units
Course Title	Human rights					
Term	2st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	none	1	-	-	1	1

Course Description

The study of the human rights concept and history and its relationship to religions and the extent of his relationship with globalization and contemporary currents.

Course Text

1-Human rights, development, contents Dr.Riyad Aziz Hadi

٢-مبادئ و قواعد عامة في حقوق الأنسان د. صلاح حسن مطرود

٣- حقوق الأنسان بين الأسلامي و العالمي د. محمد علي الشجيري

٤- حقوق الأنسان و الديمقراطية د. ماهر صالح الجبورى

٥- مشكلة الحرية د. زكريا أبراهيم

Course Objectives : at the end of the semester the student should be able to :-

1-Rooting human rights values in the local culture.
2-leading to the development of the concept.
3-principles of human rights in general.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	Psychological construction and its relationship with human right	1hr
2	Contemporary Arabs currents ,its position on human right	1hr
3	Secular :the early stage of its development ,disadvantages, her features	1hr
4	How can you balance between civil right and social	1hr
5	Capitalist and socialist society with human rights	1hr
6	Close society and an opened society	1hr
7	Theory of the social contract	1hr
8	Thomas Hughes ,Jan-jack Rousseau ,Volter ,AuxtComte,Max Weber Montesquieu	1hr
9	Relationship of right to democracy	1hr
10	Relationship of right to urbanization	1hr
11	Relationship of right with globalization	1hr
12	Human rights between rejection and acceptance	1hr
13	How can rooting the values of human rights in Arab culture and in the great cultures	1hr
14	The relationship between the political culture and ideological	1hr
15	Ideological religion	1hr

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.221**	Credits hr				Units
Course Title	Engineering MathematicsI					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I, Mathematics II	2	-	1	3	2

Course Description

This course describes the evaluation of double, triple integrals, area and volume.Provide knowledge and skills in writing a periodic function in its Fourier series form and on their applications. Develop skills for applying this course in the future on various chemical engineering applications.

Course Text

Text book:

1. Higher Engineering Mathematics by Dr.B.S.Grewal, Khanna Publishers, 40th Edition, 2007.

Reference book:

1. Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, 2007.

Course Objectives: at the end of the semester the student should be able to:-

1- Able to evaluate double, triple integrals and the area, volume by double & triple integrals respectively.

2- 2. Understand the concept of Fourier-series representation of periodic functions and their applications.

Topics Covered (Syllabus)/ Engineering MathematicsI

No.	Contents	Duration
1	**Multiple Integrals:** Double Integral, Area, Volume, Double Integral in polar coordinates, Triple Integral in rectangular coordinates, physical application of double and triple integration.	12hr
2	**Function and definite Integrals:** The error function, the gamma function, the beta function, factorial function.	6hr
3	**Infinite Sequences and Series:** Sequences, Convergence, Geometric series, nth partial sum, tests of convergence, alternating series, power and Taylor's series.	6hr
4	**Fourier series:** Periodic functions, Fourier series, Even and odd functions, Half range expansion.	6hr

Universityof Technology
Department of Chemical Engineering

Program	Oil and Gas Refinery Engineering					
Course Code	**CES.R.231**	Credits hr				Units
Course Title	Energy Balance					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemical Engineering principle I & II	2	-	1	3	2

Course Description

The aims of the course provide a deep knowledge , wide scope and improved understanding of the mechanisms in heat balance for closed and open system and for steady and unsteady state. The students should gain knowledge to apply the energy balance in engineering problems.

Course Text

1. D.M.Himmelblau and J.B.Riggs ,Basic Principles and Calculations in Chemical Engineering ,7th Edition , 2004 . Other support books :- 2. R.M.Felder and R.W.Rousseau , Elementary Principles of Chemical Processes ,3rd Edition ,2005.

Course Objectives : at the end of the semester the student should be able to :-

1. The terminology associated with energy balances , concepts , and units . 2. Introduction to energy balances for processes without reaction . 3. Calculation of enthalpy changes . 4. Energy balances : how to account for chemical reaction .

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Energy : Terminology , Concept , and units:** The terminology associated with energy balances , Types of energy : Work , Heat , Kinetic energy , Potential energy , Internal energy , Enthalpy .	4hr
2	**Introduction to Energy Balances for Processes without Reaction:** The concept of the conservation of energy , Energy balances for closed , unsteady-state systems , Energy balances for closed , steady-state systems , Energy balances for open , unsteady-state systems , Energy balances for open, steady-state systems .	6hr
3	**Calculation of Enthalpy Changes:**	6hr

	Phase transitions, Equation to estimate heat of vaporization , Heat capacity equations , Tables and charts to retrieve enthalpy values .	
4	**Application of Energy Balances in the Absence of Chemical Reaction:** Simplifications of the general energy balance , The strategy for solving energy balance problems , Applications of the energy balance to closed systems , Applications of the energy balance to open systems**.**	**8hr**
5	**Energy Balances : How to Account for Chemical Reaction:** The standard heat of formation , The heat of reaction , Merging the heat of formation with the sensible heat or a compound in making an energy balance , The heat of combustion .	**6hr**

Program	***Oil and Gas Refinery Engineering***					
Course Code	**CES.R.233**	Credits hr				Units
Course Title	Fluid Flow I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Principles of Chem. Eng. & Math	2	2	1	5	3

Course Description

Define fluid properties, stresses in fluids at rest and in motion and types of fluid flows, application of Newton law of viscosity and dimensional analysis methods…

Derive and define the governing equations of fluid flow: continuity, energy and momentum equations from principles of mass, energy and momentum conservation and define the terms of Bernoulli's equation, include major and minor losses and required energy for flow…

Define the types of fluid pumping devices and its characteristics and how to select the appropriate type and size for fluid pumping…

Define the types on Non-Newtonian and two-phase fluids flow and their pressures drop calculations…

Course Text

1- Coulson, J.M. , Richardson, J.F., Backhurst, J.R. and Harker, J.H., "Chemical Engineering" Volume(1) 6thEd., Butterworth-Heinemann, 1999
2- Holland, F.A. and Bragg, R., "Fluid Flow for Chemical Engineers", 2nd Ed., Edward Arnold, 1995.

Other support books :-

1- DARBY. R. , Dekker M. "Chemical Engineering Fluid Mechanics", 2nd Ed.Marcell Dekker, 2001
2- Wilkes J. O.,"Fluid Mechanics for Chemical Engineers", 2nd Ed. Prentice Hall PTR, 1999.
3- De Nevers, N. "Fluid Mechanics for Chemical Engineers" , 2nd Ed.McGraw-Hill 1991.
4- McCabe, W. L., Smith, J. and Harriot, P., "Unit Operations of Chemical Engineering", 6th Ed., McGraw – Hill, International Edition, 2001.
5- Christi J. Geankoplis "Transport Processes and Unit Operations" 3rd Ed. Printice Hall International Editions, 1993.

Course Objectives : at the end of the semester the student should be able to :-

1- Demonstrate knowledge of incompressible fluid flows, two phase flow, fluid statics, kinematics of flows and essential basic hydrodynamics.
2- Define and solve problems in fluid dynamics in various engineering applications. Provide the ability to describe energy variation and its application in flow and pressure measurement and frictional energy losses calculations.
3- Provide the ability to estimate the required energy for fluid pumping (selection the size and type of appropriate pumping for liquid and gas) and to design the liquid mixing

equipment.
4- Predict necessary fluid parameters of full scale projects by performing simple model experiments.
5- Share ideas and work in a team in an efficient and effective manner under controlled supervision or independently.

Topics Covered (Syllabus)/Fluid Flow I

No.	Contents	Duration
1	**INTRODUCTION:** Definition of a fluid, fluid mechanics; Physical properties of fluids: Density, specific gravity, viscosity, kinematic viscosity, surface tension and capillarity, bulk modulus of elasticity, Pressure and shear stress; Types of Fluids: Newtonian, non-Newtonian fluids ideal and real fluids, Newton's law of viscosity.	4 hrs
2	**Dimensional Analysis :** Units and dimensions; Fundamental dimensions; Dimensional homogeneity; Dimensionless number Methods of dimensional analysis, 1- Rayleigh's method (power series) 2- Buckingham's Π- method / Theorem	4 hrs
3	**Fluid Statics :** Basic consideration of fluid statics; Pressure head of liquid; Pressure force on surfaces; Buoyancy; Measurement of pressure: (Piezometer, Manometers, types of Manometers, Mechanical Gauges)	4 hrs
4	**Fluid Dynamics, Newtonian's Incompressible Fluid:** Fluid kinematics: Types of fluid flow (steady and unsteady flows, uniform and non-uniform flows, one, two, and three dimensional flows, Rotational and irrotational flows, laminar and turbulent, compressible and incompressible flows), velocity distribution in laminar and turbulent flow Boundary layer, Continuity equation, Momentum equation, Bernoulli's equation, Euler's equation of motion, modified Bernoulli's equation, pipe size selection; Two-Phase Flow, Horizontal and vertical flow regime, calculation of pressure drop of two-phase flow by Lockhart and Martinelli method.	8 hrs

5	**Pumping of Liquids** Total heads, NPSH, Horse Power and cost consumption, Pumping Efficiencies Characteristics curves Types of the pumps, Selection of Pumps. Centrifugal pump relations, homologous centrifugal pump, centrifugal pumps in series and in parallel.	6 hrs
6	**Non-Newtonian Fluids in Pipes** Definition, types of non-Newtonian fluids, flow characteristics, apparent viscosity, shear rate and description of time-independed fluid, calculation of friction and pressure drop for general time independent in laminar and turbulent flow	4 hrs

Practical :Fluid Flow I

No.	Experiment Name.
1	**Calibration of Bourdon Tube Pressure Gauge**
2	**Reynolds Experiment**
3	**Energy Loss in Pipes**
4	**Centrifugal Pump Characteristics**
5	**Bernoulli's Theorem Demonstration**
6	**Friction Losses in Piping Systems**
7	**Gear Pump**
8	**Flow Visualization**

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering.*					
Course Code	**CES.R.235**	Credits hr				Units
Course Title	Physical ChemistryI					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	1-chemical engineering principles 2-chemistry	2	2	-	4	3

Course Description

Physical chemistry is the application of the methods of physical to chemical problems. It includes the qualitative and quantitative study. Both experimental and theoretical of the general principles determining the behavior of matter.

Course Text

1. J. Laidler, physical chemistry, Bosten; Houghton M, ffl.n company, 1999.
2. G. Mortimer, physical chemistry, San Francisco; Altarcourt science and technology company, 2000.

Course Objectives : at the end of the semester the student should be able to :-

1- 1. Be able to solve problems involving ideal mixture and dilute solutions.
2- 2. Understand the principles govering phase diagrams and be able to interpret phase diagrams for various kinds of systems.
3- 3. Be able to solve problems involving surface tension.
4- 4. Be able to solve several simple rate laws and to solve a variety of problems related to these solutions.
5- 5. Be able to apply experimental techniques to the determination of rate law and rate constant.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Phase Equilibria:** Equilibrium between phases, one component systems, binary systems involving vapor, liquid vapor equilibria of two component system, liquid vapor equilibrium in system not obeying Raoults law, temperature composition diagram (boiling point curves), distillation, azeotropes, solubility of gases in liquids.	12 hr
2	**Chemical Kinetics 1:** Rate of consumption and formation, rate of reaction, empirical rate equation, order of reaction, reactions having no order, rate constants and rate coefficients, analysis of kinetic results.	6 hr
3	**Surface chemistry :** Adsorption, adsorption isotherms, surface tension and capillary rise, pressure difference across curved surface tension, liquid- films on surfaces, solid- liquid interfaces.	12hr

Practical Physical Chemistry I

No.	Experiment Name.
1	**Refractive index.**
2	**Viscosity.**
3	**Saponfication of acetate ethyl.**
4	**Three component system(water, ethanol and ethyl acetate)**
5	**Molecular weight determination by victor meyers method.**
6	**Calorimeter Constant.**
7	**Heat of solution**
8	**Surface tension.**
9	**Surface chemistry. Adsorption by solid from solution.**
10	**Spectrophotometer analysis of $k_2Cr_2O_7$.**

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.211**	Credits hr				Units
Course Title	Computer Programming II					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	7. Basic Principles of chemical engineering I. 8. Mathematics I. 9. Computer programming I	1	2	1	4	2

Course Description

To introduce chemical engineering students to modern calculating tool used in the practice of engineering by being able to construct plots, fit data, and use built-in functions in MATLAB.

Course Text

1- RudraPratap: Getting started with MATLAB 7, Oxford Press (Indian edition),2006.

2- Desmond J. Higham and Nicolas J. Higham: Matlab Guide, SIAM, 2000.

Other support books :-

1- Duane Hanselman and Bruce Littlefield: Mastering Matlab-6: A Comprehensive Tutorial and Reference, Prentice Hall, 2001.

2- Schilling R. J., Harries S.L., Applied Numerical Methods for Engineers using MATLAB & C, Thomson Books, 2002.

Course Objectives: at the end of the semester the student should be able to :-

1- Develop the confidence necessary to successfully solve Mathematical problems with a computer.
2- Formulate and write structured code in MATLAB.
3- Understand the foundation behind the basic numerical methods for Matrix manipulations.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Starting With Matlab**: MATLAB windows , Menus and the toolbar , Working in the command window , Arithmetic operations with scalars , Display formats , Elementary math built-in functions, Useful commands for managing variables, Script files and the Editor Debugger, Matlab Help System	2hr
2	**Symbolic Math :** Symbolic objects, and symbolic expressions, Changing the form of an existing symbolic expression, Solving algebraic equations, Differentiation, Integration, Solving an ordinarydifferential equation.	3 hr
3	**Creating Arrays:** Creating a one-dimensional array (vector) , Creating a two-dimensional array (matrix) , The transpose operator , Array addressing , Using a colon: in addressing arrays, Adding elements to existing variables, Deleting elements, Built-in functions for handling arrays, Strings and strings as variables.	2 hr
4	**Mathematics With Array:** Addition and subtraction , Array multiplication, Array division , Element-by-element operations , Using arrays in MATLAB built-in math functions, Built-in functions for analyzing arrays, Generation of random numbers, Solving Algebraic Equations.	3hr
5	**Polynomials, Curve Fitting, And Interpolation:** Polynomials, Curve fitting , Interpolation , Extrapolation.	2hr
6	**Programming In Matlab**: Relational and logical operators, Conditional statements, The switch case statement, Loops, Program Design and Development.	3hr

Universityof Technology
Department of Chemical Engineering

Program	***Oil and Gas Refinery Engineering***					
Course Code	**CES.R.223**	Credits hr				Units
Course Title	Material Eng. (I)					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Strength of material+ General chemistry	2	-	1	3	2

Course Description

Introduction to classification of materials and the atomic structure of it, Study the mechanical, thermal and electrical properties of materials and Crystal structure and imperfection in solid materials.

Course Text

1-Donaled R. Askeland, The science and engineering of materials, international student edition, 2006 .
2-William D. Callister, Jr. , Materials science and engineering, Fifth edition, 2000.
3-Lawrence H. Vanvlack , Elements of materials science and engineering, Fifth edition, 1987.

Course Objectives : at the end of the semester the student should be able to :-

1. Describe and solve problems on atomic arrangement and geometry of imperfections.
2. Describe and solve problems on mechanical, thermal and electrical properties of materials.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Classification of Materials:** Classification of materials, classification of materials based on structure, advanced materials	4hr
2	**Mechanical Properties of Materials:** Stress-strain behavior, ductility, brittleness, toughness, modulus of resilience, poison's ratio, hardness, effect of temperature.	6hr
3	**Atomic structure:** The structure of atom, atomic bonding, bonding energy and inter-atomic spacing	6hr
4	**Atomic order in solids :** Types of atomic or ionic arrangements, crystal structure, lattice, unit cells, metallic crystal structure, crystal systems, crystal direction and crystal planes , diffraction techniques for crystal structure analysis	8hr
5	**Thermal and electrical properties of materials:** Heat capacity, thermal expansion, thermal conductivity, thermal stresses, Glass transition temperature, Creep resistance, electrical conductivity, electron mobility, electrical resistivity of metals	6hr

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.237**	Credits hr				Units
Course Title	Properties of Petroleum fuels					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	petroleum chemistry	2	2	0	4	3

Course Description

The objective of this course to understand the petroleum(crude oil),its properties ,the physical and chemical properties of crude oil and the five or six basic products ,the purification and the distillation of crude oil to obtain different products and explain in details all the properties of the products

Course Text

1. Speight, J.G, Handbook of petroleum product analysis, John Willey & Sons,2002.
2. Speight J.G. and Ozum,B; Petroleum Refinery processes, Macel Dekker, New York, 2002.
3. Speight J.G., The chemistery and Technology of petroleum, 3rd Edition. Marcel Dekker, New York 1999.
4. Petroleum Fuels Manufacturing hand book; SurinderParkash, McGraw-Hill companies, 2010.

Course Objectives : at the end of the semester the student should be able to :-

1- To provide an understanding of the definition of petroleum ,and its classification , its quality during to its properties.

2- A comprehensive understanding of the petroleum product which they appear in visible form ,such as gasoline ,diesel , kerosene , and in less visible form over the entire spectrum of industry such as automobile lubricants , greases, carbon black for truck tires.

3- Ability to think that a refinery may produce five or six basic products such as LPG, naphtha, kerosene, diesel, and fuel oils, but specialty manufactures may produce a large number of their products from these basic refinery products..

University of Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Properties of Petroleum fuels

No.	Contents	Duration
1	**Petroleum analysis:** Historical perspective, modern perspectives, analysis of petroleum, Sampling of petroleum	2hr
2	**Definition of petroleum assay**	2hr
3	**Petroleum products:** Natural gas, refinery gas, Liquid Petroleum gas\Automotive LPG, LPG storage.	2hr
4	**LPG manufacture:** Extraction plant, Acid gas removal, Fractionation plant, Specification of gases.	2hr
5	**Naphtha:** Naphtha production,(crude distillation unit, Naphtha refractionation unit, Naphtha desulfurization)	2hr
6	**Naphtha specification:** Naphtha uses.	2hr
7	**Gasoline:** Introduction, gasoline engine, gasoline properties, gasoline blending, pollution from gasoline combustion, catalytic converter.	2hr
8	**Gasoline specification:** Benzene, aromatics, olefins, sulfur, RVP, oxygenates, gasoline distillation.	2hr
9	**Aviation Gasoline:** Aviation Gasoline specification: antiknock quality, performance number, distillation, RVP, heat of combustion, freezing point additives.	2hr
10	**Kerosene**: Introduction: Jet fuel, Grade and specification, Jet A-1,Jet A, Jet B, Millitary Jet fuel specification,	2hr
11	**Jet fuel quality characteristic:** Distillation, smoke point, aniline gravityproduct, mercaptan sulfur, acidity, hydrogen content, Aviation fuel additives.	2hr

12	**Diesel Fuel:** Introduction, Diesel engine, specifications, viscosity, sulfur, cold flow properties, Cetane Number, Cetane Index, Diesel Index, Back End Volatility	2hr
13	**Diesel Fuel Emission:** Diesel particulate matter, cabon dioxide, cabon monoxide, nitrogen oxides, hydrocarbon}, diesel storage stability, diesel fuel additives, diesel blending.	2hr
14	**Residue fuel oils:** Uses of residue fuels, Residue fuel oil specifications, marine fuel oils.	2hr
15	**Properties of residual fuel oils:** Viscosity, sulfur, ash content, ignition quality, water, heat of combustion], residual fuel oil burning.	2hr

Practical : Properties of Petroleum fuels

No.	Experiment Name.
1	**ASTM distillation exp.**
2	**Density and specific gravity exp**
3	**Viscosity& viscosity index exp.**
4	**Salt content in crude oil**
5	**Gum and gum stability**
6	**Flash & fire point**
7	**Ash content for petroleum products**
8	**Conrad Son Carbon residue of petroleum**

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.213**	Credits hr				Units
Course Title	Democracy					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	none	1	-	-	1	1

Course Description

The study of the Democracy concept and history and its relationship to religions and relations with Development , also the advantages and the disadvantages of democracy

Course Text

1-Human rights, development, contents Dr.Riyad Aziz Hadi

٢-مبادئ و قواعد عامة في حقوق الأنسان د. صلاح حسن مطرود

٣- حقوق الأنسان بين الأسلامي و العالمي د. محمد علي الشجيري

٤- حقوق الأنسان و الديمقراطية د. ماهر صالح الجبورى

٥- مشكلة الحرية د. زكريا أبراهيم

Course Objectives : at the end of the semester the student should be able to :-

1- To know the democracy and how can adapt our culture with the principles of democracy in general.

2-Lock of student to their own cultural inventories in the concepts of democratization and it has be shining in the emergence of a democratic culture in university community with the intimate and external community .

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Democracy: definition, a brief history, characteristics advantages of democracy and its disadvantages**	1hr
2	**The most important problem facing the implementation of democracy in arab-muslim world**	1hr
3	**Relationship awareness in the application of democracy**	1hr
4	**How can adapt our culture with the principles of democracy**	1hr
5	**Democracy between changes and external pressures**	1hr
6	**A pressure group the difference between them and the political parties**	1hr
7	**The advantages of democracy and the disadvantages**	1hr
8	**The theory of social determinism in state-building**	1hr
9	**Relationship between democracy and globalization**	1hr
10	**Development and democracy**	1hr
11	**Religion and democracy**	1hr
12	**The third way between socialism and capitalism**	1hr
13	**Reasons for the spread of financial and administrative corruption and how to confront it**	1hr
14	**The reasons for the collapse of democracy**	1hr
15	**The relationship between the intellectual and power** **Democracy and modernity** **Democracy and alienation**	1hr

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.222**	Credits hr				Units
Course Title	Engineering MathematicsII					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Engineering MathematicsI	2	-	1	3	2

Course Description

This course describe the providing of knowledge on solving ordinary differential equations and applications of first order ordinary differential equations and chemical engineering applications of the theory portion covered will be emphasized.

Course Text

Text book:

1. Higher Engineering Mathematics by Dr.B.S.Grewal, Khanna Publishers, 40th Edition, 2007.

Reference book:

1. Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, 2007.

Course Objectives: at the end of the semester the student should be able to:-

1- Understand methods of solving First order and Higher order ordinary differential equations along with some physical applications.

2- 2. Demonstrate the relevance of the mathematical methods learnt to chemical engineering.

Topics Covered (Syllabus)/ Engineering MathematicsII

No.	Contents	Duration
1	**Solution by Series:** Infinite series by Taylor theorem, Method of Frobenius (Case I, II, IIIa, and IIIb), Bessels's and Modified Bessel's Equation, Properties of Bessel Functions, Applications in chemical engineering ,Tubular Gas Preheater, Reaction in axisymmetric Spherical and Cylindrical pellets.	**15hr**
2	**Ordinary Differential Equations:** Introduction, Linear equation, Bernoulli's equation, Exact differential equations, Equations reducible to exact equations, Orthogonal trajectories, Newton's law of cooling. Linear differential equations with constant coefficients: Definition, Theorem, Operator D, Rules for finding the complementary function, Inverse operator, Rules for finding the particular integral, working procedure to solve the equation.	**10hr**
3	**Application of Ordinary Differential Equations:** Representation problems of 1st and 2nd ordinary differential equations (linear and nonlinear, homogeneous …etc.).	**5hr**

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering.*					
Course Code	**CES.R.232**	Credits hr				Units
Course Title	Material and Energy Balance					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Energy Balance	2	-	1	3	2

Course Description

The aims of the course provide a deep knowledge , wide scope and improved understanding the heat balance that include the effects of chemical reaction as well as unsteady state material and energy balances . The students should gain knowledge to apply the material and energy balance in engineering problems .

Course Text

1. D.M.Himmelblau and J.B.Riggs ,Basic Principles and Calculations in Chemical Engineering ,7th Edition , 2004 .
Other support books :-
2. R.M.Felder and R.W.Rousseau ,Elementary Principles of Chemical Processes ,3rd Edition ,2005 .

Course Objectives : at the end of the semester the student should be able to :-

1- 1. Energy balances that include the effects of chemical reaction .
2- 2. Ideal process , efficiency , and the mechanical energy balance .
3- 3. Heat of solution and mixing .
4- 4. Humidity (psychrometric) charts and their use .
5- 5. Unsteady state material and energy balances .

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Energy Balances that Include the Effects of Chemical Reaction:** Applications of energy balances in processes that include reactions , Calculation of an adiabatic reaction temperature , General energy balance in a process in which more than one reaction occurs , Energy balance to a process composed of multiple units .	**8hr**

2	**Ideal Processes , Efficiency , and the Mechanical Energy Balances :** Ideal reversible processes , Calculation of the work done during evaporation of a liquid , Calculation of the work in a batch process , efficiency , the mechanical energy balances , Comparison of the reversible work for a batch process with that of a flow process operating under the same conditions , the mechanical energy balance to the pumping of water .	4hr
3	**Heat of Solution and Mixing:** Heat of solution , Heat of dissolution , Heat of mixing , Introducing the effects of mixing into the energy balance .	4hr
4	**Humidity (Psychometric) Charts and their Use:** The humid heat , The humid volume , The dry-bulb temperature , The wet-bulb temperature , The humidity (psychometric) chart , Wet-bulb line , Adiabatic cooling line , Applications of the humidity chart .	6hr
5	**Unsteady state Material and Energy Balances :** Unsteady-state material balance without generation , Material balance on batch distillation , Unsteady-state chemical reaction , Unsteady-state energy balance .	8hr

Universityof Technology
Department of Chemical Engineering

Program	***Oil and Gas Refinery Engineering.***					
Course Code	**CES.R.234**	Credits hr				Units
Course Title	Fluid Flow II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Fluid Flow I	2	2	1	5	3

Course Description

Application of Bernoulli's equation and derive the flow rate equations and explain the principles of flow measuring devices in open and closed channels…

Derive and define the governing equations of compressible fluid flow: continuity, energy and momentum equations from principles of mass, energy and momentum conservation with various gas flow conditions, Mach Number and flow through conversion-diversion nozzle with application for subsonic, sonic, supersonic flow, types of gas pumping devices, Compressors types with ideal and actual gas compression cycle and calculation of compressor work …

Define and description for liquid mixing equipment and its design calculations with the energy consumption by this equipment...

Derive the terminal falling velocity and description drag coefficient for flow through packed columns and pressure drop calculation for fixed and fluidized beds and transport of particles...

Course Text

1- Coulson, J.M. , Richardson, J.F., Backhurst, J.R. and Harker, J.H., "Chemical Engineering" Volume(1) 6th Ed., Butterworth-Heinemann, 1999
2- Coulson, J.M. , Richardson, J.F., Backhurst, J.R. and Harker, J.H., "Chemical Engineering" Volume (2) 5th Ed., Butterworth-Heinemann, 2002
3- Holland, F.A. and Bragg, R., "Fluid Flow for Chemical Engineers", 2nd Ed., Edward Arnold, 1995.

Other support books :-

1- McCabe, W. L., Smith, J. and Harriot, P., "Unit Operations of Chemical Engineering", 6th Ed., McGraw – Hill, International Edition, 2001.
2- Christi J. Geankoplis "Transport Processes and Unit Operations" 3rd Ed. Printice Hall International Editions, 1993.

Course Objectives: at the end of the semester the student should be able to :-

1- Define the operation principles of the different types flow measurement, solve problems in fluid flow through flow measurement devices with applications for steady and unsteady flow.
2- Demonstrate knowledge of compressible fluid flows, with differences of equations using depending on compressible flow conditions, sonic (sub)(super)sonic flow, conversion*diversion nozzle, types of gas pumping devices.
3- Provide the ability to estimate the energy (power) consumption for liquid mixing

equipment and to design it by predict necessary fluid parameters of full scale projects by performing simple model experiments.

4- Provide the ability to estimate the terminal falling velocity and description drag coefficient for flow through packed columns and pressure drop calculation for fixed and fluidized beds and transport of particles...

5- Share ideas and work in a team in an efficient and effective manner under controlled supervision or independently.

Topics Covered (Syllabus)/Fluid Flow II

No.	Contents	Duration
1	**Flow Measurement:** Pitot tubes, orifice meter, venturi meter, nozzle meter, Rotameters other types of flow meters, flow in open channels and weirs with steady and unsteady applications	6 hrs
2	**Flow of Compressible Fluid:** General equation, equation of state, sonic velocity in fluids, Mach No. Isothermal, Non-isothermal and Adiabatic flow of an ideal gas in horizontal pipes, Converging-diverging nozzle for gas flow. Types of gas pumping devices (fans, blowers compressors) compressors types and gas compression cycle and calculations of work and efficiency of compressor	10 hrs
3	**Liquid Mixing:** Stirring and mixing and rotational force, effective forces and dimensionless numbers for rotational fluid flow. Stirred vessels (power consumption, power curve, scaled-up), equipment	6 hrs
4	**Flow of Fluid through Granular Bed and Packed Columns:** Motion of particles in a fluid, Drag force on a particle, terminal falling velocities, Sedimentation of fine and coarse particles, Pressure drop in granular beds, packed columns: packing types, Pressure drop estimation (Kozeny and Carmen equations), Fluidization Minimum fluidization velocity, Pressure, Pressure drop, Ergun equation, bed expansion and transport of particles.	8 hrs

Practical Fluid Flow II

No.	Experiment Name
1	Discharge through an orifice
2	Open Channel Flow over Weir
3	Flow through a Venturi Meter
4	Fluidization
5	Forced Vortex
6	Flow of Compressible Fluid
7	Impact of Jet
8	Non-Newtonian Fluids Behavior

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering.*					
Course Code	**CES.R.236**	Credits hr				Units
Course Title	Physical ChemistryII					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	1-chemical engineering principles 2-chemistry	2	-	-	2	2

Course Description

In this semester deals with the various transformation that can be brought about an ideal gases have played a very important part in the development of thermodynamics. It is include properties of solutions of electrolytes and with processes that occur at electrodes. It concerned with galvanic cells, in which a chemical reaction produce an electric potential difference between two electrodes.

Course Text

1. J. Laidler, physical chemistry, Bosten; Houghton M, ffl.n company, 1999.
2. G. Mortimer, physical chemistry , San Francisco; Altarcourt science and technology company, 2000.

Course Objectives : at the end of the semester the student should be able to :-

1- 1. Be able to solve problems related to the macroscopic equilibrium properties of gases and liquid.
2- 2. Understand how the thermodynamics of non simple system is applied to electrochemical cells.
3- 3. Be able to calculate cell voltages for standard conditions and other conditions using standard reduction potentials and the nerst equation.
4- 4. Be able to solve problems relating equilibrium constants and Gibbs energy changes to electrochemically measured quantities.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Applications of the equations of ideal gases** The PVT behavior of pure substances, the ideal gas, the constant volume process, the constant pressure process, the adiabatic process, the polytropic process.	10 hr
2	**Solutions of electrolytes** Electrical units, Faradays laws of electrolysis, molar conductivity, weak electrolytes, strong electrolytes, activity and ionic strength, determination of activity coefficient from solubility, the Debye-Hackle theory, acid- base catalysis and their dissociation constant.	10 hr
3	**Electrochemical Cells** Electromotive force (EMF) of a cell, measurements of EMF- the potentiometer, the polarity of electrodes, the cell reactions and reversible cells, free energy and reversible cells, typical of half cells classification EMF, standard electrode potentials, standard free energy and energy of aqueous ions, calculation of EMF of cell, oxidation- reduction reactions, concentrations cells, electrolysis.	10 hr

University of Technology
Department of Chemical Engineering

<table>
<tr><td>Program</td><td colspan="6">Oil and Gas Refinery Engineering</td></tr>
<tr><td>Course Code</td><td>CES.R.212</td><td colspan="4" rowspan="2">Credits hr</td><td rowspan="3">Units</td></tr>
<tr><td>Course Title</td><td>Computer Programming III</td></tr>
<tr><td>Term</td><td>2nd Semester</td><td>Theoretical</td><td>Practical</td><td>Tutorial</td><td>Total</td></tr>
<tr><td>Prerequisite(s)</td><td>10. Basic Principles of chemical engineering I.
11. Mathematics I.
12. Computer programming II</td><td>1</td><td>2</td><td>1</td><td>4</td><td>2</td></tr>
</table>

Course Description

To introduce chemical engineering students to modern calculating tool used in the practice of engineering by demonstrating an ability to create small structured programs in a MATLAB programming environment and understanding how user written functions interact with numerical methodsroutines.

Course Text

1- Rudra Pratap: Getting started with MATLAB 7, Oxford Press (Indian edition),2006.
2- Desmond J. Higham and Nicolas J. Higham: Matlab Guide, SIAM, 2000.

Other support books :-

1- Duane Hanselman and Bruce Littlefield: Mastering Matlab-6: A Comprehensive Tutorial and Reference, Prentice Hall, 2001.
2- Schilling R. J., Harries S.L., Applied Numerical Methods for Engineers using MATLAB & C, Thomson Books, 2002.

Course Objectives: at the end of the semester the student should be able to:-

1- Solve sets of linear and nonlinear equations using numerical methods as well as in-built MATLAB functions.
2- Apply numerical methods and MATLAB functions to differentiate and integrate a function or a set of discrete points.
3- 3. Apply explicit and implicit numerical methods and MATLAB functions to integrate single and multiple sets of initial value problems

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Two-Dimensional Plots:** The plot command , The f-plot command , Plotting multiple graphs in the same plot , Formatting a plot, Plots with logarithmic axes, Plots with error bars, Plots with special graphics , Histograms, Plotting multiple plots on the same page , Multiple figure windows Graphics.	4 hr
2	**Three-Dimensional Plots:** Line plots, Mesh and surface plots, Plots with special graphics, The view command.	2hr
3	**Using Script Files:** The MATLAB workspace and the workspace window, Input to a script file, Output commands, The save and load commands, Importing and exporting data.	1 hr
4	**Functions And Function Files:** Creating a function file, Structure of a function file, Local and global variables , Saving a function file, Using a user-defined function, Examples of simple user-defined functions, Comparison between script files and function files , Function functions, Sub-functions	4 hr
5	**Numerical Analysis :** Solving an equation with one variable, Finding a minimum or a maximum of a function, Numerical integration, Ordinary differential equations.	4 hr

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.224**	Credits hr				Units
Course Title	Material Eng. II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	general chemistry	2	2	1	5	3

Course Description

Imperfection in solid. diffusion and atomic movement in solid. Solid solution and phase diagram for different alloys. Ceramic materials and composite materials.

Course Text

1-Donaled R. Askeland, The science and engineering of materials, international student edition, 2006 .
2-William D. Callister, Jr. , Materials science and engineering, Fifth edition, 2000.
3-Lawrence H. Vanvlack , Elements of materials science and engineering, Fifth edition, 1987.

Course Objectives : at the end of the semester the student should be able to :-

1- Describe the geometry of imperfections
2- Calculate the extent of diffusion- driving composition changes based upon composition, time and temperature.
3- Predict the equilibrium microstructure of a material given the binary phase diagram, thermal history of the materials.
4- Describe the types and properties of ceramic and composite materials.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Imperfections in solids** Point defects, line defects, interfacial imperfections, Macroscopic defects	6hr
2	**Atomic and ion movements in materials** Stability of atoms and ions, mechanisms for diffusion, rate of diffusion (Fick's first law), factors affecting diffusion, non-steady state diffusion (Fick's second law) .	6hr
3	**Solid solutions and phase diagrams.** Basic concepts, solubility and solid solution, phase and phase diagram, unary phase diagram, binary Iso-morphous system, binary eutectic system.	6hr
4	**The Iron-Carbon system** The Iron-Iron carbide phase diagram, development of microstructures in Iron-carbon alloys	6hr
5	**Ceramic materials** Crystal structure, mechanical properties of ceramic, classification of ceramic materials on the basis of its application .	2hr
6	**Composites** Material combination, Reinforced composites, structural composites.	4hr

Practical: Material Eng. II

No.	Experiment Name
1	**Tension test**
2	**Hardness Testing**
3	**Bending Test**
4	**Creep Test**
5	**Abrasion Test**
6	**Impact Test**
7	**Moisture Measurement in Engineering Materials**
8	**Determination of Linear Thermal Expansion for a Solid**
9	**Microstructure Examination of pb-Sn alloys using the metallurgical microscope**

Universityof Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.228**	Credits hr				Units
Course Title	Properties of Petroleum Products					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Properties of Petroleum fuels	2	0	0	2	2

Course Description

The objective of this course to understand the physical and chemical properties of the petroleum specialty products which is the invisible fuels, and explain in details all the properties of this products.

Course Text

1. Speight, J.G, Handbook of petroleum product analysis, John Willey & Sons,2002.
2. Speight J.G. and Ozum,B; Petroleum Refinery processes, Macel Dekker, New York, 2002.
3. Speight J.G., The chemistery and Technology of petroleum, 3rd Edition. Marcel Dekker, New York 1999.
4. Petroleum Fuels Manufacturing hand book; SurinderParkash, McGraw-Hill companies, 2010.

Course Objectives : at the end of the semester the student should be able to :-

1- A comprehensive understanding of the petroleum product which they appear in less visible .form over the entire spectrum of industry such as automobile lubricants , greases, carbon black for truck tires.

2- Ability to think that a refinery may produce specialty manufactures a large number of the products from the basic refinery products .such as{ LPG, naphtha, kerosene, diesel, and fuel oils}.

Topics Covered (Syllabus)/ Properties of Petroleum Product

1	**Bitumen:** Introduction,Bitumen composition{ Asphaltine, resinearomatic oil,saturated oil}, Bitumen for pavement, Bitumen evaluation for pavement	2 hrs
2	**Types of Bitumen:** Cut back bitumen, bitumen emulsion, polymer modified bitumen, oxidized bitumen,Industrialuses of bitumen, storage and handling of bitumen.	2 hr
3	**Petroleum Coke:** Introduction,manufacturing process, petroleum coke type, properties of calcined coke, uses of petroleum coke	2 hr
4	**Carbon black:** Introduction, manufacturing processes,channel blacl process, carbon black process, carbon black properties, secondary properties.	2 hr
5	**Carbon black test methods:** Application and uses,	2 hr
6	**Lube base stocks :** Introduction conventional process, catalytic dewaxing, API classification of base oil	2 hr
7	**Lubricating oil blending :** Introduction, classification of lubricating oils, effect of viscosity on fuel economy , automotive oil additives, viscosity index improvers, detergent inhibitors .	2 hr
8	**Engine oil formulation:** effect of base stock quality, gear oil, automotive lubricants test methods	2 hr
10	**Synthetic lubricants**	2 hr
11	**Turbine oil :** Introduction, base oil, formulation, life of turbine oil, tests method{ acid number, copper corrosion , rust test, foam test, turbine oil test}	2 hr
12	**Lubricating greases :** Introduction, grease composition, base oil, grease thickeners, additives	2 hr
13	**Grease manufacture:** Lubricating greases quality, automotive greases, air craft greases, marine greases, high temperature grease.	2 hr
14	**Waxes :** Introduction, nonpetroleum waxes, other plant waxes, properties, test method{ melting point, hardness, color, oil content, viscosity, acid number}	2 hr
15	**Microcrystalline waxes** Petroleum wax manufacture,	2 hr

Universityof Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.225**	Credits hr				Units
Course Title	Eng. Statistics					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I, Mathematics II	2	2	1	5	3

Course Description

Theory, applications, deferent methods calculation, sample descriptive statistics and graphical representation of data.

Course Text

1- Murry R. Spiegel, Statistics, Mc Grow-Hill international book company 1st addition.
2- Michael Sullivan III, Statistics informed decision using data 3rd addition, pearson education international 2010.
3- Jones' instrument technology.
4- Butterworth and co. (publishers) 2nd addition 1987.

Course Objectives: at the end of the semester the student should be able to:-

Use all the methods of statistical calculations to solve problems in chemical engineering and others applications.

Topics Covered (Syllabus)/Eng. Statistics

No.	Contents	Duration
1	Introduction: Statistics, population and sample descriptive and inductive statistics and graphical representation of datas	**2hr**
2	Frequency distribution table, raw data, arrays, types of frequencies.	**2hr**
3	Graphical representation of frequency distribution table..	**2hr**
4	Measures of central tendency.	**2hr**
5	Measures of dispersion	**2hr**
6	Curve fitting, Least squares method, Straight line forms, polynomial regression, variance and correlation coefficient.	**4hr**
7	Multiple and partial correlation: regression equation, normal equations for the least square regression, the coefficient for multiple correlation, relationship between multiple and partial correlation.	**4hr**
8	Probability distribution, continuous and discrete probability distribution, normal distribution.	**2hr**
9	The binomial distribution, the poisson probability distribution, approximation of standard distributions.	**2hr**
10	The chi-square test, confidence intervals, degree of significant, test of	**4hr**

	hypothesis, test for goodness of fit of probability distributions test of independence.	
11	Companing three or more means (one-way analysis of variance (ANOVA), requirements of ANOVA test, ANOVA F-test, decision rule in ANOVA test.	**4hr**

Topics Covered (Syllabus)/ Statistics Laboratory Guide

No.	Contents
1	The concept of statistical analysis, the important statistics to life, about the most important statistical programmes
2	Install Statistical ,About statistical analysis software, interfaces and quibbles
3	Working environment and Statistical data entry program
4	Using Statistica in statistical analysis with examples
5	Regression And Correlation (Curve Fitting)with Examples
6	How to finds With examples 1- Find minimum and maximum and variance. 2- Find standard deviation, mean, mode. 3- Find second max frequency. 4- Find max class mark and its frequency? 5- Find max frequency. 6- Find second class mark and its frequency.
7	Ways to validate the equation imposed with examples
8	Line (45) Method with examples
9	Correlation Coefficient Method with examples
10	Residual Plot Method with examples
11	Multiple Linear Regression liner model with examples
12	Multiple Linear Regression Non liner model with examples

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.331**	Credits hr				Units
Course Title	Thermodynamics I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Material &Energy Balance, Physical Chemistry,Fluid Flow	2	2	1	5	3

Course Description

The course of chemical engineering thermodynamics I comprises the study of volumetric properties of pure fluids; Entropy and second law analysis of engineering systems; Thermodynamic properties of fluids; Applications of thermodynamics to flow processes.

Course Text

1- J. M. Smith,H.C.Van Ness, Introduction to chemical engineering thermodynamics, 6th edition (International Edition), Mc-Graw Hall, 2008.

Other support books :-

1-K.V.Narayanan, Atext book of chemical engineering thermodynamics, prentice Hall of India, New Delhi, 2011.
2- B.G.Kyle, Chemical and process thermodynamics ,(3rd Edition), prentice Hall Inc.New Jersey, 1984.
3-J. Rayner, Basic engineering thermodynamics inSI units, printed in great Britain,1971

Course Objectives : at the end of the semester the student should be able to :-

1- To familiarize the students with basic concepts of the first and second laws of thermodynamics and their applications in engineering problems.
2- Develop a practical ability to solve energy balance problems , minimum work.
3- 3.Students will demonstrate basic understanding of basics and definitions of thermodynamics and properties of pure substances.
4- 4.Describe the reversible and irreversible processes (macroscopic description of an ideal and real processes).

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Volumetric properties of pure fluids** Review on virile equation of state, cubic equation of state, generalized correlations for gases and for liquids.	6 hr
2	**The 2nd law of thermodynamics** Review on the 2nd law and Carnot heat engine, entropy balance for open system, calculation of ideal work, lost work.	9 hr
3	**Thermodynamic properties of fluids** Review on the property relations ($\Delta H, \Delta S, \Delta U and \Delta G$) residual properties, two phase systems, thermodynamic diagrams and tables, generalized property correlations for gases.	6 hr
4	**Applications of thermodynamics to flow processes** Duct flow of compressible fluids, pipe flow, nozzles, throttling process, turbines, compression processes compressors, ejectors.	9 hr

Practical Thermodynamics I

No.	Experiment Name
1	Measurement of the solar irradiation
2	Alternating current solar installation
3	Refrigeration
4	Hydrolysis of methyl acetate
5	Pressure and Temperature relationship for steam
6	Liquid -vapor equilibrium Isotropic Mixtures
7	Boyles' law
8	Regulating and charging battery

Universityof Technology
Department of Chemical Engineering

Program	Oil and Gas Refinery Engineering					
Course Code	CES.R.321	Credits hr				Units
Course Title	Numerical Analysis					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Computer Programming II , III	2	2	1	5	3

Course Description

This course introduces students to: Error analysis; Finding roots of a non-linear function; Approximation and interpolation; Numerical integration and differentiation; direct and indirect solution of systems of linear equations; Solution of systems of nonlinear equation; solving ordinary differential equations and partial differential equations. All examples within the course concerning with principles of chemical engineering.

Course Text

1. "Numerical Methods for Engineers", Steven C. Chapra, Raymond P. Canale, McGraw Hill, 6th edition, 2010.
2. "Numerical Methods for Engineers and Scientists", Joe Hoffman, McGraw-Hill Book Company,1993.
3. "Applied Numerical Analysis", Gerald,C.F. and Wheatley, P.O., 6th Edition, Pearson Education, 2006.
4. "Numerical Methods for Chemical Engineers with MATLAB Applications", Alkis Constantinides, Navid Mostoufi, Prentice Hall, 1999.

Course Objectives: at the end of the semester the student should be able to:-

To solve chemical engineering problems with numerical analysis techniques.

Topics Covered (Syllabus)/ Numerical Analysis

No.	Contents	Duration
1	**Introduction to Numerical Analysis:** Numerical Solution, type of errors; relative error, absolute error, percentage error, truncation error, round off error. Floating point.	2hr
2	**Root Finding:** Roots of polynomials, Bisection method, Secant method, Newton-Raphson method.	4hr
3	**Interpolation and Polynomials Approximation:** Lagrangian Polynomials, Divided differences, Cubic spline interpolating polynomials, Newton's forward and backward difference formulas.	4hr

4	**Numerical Differentiation and Numerical Integration:** Forward, backward and central difference approximation. Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules. Double integrals using trapezoidal and Simpson's rules.	6hr
5	**Solving System of Equations:** Solution of linear system of equations by direct methods (Gaussian elimination and Gauss-Jordon). Solution of linear system of equations by Iterative methods (Jacobi and Gauss-Seidel). Solution of non-linear system of equations by Newton-raphson.	4hr
6	**Solution of ordinary Differential Equations:** Initial value problems. Solution of first-order ordinary differential equations using Taylor', Eular, Runge-Kutta and Predictor-corrector methods. Solution of simultaneous ordinary differential equations.	4hr
7	**Solution of Partial Differential Equations:** Types of Partial Differential Equations: Elliptic (Poisson) equation, Parabolic (heat) equation, Hyperbolic (wave) equation. Finite difference solution of Partial Differential Equations. Numerical solution of partial differential equations using explicit, implicit and Crank-Nicolson methods elliptic (Laplace) equation.	6hr

Topics Covered (Syllabus)/ Numerical Analysis Laboratory Guide

No.	Contents
1	Review of properties of Matlab programming language.
2	Bisection method and Secant method.
3	Newton-raphson method.
4	Lagrange interpolation.
5	Newton's forward and backward difference formulas.
6	Trapezoidal rule.
7	Simpson's 1/3 and 3/8 rules.
8	Solution of linear system of equations by direct methods (Gaussian elimination and Gauss-Jordon).
9	Solution of linear system of equations by Iterative methods (Gauss-Seidel and Jacobi).
10	Solution of differential equation using Euler's method.
11	Solution of differential equation using Runge-Kutta method.
12	Solution of partial differential equations using explicit and implicit methods.
13	Solution of partial differential equations using Crank-Nicolson method.
14	Solution of steady state diffusion through catalyst
15	Solution of un-steady state diffusion through catalyst

Universityof Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.333**	Credits hr				Units
Course Title	Mass Transfer					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemical engineering principles, thermodynamics, fluid flow	2	2	1	5	3

Course Description

This course covers diffusion and mass transfer in binary& multi-components, molecular diffusion in fluids, convective mass transfer, mass transfer coefficients, mass transfer correlations, interphase mass transfer, mass transfer theories.

Course Text

1- Coulson, J. M & Richardson J. F. (2006). “Chemical engineering, Volume 1”, 3rd Edition, Robert Maxwell. M. C.
2- Dutta Binary K. (2007), “Principles of Mass Transfer & Separation Process”, Bvt. Ltd. Prentice Hall, ISPN 8-1203-2990-2.

Other support books:-

1- Treybal Robert E. (1975), “Mass transfer Operation” 2ed Edition, Mc-Graw-Hill Book.
2- McCabe, W., Smith, J., Harriott, P. (2004), “Unit Operations of Chemical Engineering”, Mc-Graw-Hill Co., 7th Edition, ISBN0072848235.

Course Objectives: at the end of the semester the student should be able to:-

1- Understand the basics of diffusion as applicable to mass transfer phenomena.
2- Estimate Molar fluxes in convective and inter phase mass transfer.
3- Explain the concept of diffusion theories.
4- Applying the convective mass transfer correlations to calculate mass transfer rates in many units operation.

Topics Covered (Syllabus)/ Mass transfer

No.	Contents	Duration
1	**Introduction:** Fundamentals of mass transfer processes, concentrations, velocities, mass & molar fluxes.	2 hrs
2	**Diffusion in binary gaseous:** Fick's first law of diffusion. Diffusion in gas mixtures, Equimolecular diffusion, diffusion in stationary layer. Correlations to calculate diffusivity, correcting diffusivity	6 hrs
3	**Diffusion in multi component mixtures:** Multi-component gas phase systems, effective diffusivity. Maxwell's law of diffusion	4 hrs
4	**Diffusion in liquids.**	2 hrs
5	**Diffusion in solids.**	2 hrs
6	**Diffusion theories**: Diffusion across phase boundary, Film theory, two film theory, Mass transfer coefficients (individual & overall) in laminar and turbulent flow.	4 hrs
7	**Diffusion resistances:** Calculating the resistance to mass transfer in both phases. Calculating intermediate concentrations.	4 hrs
8	**Unsteady state mass transfer:** Introduction to unsteady state mass transfer, mass transfer accompanied by a chemical reaction.	6 hrs

Practical :Mass Transfer

No.	Experiment Name
1	Liquid-Liquid diffusion
2	Absorption
3	Batch Distillation Column
4	Fluid Mechanics of Packed Bed
5	Sieve Analysis
6	Gas Solid Fluidization

University of Technology
Department of Chemical Engineering

Program	Oil and Gas Refinery Engineering					
Course Code	**CES.R.335**	Credits hr				Units
Course Title	Chemical reaction kinetics					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physical chemistry	2	-	-	2	2

Course Description

Theory,Kinetic parameters and rate law, multiple reactions, yield and selectivity, stoichiometric considerationsand collection and analysis of rate data
.

Course Text

1-Octave Levenspiel (1999),*CHEMICAL REACTOR ENGINEERING*, 3rd edition, John Wiley & Sons Inc., USA ISBN: 9780471254249.

2-J.M. Smith (1987), *CHEMICAL ENGINEERING KINETICS*, 3rd edition, McGraw-Hill International Editions, Singapore. ISBN: 9780070587106

Other support books :-

1- Ronald W. Missen; Charles A. Mims; Bradley A. Saville (1999), *INTRODUCTION TO CHEMICAL REACTION ENGINEERING AND KINETICS*,1stedition, John Wiley & Sons Inc.,USA.

Course Objectives : at the end of the semester the student should be able to :-

This course aims to establish fundamental knowledge for the students in chemical reaction kinetics. At the end of this course, students should be able to:

(i) interpret and analyseschemical reaction kinetics data.
(ii) apply reaction kinetics principles in chemical reaction.
(iii) identify and formulate problems in chemical reaction kinetics and find appropriate solutions.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Kinetic parameters and rate law:** L1: Definition in terms of reacting compounds and reaction extent; irreversible and reversible reactions, homogeneous catalyticreactions L2: Symbols and relationships between concentration and conversion L3: Introduction to rate laws, stoichiometry. L4: Reaction order and elementary reactions. L5: Reaction rate constants, Arrhenius equation, Van't Hoff equation L6: Temperature and pressure effects on reaction rates. L7: Thermal effects due to heat of reaction.	10hr
2	**Multiple reactions, yield and selectivity:** L8: Types of multiple reactions. L9: Definitions of yield and selectivity. L10: Analysis of parallel, series, consecutive reactions. L11: Effect of pressure and temperature on multiple reactions L12: The Denbigh reaction and its special cases	10hr
3	**Stoichiometric considerations:** L13: Stoichiometric considerations in batch systems (constant and variable density). L14: Stoichiometric considerations in flow systems (constant and variable density). L15: Examples: batch, semi-batch reactors, flow reactors, and Industrial reactors.	6hr
4	**Collection and Analysis of rate data:** L16: Differential and integral methods. L17: Initial rate and half-life methods.	4hr

Program	*Oil and Gas Refinery Engineering*					
Course Code	CES.R.337	Credits hr				Units
Course Title	Heat transfer I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Fluid flow &Math	2	0	1	3	2

Course Description

To introduce and develop an understanding the modes of heat Transfer (conduction, convection and radiation).Derive and discusses all types of equation in these modes of heat transfer. Analyze heat transfer rate data in different modes. Derive the necessary equations for hydrodynamics and thermal boundary layer. Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

Course Text

1- J.P.Holman, Heat Transfer, Ninth edition.
2- Frank P. Incropera & David P. Dewitt, Fundamentals of Heat and Mass Transfer, Fifth Edition.

Other support books :-

1- Coulson ,J.M and Richardson J.F. "Chemical Engineering , volume 1",3rd edition.

Course Objectives: at the end of the semester the student should be able to:-

1- Develop a deep understanding of issues related to the heat and energy balance for different chemical process
2- Define and solve problems in heat transfer mechanism in various engineering applications.
3- Explain and derive heat equations for the conduction and convection heat transfer.
4- Apply the analytical equations and correlations in convection heat transfer problems.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Modes of Heat Transfer:** Conduction, Convection and Radiation.	**4 hrs**
2	**Steady State Heat Conduction in One Dimension:** General heat conduction equation in different coordinates, Plane wall, Radial systems, heat source systems, Boundary surrounded by fluids, Overall heat transfer coefficient, Conduction convection systems and fins.	**10 hrs**
3	**Unsteady State Heat Transfer:** Temperature as a function of time, lumped capacity system, quenching of small bodies and heating of tank.	**4 hrs**
3	**Principles of Convection:** Transport equations, Fluid mechanism aspect of convection, laminar boundary layer, The turbulent portion of boundary layer, The laminar sub-layer. Thermal boundary layer, Empirical and practical relations for pipe and tube flow and flow normal to single and tube banks. Reynolds analogy.	**12 hrs**

Universityof Technology
Department of Chemical Engineering

Program	Oil and Gas Refinery Engineering					
Course Code	**CES.R.339**	Credits hr				Units
Course Title	Combustion					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	1.Chemical Engineering principle 2.Energy balance	2	-	-	2	2

Course Description

Scope and History of Combustion, Combustion of Gaseous and Vaporized Fuels. Gas –fired furnace combustion and flames, Combustion of Liquid Fuels and Oil –Fired Furnaces Combustion , Direct –Injection Engine Combustion , Combustion of Solid Fuels

Course Text

1-Gary L.borman,Combustion(Engineering),1998 by Mc Grawhill
2-Stephen R.turns,(An introduction to Combustion), 2000 by Mc Grawhill.
3-F .ElMahallawy and S.ElD in Habik ,"(Fundamentals and Technology of Combustion)",2002 by Elsevier

Course Objectives : at the end of the semester the student should be able to :-

1- Study the nature of combustion ,scope of internal combustion engine
2- Types of flame ,study the effect of temp and pressure
3- study the types of solid fuels and the drying of solid fuels
4- Study the types of furnaces and furnaces efficiency

Topics Covered (syllabus) / Course Title

No	Contents	Duration
1	**Scope and History of Combustion:** The nature of combustion, Historical perspective of fuels, Historical perspective of combustion technology (lighting /steam boilers/ internal –combustion engines/compression ignition engines/gas turbines/rocket engines).	**2 hr**
2	**Combustion of Gaseous and Vapourized Fuels :** **1-Gas –fired furnace combustion** Furnaces and tubular furnace, energy balance and furnace efficiency (Furnace efficiency and heat loss calculations), burners types, radiation and convection rooms in furnace, furnace wall layers and refractories ,chimney height calculation, tube layers in furnaces.	**16 hr**

	2- Flames: First law combustion calculations (adiabatic flame temperature), Laminar premixed flames: (effect of stoichiometry on laminar burning velocity /effect of reactant pressure and temperature on laminar burning velocity/stabilization of a premixed flame), laminar flame theory(laminar burning velocity theory /simplified laminar flame model), diffusion flames, combustion zones and temperature profiles, flammability limits, flame stability, flame and combustion speed.	
3	**Combustion of Liquid Fuels:** **1- Spray Formation And Droplet Behavior** Spray formation, size distributions, fuel injectors, spray dynamics (diesel spray dynamics, single –droplet dynamics), vaporization of single droplets. **2-Oil –Fired Furnaces Combustion** Gas turbine sprays combustion, Gas turbine operating parameters, combustor design, combustion rate, Liner heat transfer. **3-Direct –Injection Engine Combustion** introduction to diesel engine combustion, fuel injection, combustion rates	10 hr
4	**Combustion of Solid Fuels:** **Solid Fuel Combustion Mechanisms** Solid fuel, drying of solid fuels, devolatilization of solid fuels.	2hr

Universityof Technology
Department of Chemical Engineering

Program	***Oil and Gas Refinery Engineering***					
Course Code	**CES.R.3311**	Credits hr				Units
Course Title	Chemicals from Petroleum					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	General ,Organic chemistry and unit operation	2		1	3	2

Course Description

Primary and secondary raw materials ,Ethylene ,Butylenes ,Higher olewfins and Syn gases Derivative Of Ethylene ,Propylene ,Syn gas ,End products –Polymers PCS and complexes.

Course Text

1. Hydrocarbonn processing:petrochemicalprocesses,2005

Other support books :-
1-Shreve's Chemical Process Industries, 5th edition,1988.
2-List,H.L."Petrochemical Technology, 1986
3-Jamaly,J.S."Petrochemical processes,1984:Arabic

Course Objectives : at the end of the semester the student should be able to :-

1- To know sourses:(feed stock).These sources are petroleum fractions and natural gases.
2- To introduce petrochemicals generations:first :basic PCs,2^{nd}:derivatives,3^{rd}:end product.
3- Ability to select of appropriate equipment for the separation of materials in process plant.
4- Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction :** Raw material, characterization	**2hr**
2	**Primary Petrochemicals:** Olefins, Diolefins, Higher Olefins, LAB, Aromatics, separation Aromatics, Syn gas, H_2 production, steam reforming ,PO	**11hr**
3	**Derivatives Syn gas derivatives**: Methanol, Acetic acid **Ethylene derivatives :** Vinyl chloride M, Ethylene Oxide. Ethylene glycol, MEA, DEA&TEA	**9hr**

	Propylene derivatives : Acrylonitrile, **Derivatives of C_4 hydrocarbon** : MTBE, Adipic acid . **Benzene derivatives** Ethyl benzene, styrene, nitrobenzene, aniline, cyclohexane, cumene, Phenol, acetone. **Toluene derivatives :** Benzoic acid **Xylene derivatives :** Terephthalic acid .	
4	**Products:** polymers: LDPE, HDPE, PVC, PP.	**6hr**
5	**Petrochemical complexes:** Ethylene ,Propylene ,Benzen , C4 ,BTX	**2hr**

Universityof Technology
Department of Chemical Engineering

Program	Oil and Gas Refinery Engineering					
Course Code	**CES.R.3313**	Credits hr				Units
Course Title	Equipment Design					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Basic Principles of chemical ,fluid flow,	2	---	1	3	2

Course Description

.The course content process planning, piping and pumps network , gas-gad separation ,solid handling, hear and mass transfer equipments

Course Text

. Sinnott R. and Towler C; 2013 " chemical Engineering Design" 5th edition Butterworth-Heinemann
Coke,A.K ;2007"Ludwig s Applied Process Design of Chemical and petrochemical Plant" vol. 1 4th edition Gulf professional Publisher

Course Objectives : at the end of the semester the student should be able to :-

The ability to apply the design equation and equipments specifications as practical

To prepare students to be able to read and understand chemical engineering plants drawing

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Process planning:** Introduction, Nature of design ,the organization of a chemical engineering projects Scheduling .Standards and codes. Flow sheet design, flow sheet types and designation .Block diagram .Process flow sheet .Piping and instrumentation diagram .Utilities, Computer aided drafting ,process simulation programs .Layout and plot plan .Project evaluation and cost estimation	6hr
2	**Piping network and Pumps:** Valves selection . Piping design standards and codes . Pipe size selection .Mechanical design of piping system. Pump type, pump specifications, and pump data sheet	4hr
3	**Gas-Gasseparation:** (adsorption, membrane …….etc); Solid-Solid separation ;Liquid-Solid Separation	4hr

4	**Solid Handling**: Screening Classification with Streams of Air or Water Air Classifiers . Size Reduction. Equipment for Size Reduction Particle Size Enlargement Extrusion Processes	4hr
5	**Heat Transfer Equipments:** Heat exchanger types and applications. Basic design procedure and theory. Overall heat transfer coefficient. Heat exchanger data sheet. Furnaces convection and radiation zone. Steam boilers	6hr
6	**Mass Transfer Equipments:** Columns types . Plate Types. Packing types . Pressure drops in columns . Column data sheets	6hr

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.332**	Credits hr				Units
Course Title	Thermodynamics II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mass Transfer, Unit Operation I, Equipment Design	2	-	1	3	2

Course Description

The course discuss the study of Power cycles; Refrigeration and liquefaction process; Theory and application of solution thermodynamics ;Vapor/liquid equilibrium in both: binary and multi-components; Ideal and non-ideal solutions are discussed using Raoult's and modified Raoult's law; Fugacity and fugacity coefficient definitions; Chemical reaction equilibriumandThermodynamic analysis of processes.

Course Text

1- J. M.Smith,H.C.Van Ness, Introduction to chemical engineering thermodynamics, 6th edition (International Edition), Mc-Graw Hall, 2008.

Other support books :-

1-K.V.Narayanan, Atext book of chemical engineering thermodynamics, prentice Hall of India, New Delhi, 2011.

2- B.G.Kyle, Chemical and process thermodynamics ,(3rd Edition), prentice Hall Inc.New Jersey, 1984.

3-J. Rayner, Basic engineering thermodynamicsinSI units, printed in great Britain,1971.

Course Objectives : at the end of the semester the student should be able to :-

1- Apply the laws of thermodynamics to power, refrigeration and liquefaction cycle.
2- Establish thermodynamic constraint that apply to VLE, and explain qualitatively the VLE diagram.
3-Apply thermodynamics to VLE of pure components and solutions in terms of fugacity and fugacity coefficients.
4-Apply equilibrium criteria to chemical reactions and evaluate the effect of temperature.
5. Revision for thermodynamic analysis of processes.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Production of power from heat**: The steam power plant, Rankin cycle, the regenerative cycle, internal combustion engines Otto engine, diesel engine, gas turbine engine.	4 hr
2	**Refrigeration and liquefaction:** The Carnot refrigerator, the vapor compression cycle, the choice of refrigerant, absorption refrigeration, the heat pump, liquefaction processes.	6 hr
3	**Vapor\liquid equilibrium; introduction :** The nature of equilibrium, the phase rule, Duhem,s theorem, diagrams for vapor liquid equilibrium, simple models for VL equilibrium: Rault,s law, dew point and bubble point calculations, Henrys law, VLE by modified Raults law, VLE from K value correlations, flash calculations.	9 hr
4	**Solution thermodynamics: theory:** Fundamental property relations, the chemical potential and phase equilibrium, ideal gas mixtures, fugacity and fugacity coefficient, the fundamental residual property relations, the ideal solutions.	2 hr
5	**Chemical Reaction equilibrium:** The reaction coordinate, standard Gibbs energy change and equilibrium constant, effect of temperature on equilibrium constant, evaluation of equilibrium constant, liquid phase reactions, equilibrium conversion for single reactions.	6 hr
6	**Thermodynamic analysis of processes:** Second law relation for steady state flow processes, calculation of ideal work, thermodynamic analysis of steady state flow processes.	3 hr

University of Technology
Department of Chemical Engineering

Program	***Oil and Gas Refinery Engineering***					
Course Code	**CES.R.322**	Credits hr				Units
Course Title	Applied Mathematicsin chemical Engineering					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I, II	2	-	1	3	2

Course Description

This course introduces students to: Solve ordinary differential equations: apply Laplace transform to solve various systems of ordinary differential equations: Solve different types of partial differential equations. At the end of the course students should be able to apply these methods to tackle all kinds of problems that appear in chemical engineering.

Course Text

1- “Mathematical Methods in Chemical Engineering”, Jenson. V.J. and Jeffereys, G.V, 2nd Edition, Academic Press New York, 1977.
2- “Applied Mathematics and Modeling for Chemical Engineers”,Rice R G. and. Do, D. D., John Wiley and Sons, New York, 1995.
3- “Applied Mathematical Methods for Chemical Engineers”,Loney, Norman W., 2^{nd} edition, CRC Press – Taylor & Francis Group, Boca Raton, 2007.

Course Objectives: at the end of the semester the student should be able to:-

Apply different analytical methods to solve chemical engineering problems.

Topics Covered (Syllabus)/Applied Mathematics in chemical Engineering

No.	Contents	Duration
1	**Ordinary Differential Equations :** First-order differential equations, Linear and nonlinear first-order equations, Formation of differential equations, Solutions of linear differential equations, Initial and Boundary value problems, Separable first-order ode’s, Exact differential equations, Differential operator, Integrating factors, Solutions of second order linear homogenous equations, Coupled first order equations, Method of reduction of higher order differential equations, Solutions of higher order homogenous linear equations. Chemical engineering applications: Application of the law of conservation of mass, First-order chemical reaction in a batch reactor,	**10 hr**

	Heating a closed kettle, Cooling of a hot object, Dilution of a salt solution in a stirred tank, Consecutive reaction system in a batch reactor, Radial heat transfer through a cylindrical conductor, Reaction in a spherical and cylindrical catalyst, Flow of heat from fin. Simultaneous diffusion and chemical reaction in a tubular reactor, Solvent extraction in N stages.	
2	**Laplace transform**: Laplace transforms, Laplace transform of the derivatives, Laplace transform of Integral, Laplace Transform of t.f (t) (multiplication by t), Properties of Laplace transform, Laplace transform of special functions (step, pulse, Impulse, ramp and periodic functions), Convolution theorem, Initial value problems (multiplication by s), Final value problems (division of s), First shifting properties, second shifting properties, Inverse of Laplace transform, Inverse Laplace transform of derivatives, Inverse Laplace Transform of Integrals, Partial Fraction, Solution of differential equations, Solution of simultaneous ordinary differential equations, Application of Laplace transform to solve chemical engineering problems.	**10 hr**
3	**Partial differential equations:** Classification of partial differential equations, Formulation of partial differential equations, Continuity equation, Unsteady-state component mass transfer with axial symmetry, Unsteady-state heat conduction with axial symmetry, Boundary conditions, Solution of partial differential equation by direct Integration, General and particular solutions, superposition of solutions, Complementary solution, Particular solution, Solution using separation of variables method, Solution using Laplace transforms method, Solution using combination of variables method. Chemical engineering applications: i. Heat conduction in a semi-infinite slab. ii. Unsteady conduction/diffusion in one dimension. iii. Steady-state heat conduction in two-dimensions.	**10 hr**

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.334**	Credits hr				Units
Course Title	Unit Operations I					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mass transfer	2	0	1	3	2

Course Description

This course covers two main operations, gas absorption, stripping and distillation for binary and multi component mixtures. Concepts to design mass transfer equipment.

Course Text

1- Coulson, J. M & Richardson J. F. (2006). "Chemical engineering", Volume 2, 3rd Edition, Robert Maxwell. M. C.
2- Dutta Binary K. (2007), "Principles of Mass Transfer & Separation Process", Bvt. Ltd. Prentice Hall, ISPN 8-1203-2990-2.

Other support books:-

1- Treybal Robert E. (1975), "Mass transfer Operation" 2nd Edition, Mc-Graw-Hill Book.
2- McCabe, W., Smith, J., Harriott, P. (2004), "Unit Operations of Chemical Engineering", Mc-Graw-Hill Co., 7th Edition, ISBN0072848235.

Course Objectives: at the end of the semester the student should be able to:-

1- Understand the basics of gas absorption, stripping and distillation.
2- Design absorbers, strippers and distillation columns.
3- Find Operating lines, feed line and No. of trays or amounts of packing required.
4- Calculate columns efficiency.

Topics Covered (Syllabus)/ Unit Operation I

No.	Contents	Duration
1	**Introduction to separation processes:** General separation techniques. The mechanism of absorption and stripping processes. Flow regimes.	4 hrs
2	**Absorption in packed bed columns**: Constructions, mass transfer coefficients & specific area, capacity, height of columns based on gas film, liquid film, and based on overall conditions, operating line, the transfer units, the importance of gas and liquid flow rates.	4 hrs

3	**Absorption in Tray towers :** Types of trays, number of trays analytically and graphically. How to calculate the tray and column efficiency.	4 hrs
4	**Introduction to distillation process:** Partial pressure, Dalton's, Raoult's & Henry's laws. Relative volatility, non ideal systems. Method of diffusion, binary mixtures, batch distillation, flash distillation, steam distillation. Fractionating column.	3 hrs
5	**Fractionating process**: Number of plates required importance of reflux ratio, location of feed point, multiple feeds and side streams.	3 hrs
6	**Multi-component Distillation:** Key components. Components distributions, equilibrium data, feed & product compositions, minimum reflux ratio, calculation number of trays required, relation between reflux ratio & number of plates.	4 hrs
7	**Plate & packed distillation columns:** General designed methods, column efficiency	4 hrs
8	**Reynolds Analogy**: Mass transfer with bulk flow, flow over a plane surface, flow in a pipe.	4 hrs

Universityof Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering,*					
Course Code	**CES.R.336**	Credits hr				Units
Course Title	Reactor Design					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemical Reaction Kinetics	2	-	-	2	2

Course Description

Theory,design fundamentals and mass conservation equations for ideal reactors, isothermal reactors for homogeneous reactions, non-isothermal reactors, multiple reactor System.

Course Text

1-Octave Levenspiel (1999),*CHEMICAL REACTOR ENGINEERING*, 3rd edition, John Wiley & Sons Inc., USA ISBN: 9780471254249.

2-J.M. Smith (1987), *CHEMICAL ENGINEERING KINETICS*, 3rd edition, McGraw-Hill International Editions, Singapore. ISBN: 9780070587106

Other support books :-

1- Ronald W. Missen; Charles A. Mims; Bradley A. Saville (1999), *INTRODUCTION TO CHEMICAL REACTION ENGINEERING AND KINETICS*,1stedition, John Wiley & Sons Inc.,USA.
2- . H. S. Fogler, Elements of Chemical Reaction Engineering, 4th Ed (2006),
   a. Prentice Hall,NewYorK.

Course Objectives : at the end of the semester the student should be able to :-

This course aims to establish fundamental knowledge for the students in chemical reactor engineering. At the end of this course, students should be able to:
(i) apply reaction kinetics principles in chemical reactor engineering.
(ii) identify and formulate problems in chemical reactor engineering and find appropriate solutions.
(iii) specify and size the most common industrial chemical reactors to achieve production goals for processes involving homogeneous reaction systems.

Universityof Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction to reactor design:** L1: Interpretation of rate data, scale-up, and design L2: Classification of reactors.	2hr
2	**Design fundamentals and mass conservation equations for ideal reactors:** L1: Conservation of mass in reactors. L2: The ideal stirred-tank reactor (Batch and steady-state flow) L3: The ideal tubular flow reactor (PFR) L4: Space time and space velocity	4hr
3	**Isothermal reactors for homogeneous reactions:** L5: Design procedure: Batch reactor (constant volume and constant pressure) L6: Design procedure: Continuous stirred-tank reactors (Single and multiple reactions) L7: Design procedure: Tubular-flow reactors L8: Comparison of stirred-tank and tubular-flow reactors. L9: Flow recycle reactors L10: Non-steady flow (semi-batch) reactors	8hr
4	**Non-isothermal reactors:** L11: Energy conservation equations L12: Batch stirred-tank reactors L13: Continuous stirred-tank reactors	8hr
5	**Multiple reactor System:** L14: Plug flow reactors in series and/or parallel L15: Equal- size mixed flow reactors in series (first order and second order reactions) L16: Mixed Flow Reactors of different sizes in series. L17: Best arrangement of a set of ideal reactors	8hr

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering,*					
Course Code	**CES.R.338**	Credits hr				Units
Course Title	Heat transfer II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Heat transfer I	2	2	1	5	3

Course Description

Characterization the design procedures for different heat transfer equipments as heat exchanger. Discuss the heat transfer in boiling and condensation processes .Characterization the design procedures for furnace. Give a new knowledge in renewable energy systems. Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

Course Text

1- J.P.Holman ,Heat Transfer, Ninth edition.
2- Frank P. Incropera & David P. Dewitt, Fundamentals of Heat and Mass Transfer, Fifth Edition.

Other support books :-

1- Coulson, J.M. , Richardson, J.F., Backhurst, J.R.and Harker, J.H., "Chemical Engineering" Volume(1) 6th Edition.

Course Objectives: at the end of the semester the student should be able to:-

1- Design heat exchanger equipments.
2- Define and solve problems in boiling and condensation heat transfer.
3- Design the furnace and understand the radiation heat transfer.
4- Solve problems in heat transfer applications.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Heat Exchangers:** Various types and their general characteristics, Overall heat transfer coefficient, fouling factor, Heat exchangers mean temperature differences and Co-current and counter current flow.	10 hrs
2	**Shell and Tube Exchanger:** Types and various specifications, design calculations by conventional and by effectiveness (NTU) methods and optimum design calculation.	6 hrs
3	**Condensation and Boiling Heat Transfer:** Condensation of single vapors, Laminar film condensation Design calculations for condenser, Pool and flow boiling, Boiling regime, General aspects, Boiling correlations.	6 hrs
4	**Radiation and Furnace design:** Radiation properties, shape factor, heat exchange for non black bodies, parallel planes, shields, gas tradition.	4 hrs
5	**Renewable Energy:** Solar radiation, Solar water heater, Solar air heaters, Heat exchangers for ocean thermal energy, Heat storage and transmits.	4 hrs

University of Technology
Department of Chemical Engineering

Practical: Heat Transfer II

No.	Experiment Name
1	**Conductive Heat Transfer in Steady State.**
2	**Coil Heat Exchanger.**
3	**Determination of Overall Heat Transfer Coefficient on Air Velocity**
4	**Performance of Cooling Tower**
5	**Graphite Heat Exchanger**
6	**Extended Surface Heat Transfer**

Universityof Technology
Department of Chemical Engineering

<table>
<tr><td>Program</td><td colspan="6">Oil and Gas Refinery Engineering</td></tr>
<tr><td>Course Code</td><td>CES.R.3310</td><td colspan="4" rowspan="2">Credits hr</td><td rowspan="3">Units</td></tr>
<tr><td>Course Title</td><td>Petroleum and Gas Field Processing</td></tr>
<tr><td>Term</td><td>2nd Semester</td><td>Theoretical</td><td>Practical</td><td>Tutorial</td><td>Total</td></tr>
<tr><td>Prerequisite(s)</td><td>Chemistry of Petroleum
Properties of Petroleum fuels
Properties of Petroleum Products</td><td>2</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
</table>

Course Description

"***Petroleum and Gas Field Processing***" course deals on the various surface unit operations commonly used in production facilities.

Course Text

1- Francis S. Manning-Oilfield Processing of Petroleum, Vol. 1_ Natural Gas -Pennwell Pub (1991)
2- Francis S. Manning, Richard E. Thompson-Oilfield Processing, Vol. 2_ Crude Oil -Pennwell Corp (1995).
3- H. K. Abdel- Aal, Mohamed eggour, M . M Fahim "Petroleum and Gas Field Processing "MARCEL DEKKER, (2003)

Course Objectives: at the end of the semester the student should be able to :-

1- To provide an understanding of the general principles and importance of ***Petroleum and Gas Field Processing*** in the petroleum industry,
2- A comprehensive understanding the fundamentals of the ***Petroleum and Gas Field Processing*** mechanisms at the basis of the processes.
3- Provide criteria affect the processing options and the processing equipment required in a ***Petroleum and Gas Field Processing***

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Oil and Gas, From Formation to Production :** Formation and Accumulation of Oil and Gas Types Of Petroleum Reservoir	**4hr**
2	**Two-Phase Gas-Oil Separation :** Introduction, The Separation Problem, Theory of Gas-Oil Separation, Methods of Separation, Gas-Oil Separation Equipments	**4hr**
3	**Three-Phase Oil-Water-Gas:** Introduction, Separation Theory, Separator Types, Separator Sizing Equation and Rules.	**4hr**

4	**Treatment of Crude Oil :** Emulsion Treatment and Dehydration of Crude Oil, Desalting of Crude Oil, Crude Oil Stabilization and Sweetening	4hr
5	**Field Processing and Treatment of Natural Gas :** Overview of Gas FieldProcessing, Sour Gas Treating, Gas Dehydration, Recovery, Separation,and Fractionation ofNatural Gas Liquids	14hr

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R.3312**	Credits hr				Units
Course Title	Petroleum refinery engineering 1					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Properties of petroleum products Chemistry of petroleum	2	2	1	5	3

Course Description

An introduction to petroleum feedstocks, refining processes, and how refined products are made. Heating of crude oil, Design of atmospheric and vacuum columns for petroleum fractionation will be explained. This course contains Solvent extraction processes for lube oil base stocks

Course Text

1. W.L..Nelson " Petroleum Refining Engineering " 4th Edition. McGraw Hill, New York, 1985
2. M.A. Fahim, T.A. Al-Sahhaf, and A.S. Elkilani," Fundamentals of Petroleum Refining", Elsevier, 2010.
3. J.H. Gary and G. E. Handwerk and M.J. Kaiser, "Petroleum Refining Technology and Economics", 5th Ed. CRC Press, 2007.

Course Objectives : at the end of the semester the student should be able to :-

1- Become knowledgeable in composition, properties and classification of crude oil or
2- petroleum.

3- Become familiar with the overall refinery processes including physical separation operations.
4- Be able to learn basic calculations and methods used to design and run some petroleum refining facilities.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction to petroleum refinery:** World petroleum resources, petroleum industries in IRAQ.	**2hr**

2	**General review of refining processes of crude oil. Refinery configurations**	2hr
3	**Composition and classification of crude, methods of evaluation :** ASTM, TBP and EFV distillation. Classification: Compound type, Correlation index, density, carbon distribution.	4hr
4	**Properties and specifications of petroleum products :** Such as FG, Gasoline, naphtha, kerosene, diesel oils, lubricating oils, waxes and the like. Composition: Chemical composition, hydrocarbon components. viz. paraffinic, naphthanic, aromatic olefinic.	4hr
5	**Separation processes:** introduction	2hr
6	**Heating of crude oil :** Types of pipe still heaters, calculations of radiant absorption rates, Wilson lobo Hotel equations, lobo Evans method pipe still design. Heat exchanger in refinery design and operational problems fluid mechanics and refinery applications use of combustion Charts.	4hr
7	**Distillation of crude oil** 1) Atmospheric distillation tower, types of refluxes. Energy balance in a topping tower and calculations involve estimation of top, side, bottom draw tray temperatures. Calculation of side steam strippers 2)Vacuum distillation tower, type of operations, economic consideration, flash zone & tower base calculations, flash zone pressure, steam requirements, heat & material balance calculation	8 hr
8	**Solvent extraction processes for lube oil base stocks and wax processing :** solvent de-waxing, deasphalting, clay contacting, principles operating parameters, feed and product equalities and yields.	hr4

Universityof Technology
Department of Chemical Engineering

Practical:Petroleum Refinery Eng I

No.	Experiment Name
1	Atmospheric Distillation
2	Characteristics of Airplane Turbine Fuel
3	Combustion Behavior of Gaseous Fuel
4	Asphalt Content
5	Characteristics of Diesel fuel
6	Blending Properties
7	Properties of Petroleum Products at low Temperature
8	Total Acidity
9	Lubricating oil by Gasoline Dilution
1o	Water content in crude oil
11	Sediments content in crude oil
12	Sulfur content in crude oil
13	Smoke Point

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	CES.R.3314	Credits hr				Units
Course Title	Equipment, Storage Design Using CAD					
Term	2 nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Thermodynamics, heat and mass transfer	2	2	1	5	3

Course Description

. **The aim of the subject is to engaged students with chemical plants by explain to them the main items of plant design and teach them procedures to design different equipments with computer programs**

Course Text

.Sinnott R. and Towler C; 2013 " chemical Engineering Design" 5th edition Butterworth-Heinemann
Coke,A.K ;2007"Ludwig s Applied Process Design of Chemical and petrochemical Plant" vol. 1 4th edition Gulf professional Publisher

Course Objectives : at the end of the semester the student should be able to :-

1-Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.
2- The student be able to use computer software packages to perform design activity beside the conventional methods

3- The student should have the necessary skills to design equipments

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	Applied Design for Pressure vessels ,pumps and compressors flash drum, gas-liquid separator, liquid-liquid separator, gas movers and compressors manually and with computer aided	**12 hr**
2	Applied Design for heat equipments (shell And tube heat exchanger, plate heat exchanger , coil type exchanger, condenser, vaporizer, air cooler …….etc) manually and with computer aided	**12 hr**
3	Applied Design for mass transfer equipments (distillation column, absorber column, leaching equipment, scrubber…………..etc) manually and with computer aided	**6 hr**

University of Technology
Department of Chemical Engineering

Practical: Equipment, Storage Design Using CAD

No.	Contents
1	**Introduction**
2	**Equation of state & stream**
3	**Rotating Equipment (3.1 Compressor, 3.2 Expander, 3.3 pump)**
4	**Separation Operations (Separator , 3-Phases Separator , 4.3 Tank)**
5	**Heat Transfer Equipment (Heater & Cooler, Heat Exchanger, LNG,Air Cooler)**
6	**Column distillation (Column Installation, Column Property View, Column-Specific Operations and Running the Column)**
7	**Reactors(CSTR, General Reactor, Gibbs, Equilibrium, conversion)**
8	**Logical Operations (Adjust, Balance, Recycle, Set)**
9	**process plant involving reaction and separation**
10	**Examination lab**

Program	Oil and Gas Refinery Engineering					
Course Code	**CES.R.421**	Credits hr				Units
Course Title	Project I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	10. Basic Principles of chemical engineering I 11. Basic Principles of chemical engineering II 12. Material &Energy Balance. 13. Thermodynamics I & II	1	2	---	3	2

Course Description

The course includes the design aspects and design considerations for plant of chemical industry.

Course Text

Sinnott R.K. "Chemical Engineering Design", Coulson and Richardson's. Chemical Engineering, Volume 6, Fourth edition, (2005).

Other support books :-

1- Peters M. S.,Timmerhaus K.D. and West R.E. Plant Design and Economics for Chemical Engineering, Fifth edition, (2003).

Course Objectives: at the end of the semester the student should be able to:-

To learn the students the basic information's of designing the chemical plants and the economic and engineering aspects

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction to Design:** The anatomy of chemical manufacturing process, general overall design considerations, development of design data base, process creation, types of process design.	**5 hr**
2	**Design Information and Data:** Source of information of physical properties , predication of physical properties (density, viscosity, thermal conductivity , etc)	**5 hr**
3	**Material and Energy Balance**: Review of material and energy balance, flow sheet symbols, PFD information in flow diagram	**5 hr**

Project Requirements

No.	Contents	Duration
1	**Chapter One** Introduction, Historical Profile, Physical and Chemical Properties, Applications for chemical material production.	4 hr
2	**Chapter Two** Production Methods, Comparison between Processes, Selected the optimum Process, Physical properties of raw materials and by products, Production Capacity.	4 hr
3	**Chapter Three** Material balance for the plant process.	10 hr
4	**Chapter Four** Energy balance for the plant process, Process flow diagram (PFD).	10 hr
5	**Poster and Oral Presentation**	2 hr

University of Technology
Department of Chemical Engineering

Program	***Oil and Gas Refinery Engineering***					
Course Code-	**CES.R. 431**	Credits hr				Units
Course title	Unit Operation II					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics II, Engineering Mathematics I , II, Numerical Analysis, Energy Balance, Material &Energy Balance, Fluid FlowI, II, Thermodynamics I, II, Mass Transfer, unit operation I , II, Heat treansfear I, II,	2	2	1	5	3

Course Description

Theory, applications and design of unit operations which are mostly employed in the chemical industry, drying of solid, humidification, dehumidification and cooling tower and liquid evaporation and crystallization.

Course Text

1- Coulson ,J.M and Richardson J.F. "Chemical Engineering , Volume 1, 3rd edition ,Robert Maxwell.M.C.
2- Coulson J.M, and Richardson J.F. "Chemical Engineering, Volume 2, 3rd edition, Robert Maxwell.M.C.

Other support books :-

1- Perry,J.H, "Chemical engineering handbook ",Mc-Graw –Hill Bookcom.1975.
2- Binay.K.Dutta "Mass transfer and separation process" 2007.
3- Trebal Robert E., "Mass transfer operation"2nd edition, Mc-Graw –Hill Book com.1975.

Course Objectives: at the end of the semester the student should be able to:-

1- To provide an understanding of the general principles of separation processes to allow students to make sensible options given a separation task (Humidification, Dehumidification and Cooling tower, Evaporation, crystallization, and Wet Solid Drying).
2- A comprehensive understanding of the transport processes related to chemical engineering operations, with focus on both theory and applications.
3- Ability to select of appropriate equipment for the separation of materials in process plant.
4- Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

Topics Covered (Syllabus)/Course Title

No.	Contents	Duration
1	**Drying of Solids:** Introduction Drying of Solids....General Principles. Wet Solid Group.Terminology and Definitions. Humidity Measurement. Humidity Data for Air – Water system. Temperature –Humidity Chart (Psychometric Chart). Uses of Humidity Chart. Rate of Drying. Calculation method of Drying Rate and Time. Drying Rate. Drying Time. Mechanism of Moisture Movement in Wet Solid. Material and Heat Balance for Continuous Dryers. Rate of Drying for continuous Direct Heat Driers. Drying at High Temperature. Drying at Low Temperature. Drying Equipment.	6 hrs
2	**Humidification, dehumidification and Cooling towers:** Introduction. Humidification Operations. Adiabatic Operations. Non-Adiabatic Operations. Mixing of Humid Streams. Mixing of Two Stream of Humid Gas. Addition of Liquid or Vapor to a Gas. Humidification Processes Theory. Cooling Tower Principles and Operations. Cooling Tower Classification. Design Cooling Tower. Adiabatic Humidification — Cooling. Dehumidification Tower	9 hrs
3	**Evaporation:** Introduction, Types of Evaporations, Evaporation Equipment, Heat transfer in Evaporation Process, single, double and Multi effect Evaporators, Design of evaporators, Comparison of Forward, backward and Parallel effect evaporators, boiling Point rise.	9 hrs
4	**Crystallization:** Crystallization fundamentals, cooling crystallizer, Evaporating crystallizer, Batch and continuous crystallization Crystallizer selection.	6 hrs

University of Technology
Department of Chemical Engineering

Practical Unit Operation II

No.	Experiment Name
1	**Tray Dryer**
2	**Plate and Frame Filtration**
3	**Rotary Drum Filtration**
4	**Design of Cooling Tower**
5	**Sedimentation**
6	**Liquid - Liquid Extraction**

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R. 433**	Credits hr				Units
Course Title	Process Dynamics					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	1.Heat and Material balance 2.Applied Mathematics	2	-	1	3	2

Course Description

Study of dynamics characteristics of open-loop Oil and Gas Refinery Engineering processes to formulate transfer function and analysis response of the system to design and select closed-loop controlscheme.

Course Text

1. D.R. Coughanowr and S. LeBlanc, Process Systems Analysis and Control, McGraw-Hill, 3rd edition, 2008.

2. Stephanopoulos G., "Chemical Process Control-An Introduction to Theory and Practice, "Prentice -Hall, New Jersey, 1984.

Other support books :-

1. Luyben W. L., "Process Modeling, Simulation and Control for Chemical Engineers," McGraw-Hill, New York, 2nd Ed., 1990 .

2. *Process Dynamics: Modeling, Analysis and Simulation, by Wayne Bequette.*

Course Objectives : at the end of the semester the student should be able to :-

1. Study of dynamic analysis of chemical processes to allow students to identify the system under different operating conditions.
2. Understanding of formulate transfer function of the system.
3. Testing and selecting of critical process variables.
4. Developing of skills, solving open ended problems and to work in teams.

Topics Covered (Syllabus)/ Process Dynamic

No.	Contents	Duration
1	**Linear Open-Loop Systems** Transfer function**,** Transient Response,Forcing Functions:Step Response ,Impulse Response Ramp Response Sinusoidal Response.	10hr
2	**Applications of First Order Systems** Liquid –level system, heating system, Mass transfer system, Reactors, absorber, pressure vessel, Linearization.	8hr
3	**Response of First-Order Systems in Series** Non-interacting System, Interacting System.	4hr
4	**Higher-Order Systems** Second-Order: Under-damped, Critical and over-damped, Transportation Lag	8hr

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R. 435**	Credits hr				Units
Course Title	**Petroleum Refinery Eng II**					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemistry of Petroleum Properties of Petroleum fuels Properties of Petroleum Products Petroleum and Gas Field Processing	2	-	1	3	2

Course Description

"***Petroleum Refinery Eng II***" course deals with conversion processes for petroleum fractions as produced by the separation operations that are covered in the ***Petroleum Refinery Eng I course***.

Course Text

1. W.L..Nelson " Petroleum Refining Engineering " 4th Edition. McGraw Hill, New
2. York, 1985Mohamed A. Fahim, Taher A. Al-Sahhaf, Amal Elkilani-Fundamentals of Petroleum Refining-Elsevier Science (2009)
3. Pierre Leprince-PETROLEUM REFINING V.3_ Conversion Processes (Publication IFP)-Editions Technip (2000)

Other support books :-

1. James H. Gary, Glenn E. Handwerk, Mark J. Kaiser, PETROLEUM REFINING Technology and ,Fifth Edition, CRC Press © 2007 by Taylor & Francis Group, LLC

Course Objectives: at the end of the semester the student should be able to :-

1- To provide an understanding of the general principles and importance of conversion processes in the refining industry,

2- A comprehensive understanding the fundamentals of the chemical mechanisms at the basis of the processes. These disciplines are thermodynamics, chemical kinetics, reactor calculation and industrial catalysts..

3- Provide criteria affect the processing options and the processing equipment required in a modern refinery

Universityof Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Petroleum Refinery Eng II

No.	Contents	Duration
1	**Thermal Cracking : introduction, Coking**: Delayed Coking, Feed Types, Background, Typical Product Yields and Characteristics, Description of the Delayed Information, Typical Yields, Process Description, Uses for Low Btu Gas, Use of Purge Coke	2hr
2	**Visbreaking of Residues:** Background Information, Feed Composition, Cracking Reactions, Reaction Kinetics and Mechanism, Process Data, Operating Variables, Product Properties and Yields, Process Flow Schemes, Specific Equipment, Environment,	2hr
3	**Catalytic Cracking** : Overview, The FCC Process, Introduction, Feeds and Products, Description, Thermal Balance, Fluidization and Pressure Balance, Operating Variables, Conversion, and Cracking Severity, Changing Technology, Residue Cracking, Reactions, Reactivity, and Mechanisms, Reactions, Modern FCC Catalyst,	4hr
4	**Hydrocracking:** Importance, Background, Typical Feeds, Reaction Thermodynamics, Kinetic, Catalysts, Effects of Feed Impurities and Components,, Typical Flow Schemes, Operating Conditions, Product Yields and Quality, Hydrogen Consumption, ,	2hr
5	**Catalytic Reforming:** Importance, Process Background, Reactions, Catalysts ,Operating Variables, Influence of Feeds, Technology, Fixed Bed, Moving Bed, Industrial Performance , Operating Conditions, Typical Yields, Reformate Characteristics, , Capacity	4hr
6	**Isomerization of C5-C6 Paraffins:** Aim, Thermodynamics, The Catalyst, Reaction Mechanism, Kinetics, The Isomerization Process, , Isomerization of n-Butane, Aim, Thermodynamics, Catalysts, Reaction Mechanism, Kinetics, Process	2hr
7	**Aliphatic Alkylation:** Importance, Reaction Thermodynamics, Alkylate Compositions, Catalysts, Production Mechanisms, Red Oil Production Mechanisms, Structure and Function of Red Oils, Process Data, Feed Composition, Feed Pretreatment, Operating Conditions, Sulfuric Acid Alkylation Processes, HF Alkylation	2hr
8	**Olefin Etherification :** Importance, Properties of Ethers, Feedstocks, Etherification Process, Reaction Mechanism, Kinetics and Thermodynamics, Catalysts, Side Reactions, Process Data, Feed Treatment, Raffinate Treatment, Operating Conditions, Process Flow Schemes, Reactor Design, Product Yield and Quality,	2hr

9	**Residue Hydroconversion:** Introduction, Background, Reactions, Catalysts, Kinetics and Operating Conditions, Technologies and Process Data, Fixed Bed Processes, Moving Bed Processes, Product Yields and Characteristics, Associating the Hydrotreating Process with Deasphalting and	2hr
10	**Hydrogen Production:** Hydrogen in the Refinery, Requirements, Sources, Hydrogen Balance, Hydrogen Production by Steam Reforming, Production of Synthesis Gas, Carbon Monoxide to Hydrogen Conversion, Carbon Dioxide Removal, Methanation of Residual CO and CO2, Purification by Adsorption, Comparison of Conventional Methanation and Adsorption (PSA) Methods, Ongoing Developments, Hydrogen Production by Partial Oxidation, Synthesis Gas Production, Hydrogen Production Sequencing, Hydrogen and Electricity Coproduction, Other Technologies, Hytex Process, Catalytic Autothermal Process,	2hr
11	**White Products Refining by Sweetening:** Mercaptan Distribution in Petroleum Cuts, Background Data, Recapitulation of Process History, Current Technologies, Industrial Processes, Liquid/Liquid Contact Technologies, Fixed Bed Catalyst Processes, Economic	2hr
12	**Hydrotreating:** Objectives, Impurities and their Origins, Heteroatoms and Metals, Unsaturated Products, Hydrotreating Processes, Background Information, Hydrotreating Reactions, Catalysts, Process Information, Catalyst Reaction Kinetics, Operating Variables, Catalysts, Process Technology, Reactors, Process Flow Schemes, Selecting Construction Materials, Industrial Performance, Feed Pretreatment for Gasoline Catalytic Reforming Units, Hydrotreating Kerosene and Gas Oil, Hydrotreating Vacuum Distillates,	2hr
13	**Desulfurization of Stack Gases:** Principle of Stack Gas Desulfurization Processes, Choice of Sulfur Oxide Chemical , Operating Conditions, Regenerative Processes and Throwaway Processes, Characteristics of Stack Gas Desulfurization Processes, Stack Gas/Reactant Contactor, Heating the Stack Gases, Corrosive Nature of the Stack Gases, The Main Processes, Processes Using Lime orLimestone, Semiwet Processes, Dry Processes with Discharges, Regenerative Processes with Production of Concentrated SO2	2hr

Universityof Technology
Department of Chemical Engineering

Program	***Oil and Gas Refinery Engineering***					
Course Code	**CES.R. 435**	Credits hr.				Units
Course Title	Refinery Management and Ethics					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Equipment Design Heat transfer Mass transfer	2	-	1	3	2

Course Description

Theory and applications, of Industrial Engineering Management which are mostly employed in The chemical industryIndustrialEngineering Management; ,Industrial organization, Maintenance Work Measurement Techniques, Engineering Ethics, Quality Control, ISO and Safety Requirements.

Course Text

T.R. Banga and S.C. Sharma “Industrial Engineering Management” including Production Management, Eleventh Edition:2008.
M.S. Peters, K.D. Timmerhaus and R.E. West “Plant Design and Economics for Chemical Engineers” Fifth Edition: 2003.

Course Objectives: at the end of the semester the student should be able to:-

To helps and learn in the optimum use of plant, equipment, efforts towards productivity improvement, establishing the most efficient and effective utilization of human effort and synchronizing various resources like men, machine and material as well as Engineering Ethics.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Management:** Principle of management, types and classifications, management responsibility, organization responsibility.	**4hr**
2	**Industrial organization**: Site, Feasibility study, Development of efficient work method (plant layout, flow of material, material handling), Workstations, Inputs and Outputs, Production planning (types of Productions).	**3hr**
3	**Maintenance**: Classification, Cost, Machine replacements, Case studies and examples.	**3hr**

4	**Network Analysis:** Principles and applications, Critical path method (CMP), Gant Chart, Pert techniques (examples and case studies).	3hr
5	**Work Measurement Techniques** Time and Motion study.	3hr
6	**Engineering Ethics:** Engineering has a direct and vital impact on the quality of life for all people. Engineering is an important and learned job. Engineers are expected to exhibit the highest standards of honesty and integrity. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct.	3hr
7	**Quality Control:** Standardization, Specification, Sampling techniques, Inspection- analysis of results. Quality costs (preventive cost, appraisal cost and failure cost). Application of quality control chart-examples, Reliability.	4hr
8	**ISO:** Requirements, applications, ISO series, Quality management system (QMS), Total Quality management (TQM), Requirements and applications.	3hr
9	**Safety Requirements:** Hazards (type's e.g. industrial hazards, pollution (air pollution, water pollution, industrial pollution). Industrial by products and industrial waste, Safety requirements of industrial sites, Requirements of suitable work environment (examples with particular emphasis in chemical industry).	4hr

University of Technology
Department of Chemical Engineering

<table>
<tr><td>Program</td><td colspan="6">Oil and Gas Refinery Engineering</td></tr>
<tr><td>Course Code</td><td>CES.R. 437</td><td colspan="4" rowspan="2">Credits hr</td><td rowspan="3">Units</td></tr>
<tr><td>Course Title</td><td>Heterogeneous Reactor and catalyst</td></tr>
<tr><td>Term</td><td>1st Semester</td><td>Theoretical</td><td>Practical</td><td>Tutorial</td><td>Total</td></tr>
<tr><td>Prerequisite(s)</td><td>Physical chemistry ,mass- and heat- transfer, fluid and thermo-dynamics</td><td>2</td><td>-</td><td>1</td><td>3</td><td>2</td></tr>
</table>

Course Description

Definition, classification of catalysts, properties of heterogeneous catalysts (activity, acidity, selectivity, and porosity), effectiveness of presence the catalysts on kinetic and thermodynamic properties, mechanism of chemical interactions occurring within the catalysts, applications of catalysts in catalytic processes, movement of the reactant molecules around and throughout the body of a catalyst in different types of reactors (fixed-, fluidized-, slurry-, and trickle-bed), intra-particle and diffusivities inside porous catalysts, and modern characterization techniques.

Course Text

1-J. M. Smith (1981), Chemical Engineering Kinetics, 3rd edition, Mc Grow – Hill, Singapore.

2-H. V. Bekkum, E. M. Flanigen, P. A. Jacobs, and J. C. Jansen (2001), Introduction to zeolite science and practice, 2nd edition, Amsterdam: Elsevier.

Other support books :-

1-J.F. Lepage, J. Cosyns & P.Couty, (1987), Applied heterogeneous catalysis. Paris: Editions Technip.
2-R. W. Missen, C. A. Mims, and B. A. Saville (1999), Chemical reaction engineering and kinetics, John Wiley & sons.
3-Daniel Decroocq (1984), Catalytic cracking of heavy petroleum fractions, Paris: Editions Technip.

Course Objectives: at the end of the semester the student should be able to :-

1-The objective of this course focuses on:
in-depth understanding of the catalyst and its impact on either chemical reactionskinetics or thermodynamics.
2-comprehension the principle of diffusion on the internal and external surfaces of the porous catalyst particles with their impact on the nature of reaction products in terms of increasing the quantity and quality and reducing the operating cost.
3-As well as the utilize of the operating equations and design for various kinds of reactors containing the catalyst particles as a key parameter in their work.
4-also to discover the theoretical knowledge about the equipments and characterization techniques used in catalyst and catalysisscience.

5-In addition, identify scientific and engineering information about the performance of a catalyst in enhancing the reaction mechanisms, problem solving, and other related issues.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction:** Definition, classification of catalysts, mechanisms of catalysis, properties of porous catalysts (i.e. mechanical strength, stability, activity, and selectivity), morphology, pore size, solid density and porosity calculations, pore volume distribution, developing the support, promoters and inhibitors, coke formation on the catalyst surface, catalyst deactivation and reactivation.	6 hrs
2	**Applications of catalysts in catalytic processes:** History of the catalysts in catalytic processes, direct oxidation of methanol to formaldehyde, hydrogenation of acetone in a packed bubble column.	4 hrs
3	**Surface area and kinetic parameters determinations:** Determination the surface area of catalyst, calculations of pressure drop and void fraction in a solid catalyst within a packed bed, calculations both the reaction rate and the activation energy over a solid catalyst, operating condition (i.e. temperature, pressure, residence time; W/F) and catalyst performance.	4 hrs
4	**Diffusion of bulk fluid over a solid catalyst within a packed bed and reactor design:** Fixed-bed reactors: mass and heat-transfer coefficients (fluid-particle), fluidized-bed reactors: particle-fluid mass and heat transfer, slurry-bed reactors:mass-transfer coefficients: gas bubble to liquid (k_L), and liquid to catalyst particle (k_c), trickle-bed reactors: mass-transfer coefficients: gas to liquid ($k_L a_g$), and liquid to particle ($k_c a_c$) with calculation of global rate.	10 hrs
5	**Intra-particle and diffusivities estimation inside porous catalysts:** Diffusion coefficient of Knudsen and Bulk diffusion, Gaseous diffusion in the micro- and macro- cylindrical pores, Diffusion in liquids, Diffusion within porous catalysts (effective diffusivity), pore models (parallel-pore model and random-pore model), surface diffusion, effectiveness factors.	6 hrs

Program	***Oil and Gas Refinery Engineering***					
Course Code	**CES.R. 438**	Credits hr				Units
Course Title	Environmental Pollution. & Safety in Petroleum Refineries					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Petroleum Refinery	2	0	1	3	2

Course Description

Definitions of pollutants emission from petroleum refinery. Classification of air pollutants, Sources and type of air pollution, Particulate and air born particulate. Air pollution control equipment: types of equipment, Design of settling chamber and cyclones.

Source of water, Utilization, and classification. Type of water pollutants and its effect, Wastewater treatment. Oxygen demanding wastewater: Dissolved Oxygen DO, BOD, Oxygen sage curve and the related equations.Classification of solid waste, the methods of disposal of the solid waste.

Safety in petroleum refinery

Course Text

1- C.S.Rao, “Environmental Pollution Control Engineering”, 2nd Edition, New Age International(P) Limited, Published, 2006, Reprint 2007.
2- R. K. Sinnott, Chemical Engineering Design, Vol. 6. 4th edition, Chemical Engineering Design, 2005, pp. 450-457.
3- Noel de Never, “Air Pollution Control Engineering”, McGrow-Hill, Inc 1987.

Course Objectives: at the end of the semester the student should be able to :-

1- Understand the concept of the environment and environmental pollution and global problems resulting from environmental pollution.
2- Provide solutions to environmental problems.
3- Concerned with local and worldwide environmental issues.
4- Design devices that are used in the control of air pollution.
5- Environmental engineers conduct hazardous-waste management studies in which they evaluate the significance of the hazard, offer analysis on treatment and containment.

Topics Covered **(Syllabus)/ Course Title**

No.	Contents	Duration
1	**Introduction:** Definition: Environment, Environmental Eng., Environmental Pollution and Pollutant. Causes effect and control measures of different types of petroleum pollutants of; Air, Water, Soil, Marine, Noise pollution and Nuclear Hazards. Petroleum pollution allowable limits in the environment.	**2hr**
2	**The Impact of Production Operations:** Measuring Toxicity, Hydrocarbons, Salt, Heavy metals, Production chemicals, Produced water, Air pollution.	**2hr**
3	**Treatment of Wastewater from Petroleum Industry:** Removal of suspended Hydrocarbons, Removal of Dissolved Hydrocarbons, Removal suspended solids and Removal of Dissolved Solids processes.	**10hr**
4	**Treatment of Air Emissions:** Air pollutants (Hydrocarbons, Particulates, Gases), Characterization, Meteorological factor influencing, Characteristics of Stack Plume. Control of Particulates. Control of Gases (CO, SO_X, NO_X). Chimney Design.	**8hr**
5	**Treatment of Solids:** Removal water, Removal Hydrocarbons, Solidification	**2hr**
6	**Safety in Petroleum Refinery:** Fire Prevention and Control. Materials handling and storage, Noise Hazardous, Radiation Hazardous, Common Hazardous Materials in Refinery	**6hr**

University of Technology
Department of Chemical Engineering

Program	Oil and Gas Refinery Engineering					
Course Code	CES.R. 422	Credits hr				Units
Course Title	Project II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	14. Mass Transfer 15. Unit OperationI and II 16. Heat Transfer I and II 17. Equipment Design 18. Catalysis Eng. And Reactor Design	1	2	---	3	2

Course Description

The course includes the design aspects and design considerations for plant of chemical industry.

Course Text

Sinnott R.K. "Chemical Engineering Design", Coulson and Richardson's. Chemical Engineering, Volume 6, Fourth edition, (2005).

Other support books :-

1- Peters M. S.,Timmerhaus K.D. and West R.E. Plant Design and Economics for Chemical Engineering, Fifth edition, (2003).

Course Objectives: at the end of the semester the student should be able to:-

To learn the students the basic information's of designing the chemical plants and the economic and engineering aspects

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Choice of Plant Location and Layout Standard**	3 hr
2	**Piping and Instrumentation** Pipes, valves, Pumps, Mechanical design and control	4 hr
3	**Cost and Project Evaluation**	3 hr
4	**Safety and Loss Prevention**	2 hr
5	**Design with Computer Aided**	3 hr

Project Requirements

No.	Contents	Duration
1	**Chapter Five** Design main equipment by design equation with mechanical design, cost evaluation, control andcomputer aided using Hysys software	**14 hr**
2	Design supported equipment with mechanical design, cost evaluation and control.	**6 hr**
3	**Chapter Six** Environmental effect for raw materials, products and by products	**6 hr**
3	**Poster and Oral Presentation**	**4 hr**

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code-	**CES.R. 432**	Credits hr				Units
Course title	Unit Operation III					
Term	2 nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics II, Engineering Mathematics I , II, Numerical Analysis, Energy Balance, Material &Energy Balance, Fluid FlowI, II, Thermodynamics I, II, Mass Transfer, unit operation I , II, Heat treansfearI, II,	2	0	1	3	2

Course Description

A comprehensive understanding of the transport processes related to chemical engineering operations with focus on theory, design and applications ofSolid–liquid filtration, Sedimentation, liquid - liquid extraction, Leaching and Washing.

Course Text

- Coulson ,J.M and Richardson J.F. “Chemical Engineering” , Volume 1, 3rd edition, Robert Maxwell.M.C.
- Coulson,J.M and Richardson J.F. “Chemical Engineering” , Volume 2, 3rd edition , Robert Maxwell.M.C.

Other support books :-

- De Sinha and Parameswar De “Mass Transfer: Principles and Operations”, Parameswar De , New Delhi, 2012
- Binay.K.Dutta “Mass transfer and separation process” 2007.
- Trebal Robert E., “Mass transfer operation”2nd edition, Mc-Graw –Hill Book com.1975.

Course Objectives: at the end of the semester the student should be able to :-

1- Basic information, concepts and terminology of the general principles of separation processes of Solid –liquid filtration, Sedimentation, liquid - liquid extraction, Leaching and Washing.

2- Demonstrating a broad and integrated knowledge and a deep understanding of issues related to separation processes in a chemical process and important role it plays in the success of the process both economically and environmentally.

3- Ability to select of appropriate equipment for the separation of materials in process plant.

4- An ability to apply effective, creative and innovative solutions, both independently and cooperatively, to current and future problems in separation processes and transport phenomena.

Topics Covered (Syllabus)

No.	Contents	Duration
1	**Filtration :** Type of Filters, Filtration theory, Plate and frame filter press, leaf filter, filtration at Constant ΔP, Filtration at Constant rate, washing Time, centrifugal filtration	9 hrs
2	**Sedimentation:** Introduction, Settling and Sedimentation in particle fluid separation, Sedimentation and thickening design, equipment for settling and Sedimentation.	6 hrs
3	**Liquid - Liquid Extraction:** Definition, Extraction process, Equilateral Triangular coordinates (Ternary Diagram), system of three liquid _ one pair partially soluble, choice of solvent, Equipment in extraction cross _ current extraction, multi stage Cross Current extracting cross current for insoluble Liquid , Continuous Counter current extraction , Continuous Counter Current in Soluble , Liquid , Minimum Solvent .	12 hrs
4	**Leaching :** General principles, Equipment for leaching, Mass transfer in leaching, continuous operation, Equilibrium-stage model for leaching and washing.	3 hrs

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R. 434**	Credits hr				Units
Course Title	Process Control and Instruments for Petroleum Refinery					
Term	2st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Process Dynamic	2	2	1	5	3

Course Description

Analysis ofclosed-loop Petroleum Refinery Engineering processes system to design and select closed-loop controlscheme that will operate the plant with stable conditions.

Course Text

1. D.R. Coughanowr and S. LeBlanc, Process Systems Analysis and Control, McGraw-Hill, 3rd edition, 2008.

2. Stephanopoulos G., "Chemical Process Control-An Introduction to Theory and Practice, "Prentice -Hall, New Jersey, 1984.

Other support books :-

1. Luyben W. L., "Process Modeling, Simulation and Control for Chemical Engineers," McGraw-Hill, New York, 2nd Ed., 1990 .

2. *Process Dynamics: Modeling, Analysis and Simulation, by Wayne Bequette.*

Course Objectives : at the end of the semester the student should be able to :-

1- To enhancement the ability of students for the analysis of closed-loop system and response of controlled system under different operating conditions.
2- Construction of transfer function of the closed system for different schemes.
3- Provide practice of tuning of controller parameters and limiting of stable operating conditions.
4- Motivation and encourage the students for solving open ended problems.

Topics Covered (Syllabus)/ Process Control and Instruments for Petroleum Refinery

No.	Contents	Duration
1	**Instrumentation:** Sensors: pressure, temperature, level, flow and concentration. Control valve. Dynamics characteristics of Instruments.	6hr
2	**Linear Closed-Loop Systems:** The Control System, Controllers and Final Control Elements, Block Diagram of Controlled System, Overall Closed-Loop Transfer Functions.	4hr
3	**Characteristics of the Closed Loop System** Transient Response of Simple Control Systems, Stability	7hr
4	**Frequency Response Methods:** Introduction to Frequency Response Bode Diagrams, Control System Design by Frequency Response, Ziegler-Nichols Controller Settings.	7hr
5	**Computer Control of Chemical process:** Analog Computer, Digital Computer, Computer Control Loops.	3hr
6	**Control of Complex Processes:** Distillation Column, Heat Exchanger, Catalytic Reactor.	3hr

Practical)/ Process Control and Instruments for Petroleum Refinery

No.	Experiment Name
1	**Feedback Control**
2	**Dynamic Behavior of Second order under Damped System (Orifice)**
3	**Flow rate Control**
4	**Level Control in the Tank**
5	**Pressure Control**
6	**Dynamic Behavior of Second order over Damped System (Stirred Tanks)**
7	**Dynamic Behavior of Second order over Damped System (Stirred Tanks Heater)**
8	**Temperature Control**
9	**PH Control**
1o	**Control of Water Treatment Unit**

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R. 436**	Credits hr				Units
Course Title	Petroleum Refinery Economics					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Pet. Ref. eng. 1 Pet. Ref. eng. 2	2	0	0	2	2

Course Description

This course presents an overview of refinery economic terminology, including fundamentals and methodology used to assess profitability of ongoing operations, planned.

This course contains Refining Capacity, Refining Costs Estimation: including capital and operating costs, calculation of crack spreads and refining margins, issues influencing feed and product pricing, refinery complexity, Refinery Economic Evaluation,

Process models and linear program applications as operating and optimization tools, feed and process unit economic drivers.

Course Text

1. R.E. Maples, "Petroleum Refinery Process Economics" , Pennwell Books, 2nd edition., 2000.
2. James H. Gary, Glenn E. Handwerk "Petroleum Refining, Technology & Economics", 5th ed., & Mark J. Kaiser
3. M.A. Fahim, T.A. Al-Sahhaf, and A.S. Elkilani," Fundamentals of Petroleum Refining", Elsevier, 2010.

Course Objectives : at the end of the semester the student should be able to :-

1- Become familiar with refinery margins and economics

2- Ability to maximize refinery margins by optimizing a number of variables including: the type of crude feedstocks and products etc.

3- Ability to use appropriate analytical tools for planning strategy, improving operations, and assessing investment opportunities.

University of Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Petroleum Refinery Economics

No.	Contents	Duration
1	**Introduction**	2hr
2	**Refining Capacity**	2hr
3	**Refining Costs Estimation**: Capital Costs, Operating Costs (Variable Cost, Fixed Cost), Factors Affecting Refinery Costs.	6hr
4	**Refining Margins**	2hr
5	**Refinery types and complexity**	2hr
6	**Refinery Economic Evaluation**: Cash Flow Diagram, Time Value of Money, Inflation, Taxation and After-tax Cash Flow, Profitability and Project Evaluation.	6hr
7	**Refinery Value Drivers:** Cost of Inputs vs. Price of Outputs**,** “Crack” Spreads	
8	**Global Trends**	2hr
9	**Refinery Planning:** Linear Programming Overview, Refinery Linear Programming Models, Economics and Planning of Refining processes and process economics: Crude oil evaluation, Production planning, Product blending, Shutdown planning , Configuration studies,Technology evaluation	8hr

University of Technology
Department of Chemical Engineering

Program	Oil and Gas Refinery Engineering					
Course Code	CES.R. 424	Credits hr				Units
Course Title	Optimization					
Term	2^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Eng.Mathematics1,2 ,Unit Operation.	2	-	1	3	2

Course Description

The subject is to be given in one semester. studying the formulation of objective the theory of optimization of single variable using analytical and numerical methods. Determination in the solution of multi variables problems .studying and solving the linear programming problems(LP).

Course Text

1) Optimization, Greirg D.M. Longmangroup limited London.
2) Optimization, converse A.O ,Holt, Reinhart, and Winston.

Other support books :-

1) Numerical methods for unconstrained optimization, Murrayw. Academic press.
2) Constrained optimization by direct search Swann, W.H. Gill and Murray.

Course Objectives : at the end of the semester the student should be able to :-

1- To formulate many problems arising in widely different situations.
2- Ability for finding optimum. Minimum, or maximum in unconstrained or constrained single or multi variables functions..
3- Deals with the special case of linear programing (functions and constraints are linear).
4- Provide practice to deal with industrial optimization problems.

Topics Covered (Syllabus)/ Optimization

No.	Contents	Duration
1	Introduction to optimization.	2hr
2	Recognizing an optimization problems and their solution. - Formulation of optimization problems. - Unconstrained and constrained problems.	6hr
3	Optimization methods for single variable problems. - Analytical methods; constrained and unconstrained. - Graphical method. - Numerical methods. c- Unconstrained functions; fixed step method, DSC method, Newton method. d- Constrained functions; sequential search, Dichotomous search; Fibonacci search, Golden ratio search.	12hr
4	Determining the solution to multivariable optimization problems. d- Unconstrained minimization and maximization strategy.	10hr

	- Solving linear and non linear equations using matrices. - Optimality conditions for unconstrained problems. - Lagrangian criteria. - Simplex method direction step length calculation. e- Solution of constrained multivariable problems. - Analytical solution. - Lagrangian duality. - Linearization of nonlinear optimization problems. - Simplex method. - Pivot table formulation. f- Linear programming (LP) formulation. - Solving linear system. - Basic solution of an (LP) problems. - Graphical interpretation.	

University of Technology
Department of Chemical Engineering

Program	*Oil and Gas Refinery Engineering*					
Course Code	**CES.R. 4**39	Credits hr				Units
Course Title	Corrosion Eng. In Petroleum Refinery					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Material Engineering	2	-	-	2	2

Course Description

Introduction, Classification of Corrosion, Kinetics of aqueous corrosion, Thermodynamics, Determining, Passivity, Reference Electrode, Corrosion prevention, Corrosion in refining industries.

Course Text

1- Zaki Ahmed, "Principle of Corrosion Engineering and Corrosion Control",1ST Edition, ,IChemE ,ELSEVIER, 2006.
2- Denny A. Jones, "Principle and Prevention of Corrosion", 2nd Edition, Prentice Hall, 1996.
3- Herbert H. UHLIG, " Corrosion and Corrosion Control" John WILEY, 2008.
4- Fontana, M.G and Greene, N.D, "Corrosion Engineering", 3rd Edition, McGraw-HILL, 1986.
5- Sankara Papavinasam, "Corrosion Control in the Oil and Gas Industry", Elsevier, 2014.

Course Objectives : at the end of the semester the student should be able to :-

1- Understanding the concept of corrosion. The form of corrosion, How the material destroyed by corrosion.
2- Determine the corrosion rates and electrochemical behavior of the metals and the thermodynamics of corrosion reactions.
3- Applying the corrosion prevention technology.
4- Selection of materials involved in applying the corrosion prevention technology in petroleum refineries.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction:** Definitions, Corrosive environment, Consequences of corrosion, Cost of corrosion, Why metals corrode, Basic concepts on corrosion, Anodic and Cathodic reactions, Types of cells.	**2 hr**
2	**Classification of corrosion:** Wet corrosion, Dry corrosion, Sweet Corrosion, Sour Corrosion , Forms of corrosion	**4 hr**

3	**Kinetics of aqueous corrosion:** Faraday's laws of electrolysis and its application in determining the corrosion rate, reversibility and exchange current density, polarization, Activation polarization, Concentration polarization, Combined polarization.	**4 hr**
4	**Thermodynamics and its application on corrosion:** Free energy, Cell potential, Reversible electrode potential, Nernst equation	**4 hr**
5	**Determining the corrosion rate:** Corrosion rate measurement units, methods determining corrosion rate: 3- Immersion test 4- Electrochemical technique a-Tafel extrapolation b-Linear polarization	**4 hr**
6	**Passivity:** Active passive metal and conditions for passivity, Kinetics of passivity table passivity, Unstable Passivity	**2 hr**
7	**Reference electrodes:** Hydrogen electrode, Ag/AgCl electrode, $Zn/ZnCl_2$ electrode, $Pb/PbCl_2$ electrode	**2 hr**
8	**Corrosion prevention in Oil Industry:** Materials selection, Alteration of Environment, Design, Coating, Anodic protection, Inhibitors	**2 hr**
9	**Pourbaix diagram:** Equilibrium Diagram, Advantage and Disadvantage of Pourbaix Diagram	**2hr**
10	**Cathodic Protection:** Sacrificial anode corrosion protection, Impressed current anode corrosion protection, Major impressed current anodes, Galvanic systems anode, Design parameters in cathodic protection, Stray current corrosion	**4 hr**

Universityof Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.111**	Credits hr				Units
Course Title	Technical English "I"					
Term	1^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Basic principles in English language (grammars and vocabularies)	2	-	-	2	2

Course Description

Define a specialknowledge and basic concepts in English language, review of (words, terms and phrases commonly utilized)with practical everyday language that students need, the fundamental principles of grammars used in English language such as question and answer, the negative, the tail questions, the singular and plural, the numbers, nouns, pronouns, the verb (to be, to have, and to do), adjectives, regular and irregular verbs, using so & neither, and adverbs, degrees of comparison, conjunctions and interjections, kinds of letter (S) with general exercises. Also, accurate description of the nature of vocabularies and idioms used by the chemical engineers and that the student needs in his/her academic and/or in his/her professional career by means of applying two reading passages focus mainly on studying the chemical engineer work in the factories as well as equipment, tools and materials used.

Course Text

3- The language of chemical engineering in English, Roy V. Hughson (1979), Regents publishing company, Inc.
4- New headway plus (English Course), Liz & John Soars (2014), Oxford University press.

Other support books :-

3- Life Lines workbook (Pre-intermediate and Intermediate level), Tom Hutchinson (2007), Oxford University press.
4- English in a simplified way, Tahir Al- Bayati (1991), Baghdad.

Course Objectives: at the end of the semester the student should be able to :-

The objective of this course focuses on:

1-in-depth understanding and comprehension of the essential grammars in the English language that usually used in writing and/or speaking with choosing the correct way of speaking and/or listening the vocabulary (phonetics and spelling) by the use of common phrases and words.

2-Also, focus on the use of technical English(reading passages) as a heart of chemical engineer work, such as what chemical engineers do, research and development.

3- The development of the student's ability to apply and arrange knowledge in English language and thus become able to employ them appropriately in his/her daily dealing without the complexity.

4- As well, encourage students to develop their capabilities in the field of English language through participation by the training on the use and improve their language.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Academic Comprehension: (Reading passages related to chemical engineering)** The first reading passage (*What chemical engineers do*) (Special terms or definitions, vocabulary practice - the word and its meaning, paragraphs - read and explanation, review, and discussion)	8 hrs
2	**Academic Comprehension: (Reading passages related to chemical engineering)** The second reading passage (*Research and development*). (Special terms or definitions, vocabulary practice - the word and its meaning, paragraphs - read and explanation, review, and discussion).	8 hrs
3	**English Grammar:** A general introduction to the English language and its importance as a means of communication between different peoples around the world,Review of the words, terms and phrases commonly used,Review of the simple grammars in English language, such as question and answer, the negative, the tail questions, the singular and plural, the numbers, telling the date, and telling the time, Nouns, pronouns, the verb to be, the verb to have, the verb to do, Adjectives and regular and irregular verbs, Reading and writing grammars that include short forms and words with two different meanings, The use of so & neither, and adverbs, Degrees of comparison,Conjunctions and interjections with general exercises, Kinds of letter (S) with general exercises.	14 hrs

University of Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.121**	Credits hr				Units
Course Title	Mathematics I					
Term	1^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematic of secondary school	2	-	1	3	2

Course Description

Introduction to functions, limits, Special functions, Derivatives, Chain rule, and their applications. Introduction to integral calculus, Methods of integration.

Course Text

1-Thomas Calculus, by George B.Thomas,Jr, Elevnth Edition Media Upgrade 2008"
Other support books :-
2-Mathematical methods for science students, Second Edition, by G. Stephenson .
3-Advanced Engineering Mathematics, Fifth Edition, by C.Raywylie,LouisC.Barrett .
Mathematical Methods in chemical Engineering, Second Edition, by V.G.Jenson and G.V. Jeffreys .

Course Objectives : at the end of the semester the student should be able to :-

1- To develop an understanding with the concepts of calculus and analytic geometry and the applications of these concepts to the solution of engineering problems.
2- Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.
3- Develop a deep understanding of issues related to the basic principles of calculus, and how to solve problems in chemical engineering

Universityof Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Mathematics I

No.	Contents	Duration
1	**Preliminaries:** Absolute value, coordinates of the plane, slope of lines, angle of inclination, functions, graph of the functions, domain and range, identifying functions, sum, differences, products and quotients, composite functions, shifting a graph of a function, scaling and reflecting a graph of a function.	6hr
2	**Limits and Continuity:** Properties, limits involving infinity, continuity	4hr
3	**Transcendental functions:** Logarithmic and exponential functions, trigonometric functions , inverse trigonometric functions, hyperbolic functions, inverse hyperbolic trigonometric functions.	4hr
4	**Derivatives:** Definition, chain rule, derivative of inverse trigonometric functions, of hyperbolic functions, of inverse hyperbolic functions, derivative of exponential and logarithmic functions, L, hopitals rule, partial derivative, function of two or more variables.	6hr
5	**Integration:** Indefinite integration, integration of inverse trigonometric functions, integration of hyperbolic functions, integration of inverse hyperbolic functions, integration methods; (substitution, by part, trigonometric substitution, partial fraction) .	10hr

University of Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.131**	Credits hr				Units
Course Title	**Chemical Engineering Principles I**					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	**1-Basics Maths** **2-Chemistry Basics**	2	-	1	3	2

Course Description

To teach students fundamental knowledge of chemical engineering and application of this knowledge in the solving of material balances of chemical processes.

The course will cover concepts ranging from basics such as units and dimensions, stiochiometry to the simultaneous application of material and energy balances with and without occurrence of chemical reaction.

Behavior of ideal gases including the procedures for estimation of vapor pressure and heats of vaporization will be extensively covered.

Course Text

1- Himmelblau, D.M. and J.B.Riggs," Basic principles and calculations in chemical engineering",8ed , Prentice-Hall Inc., New Jersey,2013.
2- Sikdar, D.C., Chemical process calculations, PHI Learning private ltd., New Delhi, 2013.

Course Objectives: at the end of the semester the student should be able to :-

1-Identify and understand the unit operations involved in a process, draw flowcharts, and develop relationships between process variables.
2-Perform simple degree-of-freedom analysis to identify the number of unknowns relating to mass, mass flow rate, composition and energy, and develop the linearly independent mass and energy balances needed to determine unknown quantities.
3-Apply ideal gas rule and equations of state for real gases.
4-describe various forms of energy, work, enthalpy, specific properties. state functions. and volumetric properties of pure liquids.
5-Convert from SI unit to British unit system and vice versa.
6-Understand the dimension concept,Understand of conversion coefficient concept andUse conversion coefficient.

Universityof Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/Course Title

No.	Contents	Duration
1	**General Knowledge of Chemical Engineering:** Definition of chemical engineering, Chemical process industries (CPI), Generalized chemicalprocess,Flow sheet and representationof a chemical process (PFD) The difference betweenthe chemist and the chemical engineer**.**	4 hr
2	**Mathematical , Physical and Chemical Principles:** Dimensions, units, symbols and conversion factors , Precision and significant figures., Density and specific gravity, Temperature, Pressure, The mole unit , Composition and concentration. Basis of calculation, Principles and expressions of stoichiometry**.**	16 hr
3	**Gases and Vapors:** Ideal gas law, Ideal gas mixtures, Real gas relationships, Real gas mixtures, Vapor pressure and saturation**.**	10 hr

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.123**	Credits hr				Units
Course Title	Chemistry					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemistry	2	2	0	4	3

Course Description

Introduction to environmental chemistry and pollution including environmental of water and air

Course Text

1- Harrison, R.M," Understanding Our Environment An Introduction to Environmental Chemistry and Pollution",3ed edition, The Royal Society of Chemistry 1999

Other support books :-

1- Benefield, L.D,Judkins, J.Fand weand ,B.L Process Chemistry for water and west water treatment .Prientice-Hall,Inc. Eagleood Cliffs, New Jersey,1982.
2- Weiner, R. F. "environmental engineering" 4th edition Elsevier Science 2003.

Course Objectives: at the end of the semester the student should be able to :-

1- To provide an understanding of the general principles of Environmental chemistry
2- A comprehensive understanding of the water chemistry and west water.
3- Ability to select the application and uses of water depend one properties
4- Students will learn to think about Chemical pollution

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction to environmental chemistry:** concept and scope of environmental chemistry, components of environment, natural cycles of matter in the environment. Stoichiometry, Gibb's redox potential chemical potential, chemical equilibria, acid-base reaction, solubility of gases in water, definition of environmental terms.	**8hr**
2	**Chemistry of water and wastewater:** Hydrological cycle, structure of water molecule, water as a solvent principles of equilibrium chemistry, pH, oxidation-reduction and the applications of principles of chemistry for solving Environmental Engineering Problems.	**12hr**
3	**Chemistry of the air environment:** Chemistry of the atmosphere, combustion related air pollution, global environmental problems – chemistry of CFC, ozone depletion, greenhouse effect, acid rain, La Nino etc. Chemistry of pollution due to detergents, pesticides, polymers, traces organics, metals, petroleum and radioactive compounds.	**10hr**

Practical: (Chem. lab.)

No.	Experiment Name
1	Introduction and chemical safety basic rules
2	Equipment and how to use it
3	Preparation of standard solution (primary and secondary)
4	Direct Titration
5	Titration pH Curves
6	Determination of Chloride Ions in Water
7	Redox reaction
8	Determination of Hardness of Water
9	Determine of Salinity by electrical conductivity
10	Determination of Turbidity
11	Identification of organic compound

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CE- CES.E.125**	Credits hr				Units
Course Title	Environmental Physics					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physics	2	-	-	2	2

Course Description

Basic global climate, Energy, Transport of pollutants, Noise and sound.

Course Text

1-R.A.Tlinrichs and M. Klcinbach, “Energy, Its use and its Environment”
2-Egbert Boeker & Rienk Van Grondele,” Environmental Physics”

Course Objectives : at the end of the semester the student should be able to :-

1- The basic physical environmental Physics, climate physics, Energy, pollution’s source and noise

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction**: (the essentials of environmental physics),the economic system, living in green house, enjoying the sun, transport of matter, energy and momentum.	5hr
2	**Basic Environment Spectroscopy:** Solar spectrum, interaction of light with matter Lambert- Beer’s law, Biomolecules, ozone and UV. Light.	5hr
3	**The Global Climate:** Energy balance, Elements of weather and climate, climate vibration and modeling.	5hr
4	**Energy:** Heat transfer, energy from fossil fuels, renewable energy, nuclear energy.	5hr
5	**Transport of Pollutants:** Diffusion, flow in rivers, ground water flow, the equation of fluid dynamics, turbulence diffusion, particle physics.	5hr
6	**Noise:** Basic acoustics, human perceptions and noise criteria, Reducing the transmission sound	5hr

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CESE.127**	Credits hr				Units
Course Title	Engineering drawing					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	None	1	2	---	3	2

Course Description

Introduction inEngineering drawing, engineering drawing applications, engineeringprocess , analysis model to view and study the full and half Sections , conclusion of the third projection ,Draw isometric and Oblique.

Course Text

3. لرسم الهندسي،تاليف (عبد الرسول الخفاف) الطبعة الثانية،١٩٩٣
4. R.P Hoelscher and C.H Springer "Engineering Drawing and Geometry ".2nd edition

Course Objectives: at the end of the semester the student should be able to :-

1- 1.The students can be use Tools Drawing in draw and analyze geometric shapes
2- 2.Enable students to draw devices, equipment & PFD in chemical engineering.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction**	3hr
2	**Planning of Drawing paper**	3hr
3	**Types of line**	3hr
4	**Engineering operation**	3hr
5	**Projection Drawing**	3hr
6	**First angle projection**	3hr
7	**Third angle projection**	3hr
8	**Full section**	3hr
9	**Half section**	3hr
10	**The finding of third view**	3hr
11	**Application Example**	3hr
12	**Pictorial Drawing (Isometric and Oblique)**	3hr
13	**Application Example**	3hr
14	**Dimensions**	3hr
15	**Examples of chemical engineering drawing and exercises.**	3hr

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.P.113**	Credits hr				Units
Course Title	**Computer Programming(I)**					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	None	1	2	---	3	2

Course Description

This course provides an overview of the operating system Windows 10 and the program of Microsoft Office 2010 and the Visual Basic and includes the operation of Visual Basic and describe the elements of the design environment and user interface design and the difference between the project and the program and introduce students to the philosophy of programming using visual Basic and a programming process events Event-Driven Programming and programming objects Object Oriented Programming and gives the student an introduction to object-oriented programming and introduce students to the fundamental differences between the concept of the programming language BASIC visual and languages BASIC traditional and explain the steps to design and program planning.

Course Text

1-“ Visual Basic: Crash Course - The Ultimate Beginner's Course to Learning Visual Basic Programming ”, 3rd Edition, A. Tannenbaum, Prentice-Hall, 1996.
2-"Beginning Visual Basic " by Bryan Newsome Wrox, USL Press , | December 2003 | ISBN-10: 1119092116 |
3- “Course Notes for Learn Visual Basic 6.0 ”, 4th Edition, F. Halsall, Addison-Wesley, 2000.

Course Objectives : at the end of the semester the student should be able to :-

1- start Microsoft Office applications and work with the Microsoft Office interface Create documents in Microsoft Word. Create workbooks in Microsoft Excel.Create presentations in Microsoft PowerPoint
2- Define and modify the the properties and methods associated with an object
3- Load, modify, and save changes made to forms and projects in the Visual Basic environment
4- Define and implement form objects including data arrays, control arrays, text boxes, message boxes, dialog boxes, labels, controls, menus, frames, picture boxes, pull-down menus, and combo boxes

Universityof Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Computer Programming(I)

No.	Contents	Duration
1	**Windows 10 andMicrosoft Office:** the operating system Windows 10 and MicrosoftOffice word, Microsoft excel, Microsoft power point.	3hr
2	**Introduction to Visual Basic Programming**: Menu bar, Tools bar, Project explorer, Tool box, Properties windows, Form, Code, Controls, Command Buttons, Label, Textbox, Pointers, Picture box, frame, Naming Controls, Properties for controls: Height, Width, Left, Top, Font, Forecolor, Backcolor , Name, Caption, Text, and Visible, Events, Saving Visual Basic Project, Examples, Chemical Engineering Applications.	2hr
3	**Mathematics**: Arithmetic Operations: +, , *, /, \, mod, ^. (Using Simple Example for each Operation), Logical Operations. AND, OR, NOT. And the Truth Table for each Operation, (Using Simple Example for each Operation), Relational Operation: >, <, >=, <=, <>, =, String Concatenation (&), Operation Precedence. For all arithmetic, logical, relational operators, Print statement and Formatting. Illustrate (colon, comma, and semicolon), Examples: Chemical Engineering Applications	1hr
4	**Built inFunctions**: Builtin math functions, Abs(x), Int(x), Rnd(x), sgn(x), sqr(x), str(x), val(x), round(x,n),CInt(x),Fix(x),String Functions, InputBox, MsgBox, Examples: Chemical Engineering Applications.	1hr
5	**Selection Structure:** Single Selection: If/Then structure, Double Selection: If/Then/Else structure, Nested If/Then/Else structure, Select Case Multiple Selection Structure, Examples: Chemical Engineering Applications.	2hr
6	**Reputation Structure**: For ... Next Loop, While ... Wend, Do .... While ... Loop, Do ... Loop Until, Exit Do, Exit For Examples: Chemical Engineering Applications.	1hrs

7	**Variables**: Data Types: Boolean, Integer, Long, Single, Double, String, Valid Naming of Variables, Initial Value for each Type of the Variables (Initial Value for each Data Type), Size of each Variable Type in Bytes, How to Declare Variables. (Dim statement), Using: Dim variable name As Data type, Using Suffix: Integer, Long, Single, Double, String, Constant Variable. Examples: Chemical Engineering Applications.	2hrs
8	**Arrays**: Introduction: Defining Arrays, Array Declaration Statement, Assigning Values for Arrays (i.e.filling array's element value either by loop or by direct assignment statement), Re Dim Statement, Using Loops with Arrays. (i.e. writing an application on array using loops),Two Dimensional Arrays, Operations on Arrays, Fill Array Elements with Random Numbers using and Function, Sorting, Searching. (i.e. Linear search), Swapping Two Elements. Examples: Chemical Engineering Applications.	2hr
9	**Graphics in Visual Basic**: Graphics control, Picture box, Image box, Coordinate system, Pixel, Graphics methods (Line,Circle, pset) Examples: Chemical Engineering Applications.	1hrs

Universityof Technology
Department of Chemical Engineering

<table>
<tr><td>Program</td><td colspan="6">Industrial and Petroleum Pollution Engineering</td></tr>
<tr><td>Course Code</td><td>CES.E.112</td><td colspan="4" rowspan="2">Credits hr</td><td rowspan="3">Units</td></tr>
<tr><td>Course Title</td><td>Technical English "II"</td></tr>
<tr><td>Term</td><td>2nd Semester</td><td>Theoretical</td><td>Practical</td><td>Tutorial</td><td>Total</td></tr>
<tr><td>Prerequisite(s)</td><td>Basic principles in English language (grammars and vocabularies)</td><td>2</td><td>-</td><td>-</td><td>2</td><td>2</td></tr>
</table>

Course Description

Define a specialknowledge and basic concepts in English language, review of phonetics and spellingwith words and sounds that need attention in understanding the meaning and pronunciation, the fundamental principles of grammars utilized in English language such as the use of the prefixes (un, im, in, and dis), the use of since & for, the definite and indefinite articles. As well as simple, continuous and perfect tenses (present, past, and future), the punctuation, active voice and passive voice, direct and indirect speech, finite and non-finite verbs, analyses and kinds of sentences. Also, accurate description of the nature of vocabularies and idioms used by the chemical engineers and that the student needs in his/her academic and/or in his/her professional career by means of applying two reading passages focus mainly on studying the chemical engineer work in the factories as well as equipment, tools and materials used.

Course Text

1- The language of chemical engineering in English, Roy V. Hughson (1979), Regents publishing company, Inc.
2- New headway plus (English Course), Liz & John Soars (2014), Oxford University press.

Other support books :-

1- Life Lines workbook (Pre-intermediate and Intermediate level), Tom Hutchinson (2007), Oxford University press.
2- English in a simplified way, Tahir Al- Bayati (1991), Baghdad.

Course Objectives: at the end of the semester the student should be able to :-

The objective of this course focuses on:

1- Study and conception of the advance grammars in the English language that usually employed in academic writing and also explain the use of grammars correctlyin speaking and/or listening the vocabulary (phonetics and spelling) via increasing the ability to rapid recognize the words that have two different meanings depending on their presence in the context of speech

2- Accurate description of the nature of vocabulary and idioms used by the chemical engineers in dealing with their respective fields in addition to the vocabulary of daily dealing. Also, focus on the use of reading passages such as process design and plant operation, which are related to student competence and his/her profession as an engineer in the chemical companies.

3- Enhancement of student's ability by applying modern information in English language about the characteristics of the chemical engineer job and then try to the simulation that in writing the

scientific report, expression, and formulate of simple sentences and complex ones without the difficulty. 4- Finally, promote the qualifications of students in the field of English language by training on the use and the progress of their language in order to allow them to easily use it in his/her future academic study in chemical engineering.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Academic Comprehension: (Reading passages related to chemical engineering):** The third reading passage (*Process design*) (Special terms or definitions, vocabulary practice - the word and its meaning, paragraphs - read and explanation, review, and discussion)	**8 hrs**
2	**Academic Comprehension: (Reading passages related to chemical engineering):** The fourth reading passage (*Plant operation*). (Special terms or definitions, vocabulary practice - the word and its meaning, paragraphs - read and explanation, review, and discussion).	**8 hrs**
3	**English Grammar:** Phonetics & Spelling (consonant sounds & vowel sounds), Words and sounds that need attention in understanding the meaning and pronunciation, as well as the use of the prefixes (un, im, in, and dis),The use of since & for, as well as the definite and indefinite articles,Punctuation (such as the use of the capital letter, the question mark, and the comma….etc), Simple tenses (present, past, and future), Continuous and perfect tenses (present, past, and future), Active voice and passive voice,Direct and indirect speech, Finite and non-finite verbs, Analyses of sentences, and kinds of sentences (either according to form or to number of statements).	**14 hrs**

University of Technology
Department of Chemical Engineering

Program	*Industrial & Petroleum Pollution Engineering*					
Course Code	**CES.E.122**	Credits hr				Units
Course Title	Mathematics II					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I	2	-	1	3	2

Course Description

Definite integral and applications, Polar coordinates, Vector analysis, Determinant and matrices

Course Text

1- Thomas Calculus, by George B. Thomas, Jr, Elevnth Edition Media Upgrade 2008"

Other support books :-

1- Mathematical methods for science students, Second Edition, by G. Stephenson,
2- Advanced Engineering Mathematics, Fifth Edition, by C. Raywylie, Louis C. Barrett
3- Mathematical Methods in chemical Engineering, Second Edition, by V. G. Jenson and G.V. Jeffreys

Course Objectives : at the end of the semester the student should be able to :-

1- To understand these concepts of applications and how to evaluate volumes, surface area , and to understand analytic geometry.
2- Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.
3- Develop a deep understanding of issues related to the basic principles of polar coordinates, vector analysis, determinants, and how to solve problems in chemical engineering

University of Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Mathematics II

1	**Definite integration and Applications:** Double integrals, reverse order of integration, length of curves, surface area, volumes	**10hr**
2	**Polar Coordinates:** Definition, Cartesian versus polar coordinates, graphing in polar coordinate.	**4hr**
3	**Vector Analysis:** Definitions, properties, vector in space, scalar and cross product of vector, product of three vectors.	**8hr**
4	**Determinates and Matrices :** Definition, determinate evaluation, solution of system of linear equation by matrix; (Inverse of matrix, Gauss elimination), Rank of matrix, Eigen value and Eigen vectors.	**8hr**

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	CES.E.132	Credits hr				Units
Course Title	Chemical Engineering Principles II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	1-Basics Maths 2-Chemistry Basics 3.Chemical Engineering Principles I	2	-	1	3	2

Course Description

The objective of this course is to present an introduction to chemical engineering calculations, establish mathematical methodologies for the computation of material balances and to present an overview of industrial chemical processes. It is prerequisite for several junior-level courses in the curriculum, including courses in process fluid dynamics, heat transfer and phase equilibrium.

The course reviews the fundamentals of chemistry and physics as they pertain to chemical problems and applies mathematics to the development of time-dependent equations to describe materials flow through a process. Examples of the processes studied include stoichiometry in combustion and other reactions, materials flow with recycle streams.

Course Text

1- Himmelblau, D.M. and J.B.Riggs," Basic principles and calculations in chemical engineering",8ed , Prentice-Hall Inc., New Jersey,2013.
2- Sikdar, D.C., Chemical process calculations, PHI Learning private ltd., New Delhi, 2013.

Course Objectives: at the end of the semester the student should be able to :-

1-Create representative process flow diagrams and use them to organize systems of equations.
2-Formulate material balances to solve for compositions and flow rates of process streams.
3-Incorporate single and multiple reactions into unit operations within chemical processes.
4-Understanding of the degrees of freedom analysis and its significance.
5-Ability to make material balances on unit operations and processes.

Topics Covered (Syllabus)

No.	Contents	Duration
1	**Concepts of material balance.**	2 hr
2	**Systematic steps of solving material balance problems.**	2 hr
3	**Material balances without chemical reactions.**	4 hr

4	**Material balances with chemical reactions.**	**6 hr**
5	**Material balances on combustion processes.**	**6 hr**
6	**Material balances involving recycle.**	**6 hr**
7	**Bypass and purge streams.**	**4 hr**

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.124**	Credits hr				Units
Course Title	Bio-Chemistry					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemistry	2	2	0	4	3

Course Description

Fundamentals of biochemistry-chemical basis of life and in environmental

Course Text

1- Lehninger A.L., Nelson D.L., Cox, M.M. "Principles of Biochemistry, Worth Publishers, 2004

Other support books :-

1- Benefield, L.D,Judkins,J.Fand weand ,B.L Process Chemistry for water and west water treatment .Prientice-Hall,Inc. Eagleood Cliffs, New Jersey,1982.

2- Weiner, R. F. “environmental engineering" 4th edition Elsevier Science 2003.

Course Objectives: at the end of the semester the student should be able to :-

After this course students should be able to understand basic chemical processes in the cell as well as their environmental effects

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Definition of biochemistry-chemical** basis of life, polymeric biomolecules and their monomeric building blocks	2 hr
2	**Carbohydrates:** Classification, Monosaccharide, disaccharide, Oligosaccharides, Polysaccharides	4 hr
3	**Lipids:** fatty acid, waxes, phospholipids, prostaglandins, triacylglycerols, steroids, lipophilic Vitamins	4 hr
4	**amino acids:** Amino Acid Polymers, proteins, Derivatives, Peptide Bonds	4 hr
5	**nucleic acids:** Types, Nucleosides, Nucleotides, Deoxyribonucleic Acid, Ribonucleic Acid	4 hr
6	**introduction to enzymology:** classes of enzymes, enzyme specificity and mechanisms of action as well as	4 hr

	the regulation of their activity; flow of genetic information - replication, transcription, translation and regulation of gene expression; bioenergetics and basic cellular metabolic processes	
7	**Environmental Implications of Food** Fats, oils, Carbohydrates, proteins, vitamins, fertilizers.	4 hr
8	**Global problems:** Fossil Fuel energy and global warming, Greenhouse Effect	4 hr

Practical: (Bio-Chemistry.)

No.	Experiment Name
1	Introduction to Techniques Experiment 1A Use of Pipetmen
2	Specific identification of sugars -1
3	Specific identification of sugars -II
4	Specific identification of lipids- I
5	Specific identification of lipids
6	Specific identification of amino acid
7	Specific identification of amino acid
8	Specific identification of protein
9	Specific identification of protein
10	Protein Purification (chromatography)

University of Technology
Department of Chemical Engineering

<table>
<tr><td>Program</td><td colspan="6">Industrial and Petroleum Pollution Engineering</td></tr>
<tr><td>Course Code</td><td>CES.E.126</td><td colspan="4" rowspan="2">Credits hr</td><td rowspan="3">Units</td></tr>
<tr><td>Course Title</td><td>Engineering Mechanic and Strength of Materials</td></tr>
<tr><td>Term</td><td>2nd Semester</td><td>Theoretical</td><td>Practical</td><td>Tutorial</td><td>Total</td></tr>
<tr><td>Prerequisite(s)</td><td>Physics</td><td>2</td><td>-</td><td>1</td><td>3</td><td>2</td></tr>
</table>

Course Description

Principles of statics, Resultant of a force system, Equilibrium of a force system, Moment of a force, Friction, Centroid and center of gravity, Moment of inertia, Analysis of internal force, Strain, Stress-strain diagram, Hook's law, Shearing deformation, Poisson's ratio, Volumetric strain, Thin-walled cylinders, Thermal stress, Shear and bending moment in beam.

Course Text

1- Engineering Mechanic-Statics and Dynamics volume 1; Higdon, A. and Stiles, W.B., 3ed Edition, Prentice-Hall, India, (1968).
2- Strength of Materials; Singer, F.L. and Pytel, A., 3ed Edition, Harper and Row, London, (1980).

Course Objectives : at the end of the semester the student should be able to :-

3. Designed to study the effects of external forces on a group of solid objects.
4. Resistance of materials and their applications in chemical engineering.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Friction:** Theory of Friction, friction on an inclined plane	**3 hr**
2	**Centroid and Center of Gravity**	**3 hr**
3	**Moment of Inertia (Second moment of the axis):** Polar moment of inertia, Transfer formula for moment of inertia	**3 hr**
4	**Introduction Force in Rigid Bodies:** Definitions of Stress and Strain, Stress-Strain Diagrams	**2 hr**
5	**Proportional Limits:** Elastic limit, Stiffness elasticity, Plasticity, Hardness and working stress.	**4 hr**

Topics Covered (Syllabus)/ Course Title

6	**Hook 's Law**	**3 hr**
7	**Poisson Ratio, Composite Stresses:** Volumetric Stress, Bulk Modulus, Thin Walled Cylinders	**4 hr**
8	**Thermal Stress**	**4 hr**
9	**Shear and Bending Moments in Beam**	**4 hr**

University of Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.114**	Credits hr				Units
Course Title	AutoCAD					
Term	2^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Computer Programming I	1	2	---	3	2

Course Description

introduction , AutoCAD program components and how to use it , knowing AutoCAD commands like point , lines, Rectangle, Polygon, Poly line , Arc with their option to draw 2D engineering drawing, learning Hatching, text, mtext , Dimension creation and editing , Modify command and Layers for 2D engineering drawing.
3D drawing methods: Surfaces, Solids and Composite solid.
Render, background, lights for drawing.

Course Text

1-Terry T. Wohler, applying AutoCAD 2002 fundamentals, Glencoe /McGraw-Hill
2-James A. Leach, AutoCAD 2002 Companion Essentials of AutoCAD plus Solid modeling ,2003 , McGraw-Hill, Boston
3- Terry T. Wohler, applying AutoCAD a step by step approach for AutoCAD release 13, 1996, Glencoe McGraw-Hill
4- James A. Leach, AutoCAD 14 Companion Essentials of AutoCAD plus Solid modeling ,1999,WCB / McGraw-Hill, Boston
Other support books :-
David Byrnes and Mark Middlebrook, AutoCAD® 2007 For Dummies , Wiley Publishing, Inc.

Course Objectives : at the end of the semester the student should be able to :-

1. The students can use AutoCAD program and produce 2D and 3D chemical engineering drawings.
2. Enable students to draw designed equipment in AutoCAD program.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	Introduction, Drawing program screen components, Setting drawing limits, Units, Grid and snap, Zoom, Orthogonal, Osnap, UCS. 2D drafting: Cartesian system coordinate, AutoCAD drawing command: Point, Line: line, multi-line, construction line, drawing line by using: absolute coordinate, polar coordinate, relative coordinate, Example	**3hr**
2	Continuous line drawing: Rectangle, Polygon, Poly line with their options, Example	**3hr**
3	Curves drawing: Arc, Circle, point –SP line, Ellipse with their options, Example.	**3hr**
4	Hatching, text command: text, mtext, Example	**3hr**

5	Dimension creation and editing, Example	**3hr**
6	Region, block, insert block, Example	**3hr**
7	Modify command: 1-coy tool: copy, mirror, offset, array. 2- Erase tool: erase, trim, break .3-move tool: move, rotate .4- Change tool: stretch, Lengthen, Extend, Scale, Chamfer, and Fillet .5-Explode, Example	**3hr**
8	Layers: Create a new layer ,rename layer, active layer, run and extinguishing layers ,Freezing layers, Lock and open layers, the color ,Font type ,Line width, Example	**3hr**
9	3D drawing methods: Surfaces drawing: box, Wedge, Pyramid, Dome, Sphere, Cone, Torus, Dish, Example	**3hr**
10	3D drawing methods: Solids: box, Cylinder, Sphere, Cone, Wedge, Torus, Example	**3hr**
11	Composite solid: Union, Subtraction, Intersection, Example	**3hr**
12	render, background, lights, Example	**3hr**
13	Examples of chemicalengineering drawing and exercises.	**3hr**
14	Examples of chemicalengineering drawing and exercises.	**3hr**
15	Examples of chemicalengineering drawing and exercises.	**3hr**

Universityof Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.128**	Credits hr				Units
Course Title	Electrical Technology					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physics	1	-	1	2	1

Course Description

The course cover the basic electric engineering with details and examples in direct current circuits, network calculations, standards and conventions, Ohms law, Resistance and resistivity electromagnetism ,generator ,alternating current,, transformer ,motors and instrumentation ,

Course Text

1- John Bird," Electrical Circuit Theory and Technology",2nd edition, Elsevier Science, 2003
2- John Bird," Electrical and Electronic Principle and Technology", 2nd edition, 2003
3- Giorgio Rizzoni, "Fundamentals of electrical engineering", McGraw-Hill, 2009
4- Alan L. Sheldrake, "Handbook of Electrical Engineering", John Wiley & Sons Ltd,, 2003

Course Objectives : at the end of the semester the student should be able to :-

1-Understanding of the fundamentals principle of electrical technology.
2-Student should be know the basic electric principle, basic D.C. and A.C. circuit, D.C. and A.C. motors, transformer and should be able to work safety in laboratory as in field and follow the instruction relation between electrical and technology and chemical engineering.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction To Dc Circuit:** Material use in electric component, ohms law, temperature Coefficient, Review of Kirchhoff's Laws Series Parallel circuit, equivalent resistance, star / delta Conversion, Node And Mesh Analysis	**4hr**
2	**Dc And Ac Generator And Motor:** Principle of DC generator and motor, Transformer, Introduction motor(Single phase), Magnetic and electromagnetism, Natural magnetic field, magnetic flux, Feil	**2hr**
3	Electrochemical,	**5hr**
4	**Ac Circuit:** Concepts of AC circuit, rms value Average value, from and peak factors, real and Reactive power – power factor.	**2hr**
5	**Polyphases Circuit:** Introduction to three phase circuits, Introduction to three phase system , Phase and line parameter – relations ,Power measurement , Voltmeter and ammeter method	**2hr**

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.115**	Credits hr				Units
Course Title	Human rights					
Term	2st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	none	1	-	-	1	1

Course Description

The study of the human rights concept and history and its relationship to religions and the extent of his relationship with globalization and contemporary currents.

Course Text

1-Human rights, development, contents Dr.Riyad Aziz Hadi
٢-مبادئ و قواعد عامة في حقوق الأنسان د. صلاح حسن مطرود
٣- حقوق الأنسان بين الأسلامي و العالمي د. محمد علي الشجيري
٤- حقوق الأنسان و الديمقراطية د. ماهر صالح الجبورى
٥- مشكلة الحرية د. زكريا أبراهيم

Course Objectives : at the end of the semester the student should be able to :-

1-Rooting human rights values in the local culture.
2-leading to the development of the concept.
3-principles of human rights in general.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	Psychological construction and its relationship with human right	1hr
2	Contemporary Arabs currents ,its position on human right	1hr
3	Secular :the early stage of its development ,disadvantages, her features	1hr
4	How can you balance between civil right and social	1hr
5	Capitalist and socialist society with human rights	1hr
6	Close society and an opened society	1hr
7	Theory of the social contract	1hr
8	Thomas Hughes ,Jan-jack Rousseau ,Volter ,AuxtComte,Max Weber Montesquieu	1hr
9	Relationship of right to democracy	1hr
10	Relationship of right to urbanization	1hr
11	Relationship of right with globalization	1hr
12	Human rights between rejection and acceptance	1hr
13	How can rooting the values of human rights in Arab culture and in the great cultures	1hr
14	The relationship between the political culture and ideological	1hr
15	Ideological religion	1hr

Universityof Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.221**	Credits hr				Units
Course Title	Engineering MathematicsI					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I, Mathematics II	2	-	1	3	2

Course Description

This course describes the evaluation of double, triple integrals, area and volume.Provide knowledge and skills in writing a periodic function in its Fourier series form and on their applications. Develop skills for applying this course in the future on various chemical engineering applications.

Course Text

Text book:

1. Higher Engineering Mathematics by Dr.B.S.Grewal, Khanna Publishers, 40th Edition, 2007.

Reference book:

1. Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, 2007.

Course Objectives: at the end of the semester the student should be able to:-

1. Able to evaluate double, triple integrals and the area, volume by double & triple integrals respectively.
2. Understand the concept of Fourier-series representation of periodic functions and their applications.

Topics Covered (Syllabus)/ Engineering MathematicsI

No.	Contents	Duration
1	**Multiple Integrals:** Double Integral, Area, Volume, Double Integral in polar coordinates, Triple Integral in rectangular coordinates, physical application of double and triple integration.	12hr
2	**Function and definite Integrals:** The error function, the gamma function, the beta function, factorial function.	6hr
3	**Infinite Sequences and Series:** Sequences, Convergence, Geometric series, nth partial sum, tests of convergence, alternating series, power and Taylor's series.	6hr
4	**Fourier series:** Periodic functions, Fourier series, Even and odd functions, Half range expansion.	6hr

University of Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.231**	Credits hr				Units
Course Title	Energy Balance					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemical Engineering principle I & II	2	-	1	3	2

Course Description

The aims of the course provide a deep knowledge , wide scope and improved understanding of the mechanisms in heat balance for closed and open system and for steady and unsteady state. The students should gain knowledge to apply the energy balance in engineering problems.

Course Text

1. D.M.Himmelblau and J.B.Riggs ,Basic Principles and Calculations in Chemical Engineering ,7th Edition , 2004 .

Other support books :-

2. R.M.Felder and R.W.Rousseau , Elementary Principles of Chemical Processes ,3rd Edition ,2005.

Course Objectives : at the end of the semester the student should be able to :-

1. The terminology associated with energy balances , concepts , and units .
2. Introduction to energy balances for processes without reaction .
3. Calculation of enthalpy changes .
4. Energy balances : how to account for chemical reaction .

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Energy : Terminology , Concept , and units** The terminology associated with energy balances , Types of energy : Work , Heat , Kinetic energy , Potential energy , Internal energy , Enthalpy .	**4hr**
2	**Introduction to Energy Balances for Processes without Reaction** The concept of the conservation of energy , Energy balances for closed , unsteady-state systems , Energy balances for closed , steady-state systems , Energy balances for open , unsteady-state systems , Energy balances for open, steady-state systems .	**6hr**
3	**Calculation of Enthalpy Changes** Phase transitions, Equation to estimate heat of vaporization , Heat	**6hr**

	capacity equations , Tables and charts to retrieve enthalpy values .	
4	**Application of Energy Balances in the Absence of Chemical Reaction** Simplifications of the general energy balance , The strategy for solving energy balance problems , Applications of the energy balance to closed systems , Applications of the energy balance to open systems**.**	**8hr**
5	**Energy Balances : How to Account for Chemical Reaction** The standard heat of formation , The heat of reaction , Merging the heat of formation with the sensible heat or a compound in making an energy balance , The heat of combustion .	**6hr**

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.233**	Credits hr				Units
Course Title	Fluid Flow I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Principles of Chem. Eng. & Math	2	2	1	5	3

Course Description

Define fluid properties, stresses in fluids at rest and in motion and types of fluid flows, application of Newton law of viscosity and dimensional analysis methods…

Derive and define the governing equations of fluid flow: continuity, energy and momentum equations from principles of mass, energy and momentum conservation and define the terms of Bernoulli's equation, include major and minor losses and required energy for flow…

Define the types of fluid pumping devices and its characteristics and how to select the appropriate type and size for fluid pumping…

Define the types on Non-Newtonian and two-phase fluids flow and their pressures drop calculations…

Course Text

1- Coulson, J.M. , Richardson, J.F., Backhurst, J.R. and Harker, J.H., "Chemical Engineering" Volume(1) 6thEd., Butterworth-Heinemann, 1999
2- Holland, F.A. and Bragg, R., "Fluid Flow for Chemical Engineers", 2nd Ed., Edward Arnold, 1995.

Other support books :-

1- DARBY. R. , Dekker M. "Chemical Engineering Fluid Mechanics", 2nd Ed.Marcell Dekker, 2001
2- Wilkes J. O.,"Fluid Mechanics for Chemical Engineers", 2nd Ed. Prentice Hall PTR, 1999.
3- De Nevers, N. "Fluid Mechanics for Chemical Engineers" , 2nd Ed.McGraw-Hill 1991.
4- McCabe, W. L., Smith, J. and Harriot, P., "Unit Operations of Chemical Engineering", 6th Ed., McGraw – Hill, International Edition, 2001.
5- Christi J. Geankoplis "Transport Processes and Unit Operations" 3rd Ed. Printice Hall International Editions, 1993.

Course Objectives : at the end of the semester the student should be able to :-

1- Demonstrate knowledge of incompressible fluid flows, two phase flow, fluid statics, kinematics of flows and essential basic hydrodynamics.
2- Define and solve problems in fluid dynamics in various engineering applications. Provide the ability to describe energy variation and its application in flow and pressure measurement and frictional energy losses calculations.
3- Provide the ability to estimate the required energy for fluid pumping (selection the size and type of appropriate pumping for liquid and gas) and to design the liquid mixing

equipment. 4-Predict necessary fluid parameters of full scale projects by performing simple model experiments. 5-Share ideas and work in a team in an efficient and effective manner under controlled supervision or independently.

Topics Covered (Syllabus)Fluid Flow I

No.	Contents	Duration
1	**INTRODUCTION:** Definition of a fluid, fluid mechanics; Physical properties of fluids: Density, specific gravity, viscosity, kinematic viscosity, surface tension and capillarity, bulk modulus of elasticity, Pressure and shear stress; Types of Fluids: Newtonian, non-Newtonian fluids ideal and real fluids, Newton's law of viscosity.	4 hrs
2	**Dimensional Analysis :** Units and dimensions; Fundamental dimensions; Dimensional homogeneity; Dimensionless number Methods of dimensional analysis, 1- Rayleigh's method (power series) 2- Buckingham's Π- method / Theorem	4 hrs
3	**Fluid Statics :** Basic consideration of fluid statics; Pressure head of liquid; Pressure force on surfaces; Buoyancy; Measurement of pressure: (Piezometer, Manometers, types of Manometers, Mechanical Gauges)	4 hrs
4	**Fluid Dynamics, Newtonian's Incompressible Fluid:** Fluid kinematics: Types of fluid flow (steady and unsteady flows, uniform and non-uniform flows, one, two, and three dimensional flows, Rotational and irrotational flows, laminar and turbulent, compressible and incompressible flows), velocity distribution in laminar and turbulent flow Boundary layer, Continuity equation, Momentum equation, Bernoulli's equation, Euler's equation of motion, modified Bernoulli's equation, pipe size selection; Two-Phase Flow, Horizontal and vertical flow regime, calculation of pressure drop of two-phase flow by Lockhart and Martinelli method.	8 hrs

5	**Pumping of Liquids:** Total heads, NPSH, Horse Power and cost consumption, Pumping Efficiencies Characteristics curves Types of the pumps, Selection of Pumps. Centrifugal pump relations, homologous centrifugal pump, centrifugal pumps in series and in parallel.	6 hrs
6	**Non-Newtonian Fluids in Pipes:** Definition, types of non-Newtonian fluids, flow characteristics, apparent viscosity, shear rate and description of time-independed fluid, calculation of friction and pressure drop for general time independent in laminar and turbulent flow	4 hrs

Practical Fluid Flow I

No.	Experiment Name.
1	**Calibration of Bourdon Tube Pressure Gauge**
2	**Reynolds Experiment**
3	**Energy Loss in Pipes**
4	**Centrifugal Pump Characteristics**
5	**Bernoulli's Theorem Demonstration**
6	**Friction Losses in Piping Systems**
7	**Gear Pump**
8	**Flow Visualization**

University of Technology
Department of Chemical Engineering

Program	**Industrial & Petroleum Pollution Engineering**					
Course Code	**CES.E.235**	Credits hr				Units
Course Title	Physical Chemistry& Colloid Science					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	1.chemical engineering principles 2-chemistry	2	2	1	5	3

Course Description

In chapter one deals with the basic principles of adsorption in different types, the collidal systems with a number different. The simplest type of chemisorption (Langmuir adsorption isotherm).

Course Text

1. J. Laidler, physical chemistry, Bosten; Houghton M, ffl.n company, 1999.
2. G. Mortimer, physical chemistry , San Francisco; Altarcourt science and technology company, 2000.

Course Objectives : at the end of the semester the student should be able to :-

1. Be able to solve problems involving the collision theory of gas-phase reactions.

2. Understand the molecular basis of catalysis.

3. Be able to solve problems involving activities and activity coefficients in nonideal solutions.

4. Understand how the thermodynamics of a non simple system is applied to electrochemical cells.

5. Be able to calculate cell voltages for standard conditions and other conditions using standard reduction potentials.

Topics Covered (Syllabus)/ Physical Chemistry& Colloid Science

No.	Contents	Duration
1	**Surface chemistry and colloids:** Adsorption, adsorption isotherms, surface tension and capillary rise, colloidal systems, electrical properties of colloidal systems, gels, emulsions.	15 hr
2	**Catalysis**: Reaction of catalyst in homogeneity system, Enzyme reactions and kinetic of reactions.	3 hr
3	**Electrochemistry:** Conductivity measurements, Diffusion and ionic mobilities, Activity and ionic strength, Determination of activity coefficient from solubility, The debyehakle theory.	6 hr
4	**Acid base catalysis and their dissociation constant:** Electrochemical cells, Electromotive force (EMF) of a cell, The polarity of electrodes, The cell reaction and reversible cells, Free energy and reversible cells, Types of halfcells and classification EMF, Standard free energy and entropy of aqueous ions, Calculation of EMF of a cell, Oxidation – reduction reactions, Concentration cells, Electrolysis, Corrosion.	6 hr

Practical Physical Chemistry & Colloid Science

No.	Experiment Name
1.	**Decomposition of hydrogen peroxide.**
2.	**Three component system between the water& ethanol&ethyl acetate.**
3.	**Calorimeter Constant.**
4.	**Heat of solution**
5.	**Surface tension.**
6.	**Surface chemistry: Adsorption by solid from solution.**
7.	**Spectrophotometer analysis of $k_2cr_2o_7$.**

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.211**	Credits hr				Units
Course Title	Computer Programming II					
Term	1^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	13. Basic Principles of chemical engineering I. 14. Mathematics I. 15. Computer programming I	1	2	1	4	2

Course Description

To introduce chemical engineering students to modern calculating tool used in the practice of engineering by being able to construct plots, fit data, and use built-in functions in MATLAB.

Course Text

1. Rudra Pratap: Getting started with MATLAB 7, Oxford Press (Indian edition),2006.
2. Desmond J. Higham and Nicolas J. Higham: Matlab Guide, SIAM, 2000.

Other support books :-

1. Duane Hanselman and Bruce Littlefield: Mastering Matlab-6: A Comprehensive Tutorial and Reference, Prentice Hall, 2001.
2. Schilling R. J., Harries S.L., Applied Numerical Methods for Engineers using MATLAB & C, Thomson Books, 2002.

Course Objectives: at the end of the semester the student should be able to :-

1. Develop the confidence necessary to successfully solve Mathematical problems with a computer.
2. Formulate and write structured code in MATLAB.
3. Understand the foundation behind the basic numerical methods for Matrix manipulations.

Topics Covered (Syllabus)/ Computer Programming II

No.	Contents	Duration
1	**Starting With Matlab:** MATLAB windows , Menus and the toolbar , Working in the command window , Arithmetic operations with scalars , Display formats , Elementary math built-in functions, Useful commands for managing variables, Script files	2hr

	and the Editor Debugger, Matlab Help System	
2	**Symbolic Math:** Symbolic objects, and symbolic expressions, Changing the form of an existing symbolic expression, Solving algebraic equations, Differentiation, Integration, Solving an ordinary differential equation.	**3 hr**
3	**Creating Arrays:** Creating a one-dimensional array (vector) , Creating a two-dimensional array (matrix) , The transpose operator , Array addressing , Using a colon: in addressing arrays, Adding elements to existing variables, Deleting elements, Built-in functions for handling arrays, Strings and strings as variables.	**2 hr**
4	**Mathematics With Array:** Addition and subtraction , Array multiplication, Array division , Element-by-element operations , Using arrays in MATLAB built-in math functions, Built-in functions for analyzing arrays, Generation of random numbers, Solving Algebraic Equations.	**3 hr**
5	**Polynomials, Curve Fitting, And Interpolation :** Polynomials, Curve fitting , Interpolation , Extrapolation.	**2 hr**
6	**Programming In Matlab :** Relational and logical operators, Conditional statements, The switch case statement, Loops, Program Design and Development.	**3 hr**

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.**223	Credits hr				Units
Course Title	Material Eng. (I)					
Term	1^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Strength of material+ General chemistry	2	-	1	3	2

Course Description

Introduction to classification of materials and the atomic structure of it, Study the mechanical, thermal and electrical properties of materials and Crystal structure and imperfection in solid materials.

Course Text

1-Donaled R. Askeland, The science and engineering of materials, international student edition, 2006 .
2-William D. Callister, Jr. , Materials science and engineering, Fifth edition, 2000.
3-Lawrence H. Vanvlack , Elements of materials science and engineering, Fifth edition, 1987.

Course Objectives : at the end of the semester the student should be able to :-

1. Describe and solve problems on atomic arrangement and geometry of imperfections.
2. Describe and solve problems on mechanical, thermal and electrical properties of materials.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Classification of Materials** Classification of materials, classification of materials based on structure, advanced materials	4hr
2	**Mechanical Properties of Materials** Stress-strain behavior, ductility, brittleness, toughness, modulus of resilience, poison's ratio, hardness, effect of temperature.	6hr
3	**Atomic structure** The structure of atom, atomic bonding, bonding energy and inter-atomic spacing	6hr
4	**Atomic order in solids** Types of atomic or ionic arrangements, crystal structure, lattice, unit cells, metallic crystal structure, crystal systems, crystal direction and crystal planes , diffraction techniques for crystal structure analysis	8hr
5	**Thermal and electrical properties of materials** Heat capacity, thermal expansion, thermal conductivity, thermal stresses, Glass transition temperature, Creep resistance, electrical conductivity, electron mobility, electrical resistivity of metals	6hr

University of Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E237**	Credits hr				Units
Course Title	Fuel Technology					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	chemistry	2	2	0	4	3

Course Description

Introduction to fuels technology (solid, liquid, and gases). Procedure and characterization in terms of physic-chemical properties.

Course Text

1- Modern petroleum Technology, vol. 1, upstream, ed. By Richard A. Dave, 1P, 6th ed., Jhonwiley and sons. Ltd.
2- Modern Petroleum Technology, vol.2, Downstream, ed. By Alan G. Lucas, 1P, 6thed , ., Jhonwiley and sons. Ltd.
3- Fuels combustion and furnaces, Jhon Griswold, Mc-Graw Hill Book company.
4- Petroleum Refinery Engineering, Nelson, 4th ed. Mc-Graw, Hill Book Company.

Course Objectives: at the end of the semester the student should be able to :-

1- Introduces basic knowledge about solid, liquid and gases fuels, their origin, classification.
2- Knowledge of preparation, procedure and characterization in terms of physic-chemical properties
3- Knowledge in liquid fuel section. Petroleum is the liquid fuel which is elaborated in terms of distillation and secondary processing. Different important gaseous fuels are included in gaseous fuel section.

University of Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction**: History of fuels, history of solid fuel, history of liquid fuels and gases fuels, fundamental definition, properties of liquid and gaseous fuels, various measurement.	4hr
2	**Coal :** classification,Composition and basis, coal preparation and washing, combustion of coal and coke and making, coal tar distillation coal liquefaction, coal gasification.	4hr
3	**Crude Petroleum:** Exploration of crude Petroleum, Evaluation of crude, distillation cracking, thermal cracking catalytic cracking, reforming of naphtha, hydrotreatment, dewaxing deasphalting, refinery equipment.	10hr
4	**Natural gas and LPG:** Producer gas, water gas, other fuel gases.	4hr
5	**Combustion air Calculation:** Calculation of calorific value of fuels, flame properties, combustion burners, combustion furnaces .	8hr

Practical Fuel Technology

No.	Experiment Name.
1	**ASTM distillation exp.**
2	**Density and specific gravity exp**
3	**Viscosity& viscosity index exp.**
4	**Salt content in crude oil**
5	**Gum and gum stability**
6	**Flash & fire point**
7	**Ash content for petroleum products**
8	**Conrad Son Carbon residue of petroleum**

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.**213	Credits hr				Units
Course Title	Democracy					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	none	1	-	-	1	1

Course Description

The study of the Democracy concept and history and its relationship to religions and relations with Development , also the advantages and the disadvantages of democracy

Course Text

1-Human rights, development, contents Dr.Riyad Aziz Hadi
٢-مبادئ و قواعد عامة في حقوق الأنسان د. صلاح حسن مطرود
٣- حقوق الأنسان بين الأسلامي و العالمي د. محمد علي الشجيري
٤- حقوق الأنسان و الديمقراطية د. ماهر صالح الجبورى
٥- مشكلة الحرية د. زكريا أبراهيم

Course Objectives : at the end of the semester the student should be able to :-

1- To know the democracy and how can adapt our culture with the principles of democracy in general.
2-Lock of student to their own cultural inventories in the concepts of democratization and it has be shining in the emergence of a democratic culture in university community with the intimate and external community .

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Democracy:** definition, a brief history, characteristics advantages of democracy and its disadvantages	1hr
2	The most important problem facing the implementation of democracy in arab-muslim world	1hr
3	Relationship awareness in the application of democracy	1hr
4	How can adapt our culture with the principles of democracy	1hr
5	Democracy between changes and external pressures	1hr
6	A pressure group the difference between them and the political parties	1hr
7	The advantages of democracy and the disadvantages	1hr
8	The theory of social determinism in state-building	1hr
9	Relationship between democracy and globalization	1hr
10	Development and democracy	1hr
11	Religion and democracy	1hr
12	The third way between socialism and capitalism	1hr
13	Reasons for the spread of financial and administrative corruption and how	1hr

	to confront it	
14	The reasons for the collapse of democracy	**1hr**
15	The relationship between the intellectual and power Democracy and modernity Democracy and alienation	**1hr**

University of Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.**222	Credits hr				Units
Course Title	Engineering MathematicsII					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Engineering Mathematics I	2	-	1	3	2

Course Description

This course describe the providing of knowledge on solving ordinary differential equations and applications of first order ordinary differential equations and chemical engineering applications of the theory portion covered will be emphasized.

Course Text

Text book:

1. Higher Engineering Mathematics by Dr.B.S.Grewal, Khanna Publishers, 40th Edition, 2007.

Reference book:

1. Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, 2007.

Course Objectives: at the end of the semester the student should be able to:-

1. Understand methods of solving First order and Higher order ordinary differential equations along with some physical applications.
2. Demonstrate the relevance of the mathematical methods learnt to chemical engineering.

Topics Covered (Syllabus)/ Engineering MathematicsII

No.	Contents	Duration
1	**Solution by Series:** Infinite series by Taylor theorem, Method of Frobenius (Case I, II, IIIa, and IIIb), Bessels's and Modified Bessel's Equation, Properties of Bessel Functions, Applications in chemical engineering ,Tubular Gas Preheater, Reaction in axisymmetric Spherical and Cylindrical pellets.	15hr
2	**Ordinary Differential Equations:** Introduction, Linear equation, Bernoulli's equation, Exact differential equations, Equations reducible to exact equations, Orthogonal trajectories, Newton's law of cooling. Linear differential equations with constant coefficients: Definition, Theorem, Operator D, Rules for finding the complementary function, Inverse operator, Rules for finding the particular integral, working procedure to solve the equation.	10hr
3	**Application of Ordinary Differential Equations:** Representation problems of 1^{st} and 2^{nd} ordinary differential equations (linear and nonlinear, homogeneous …etc.).	5hr

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.232**	Credits hr				Units
Course Title	Material and Energy Balance					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Energy Balance	2	-	1	3	2

Course Description

The aims of the course provide a deep knowledge , wide scope and improved understanding the heat balance that include the effects of chemical reaction as well as unsteady state material and energy balances . The students should gain knowledge to apply the material and energy balance in engineering problems .

Course Text

1. D.M.Himmelblau and J.B.Riggs ,Basic Principles and Calculations in Chemical Engineering ,7th Edition , 2004 .

Other support books :-

2. R.M.Felder and R.W.Rousseau ,Elementary Principles of Chemical Processes ,3rd Edition ,2005 .

Course Objectives : at the end of the semester the student should be able to :-

1. Energy balances that include the effects of chemical reaction .
2. Ideal process , efficiency , and the mechanical energy balance .
3. Heat of solution and mixing .
4. Humidity (psychrometric) charts and their use .
5. Unsteady state material and energy balances .

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Energy Balances that Include the Effects of Chemical Reaction** Applications of energy balances in processes that include reactions , Calculation of an adiabatic reaction temperature , General energy balance in a process in which more than one reaction occurs , Energy balance to a process composed of multiple units .	**8hr**

2	**Ideal Processes , Efficiency , and the Mechanical Energy Balances** Ideal reversible processes , Calculation of the work done during evaporation of a liquid , Calculation of the work in a batch process , efficiency , the mechanical energy balances , Comparison of the reversible work for a batch process with that of a flow process operating under the same conditions , the mechanical energy balance to the pumping of water .	4hr
3	**Heat of Solution and Mixing** Heat of solution , Heat of dissolution , Heat of mixing , Introducing the effects of mixing into the energy balance .	4hr
4	**Humidity (Psychometric) Charts and their Use** The humid heat , The humid volume , The dry-bulb temperature , The wet-bulb temperature , The humidity (psychometric) chart , Wet-bulb line , Adiabatic cooling line , Applications of the humidity chart .	6hr
5	**Unsteady state Material and Energy Balances** Unsteady-state material balance without generation , Material balance on batch distillation , Unsteady-state chemical reaction , Unsteady-state energy balance .	8hr

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.234**	Credits hr				Units
Course Title	Fluid Flow II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Fluid Flow I	2	2	1	5	3

Course Description

Application of Bernoulli's equation and derive the flow rate equations and explain the principles of flow measuring devices in open and closed channels…

Derive and define the governing equations of compressible fluid flow: continuity, energy and momentum equations from principles of mass, energy and momentum conservation with various gas flow conditions, Mach Number and flow through conversion-diversion nozzle with application for subsonic, sonic, supersonic flow, types of gas pumping devices, Compressors types with ideal and actual gas compression cycle and calculation of compressor work …

Define and description for liquid mixing equipment and its design calculations with the energy consumption by this equipment...

Derive the terminal falling velocity and description drag coefficient for flow through packed columns and pressure drop calculation for fixed and fluidized beds and transport of particles...

Course Text

1- Coulson, J.M. , Richardson, J.F., Backhurst, J.R. and Harker, J.H., "Chemical Engineering" Volume(1) 6th Ed., Butterworth-Heinemann, 1999

2- Coulson, J.M. , Richardson, J.F., Backhurst, J.R. and Harker, J.H., "Chemical Engineering" Volume (2) 5th Ed., Butterworth-Heinemann, 2002

3- Holland, F.A. and Bragg, R., "Fluid Flow for Chemical Engineers", 2nd Ed., Edward Arnold, 1995.

Other support books :-

1- McCabe, W. L., Smith, J. and Harriot, P., "Unit Operations of Chemical Engineering", 6th Ed., McGraw – Hill, International Edition, 2001.

2- Christi J. Geankoplis "Transport Processes and Unit Operations" 3rd Ed. Printice Hall International Editions, 1993.

Course Objectives: at the end of the semester the student should be able to :-

1- Define the operation principles of the different types flow measurement, solve problems in fluid flow through flow measurement devices with applications for steady and unsteady flow.

2- Demonstrate knowledge of compressible fluid flows, with differences of equations using depending on compressible flow conditions, sonic (sub)(super)sonic flow, conversion*diversion nozzle, types of gas pumping devices.

3- Provide the ability to estimate the energy (power) consumption for liquid mixing equipment and to design it by predict necessary fluid parameters of full scale projects by performing simple model experiments.
4- Provide the ability to estimate the terminal falling velocity and description drag coefficient for flow through packed columns and pressure drop calculation for fixed and fluidized beds and transport of particles...
5- Share ideas and work in a team in an efficient and effective manner under controlled supervision or independently.

Topics Covered (Syllabus)/Fluid Flow II

No.	Contents	Duration
1	**Flow Measurement** Pitot tubes, orifice meter, venturi meter, nozzle meter, Rotameters other types of flow meters, flow in open channels and weirs with steady and unsteady applications	6 hrs
2	**Flow of Compressible Fluid** General equation, equation of state, sonic velocity in fluids, Mach No. Isothermal, Non-isothermal and Adiabatic flow of an ideal gas in horizontal pipes, Converging-diverging nozzle for gas flow. Types of gas pumping devices (fans, blowers compressors) compressors types and gas compression cycle and calculations of work and efficiency of compressor	10 hrs
3	**Liquid Mixing** Stirring and mixing and rotational force, effective forces and dimensionless numbers for rotational fluid flow. Stirred vessels (power consumption, power curve, scaled-up), equipment	6 hrs
4	**Flow of Fluid through Granular Bed and Packed Columns** Motion of particles in a fluid, Drag force on a particle, terminal falling velocities, Sedimentation of fine and coarse particles, Pressure drop in granular beds, packed columns: packing types, Pressure drop estimation (Kozeny and Carmen equations), Fluidization Minimum fluidization velocity, Pressure, Pressure drop, Ergun equation, bed expansion and transport of particles.	8 hrs

Practical Fluid Flow II

No.	Experiment Name
1	Discharge through an orifice
2	Open Channel Flow over Weir
3	Flow through a Venturi Meter
4	Fluidization
5	Forced Vortex
6	Flow of Compressible Fluid
7	Impact of Jet
8	Non-Newtonian Fluids Behavior

Universityof Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.236**	Credits hr				Units
Course Title	Physical Chemistry					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	1- chemical engineering principles 2-chemistry	2	-	1	3	2

Course Description

Physical chemistry is the application of the methods of physical to chemical problems. It includes the qualitative and quantitative study. Both experimental and theoretical of the general principles determining the behavior of matter.

Course Text

1. J. Laidler, physical chemistry, Bosten; Houghton M, ffl.n company, 1999.
2. G. Mortimer, physical chemistry , San Francisco; Altarcourt science and technology company, 2000.

Course Objectives : at the end of the semester the student should be able to :-

1. Be able to solve problems involving ideal mixture and dilute solutions.
2. Understand the principles govering phase diagrams and the able to interpret phase diagrams for various kinds of systems.
3. Be able to solve problems related to the macroscopic equilibrium properties of gases and liquid.
4. Be able to calculate cell voltages for standard conditions and other conditions using standard reduction potentials and the nerst equation.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Phase Equilibria:** Equilibrium between phases, one component systems, binary systems involving vapor, liquid vapor equilibria of two component system, liquid vapor equilibrium in system not obeying Raoults law, temperature composition diagram (boiling point curves), distillation, azeotropes, solubility of gases in liquids.	**15 hr**
2	**Applications of the equations of ideal gases:** The PVT behavior of pure substances, the ideal gas.the constant volume process, the constant pressure process, the adiabatic process, the polytropic process.	**10 hr**
3	**Solutions of electrolytes :** Electrical units, Faradays laws of electrolysis, molar conductivity, weak electrolytes, strong electrolytes, activity and ionic strength, determination of activity coefficient from solubility, the Debye-Hackle theory, acid- base catalysis and their dissociation constant.	**5 hr**

Universityof Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.**212	Credits hr				Units
Course Title	Computer Programming III					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	16. Basic Principles of chemical engineering I. 17. Mathematics I. 18. Computer programming II	1	2	1	4	2

Course Description

To introduce chemical engineering students to modern calculating tool used in the practice of engineering by demonstrating an ability to create small structured programs in a MATLAB programming environment and understanding how user written functions interact with numerical methodsroutines.

Course Text

1- Rudra Pratap: Getting started with MATLAB 7, Oxford Press (Indian edition),2006.

2- Desmond J. Higham and Nicolas J. Higham: Matlab Guide, SIAM, 2000.

Other support books :-

1- Duane Hanselman and Bruce Littlefield: Mastering Matlab-6: A Comprehensive Tutorial and Reference, Prentice Hall, 2001.

2- Schilling R. J., Harries S.L., Applied Numerical Methods for Engineers using MATLAB & C, Thomson Books, 2002.

Course Objectives: at the end of the semester the student should be able to:-

1. Solve sets of linear and nonlinear equations using numerical methods as well as in-built MATLAB functions.
2. Apply numerical methods and MATLAB functions to differentiate and integrate a function or a set of discrete points.
3. Apply explicit and implicit numerical methods and MATLAB functions to integrate single and multiple sets of initial value problems

Universityof Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Two-Dimensional Plots :** The plot command , The f-plot command , Plotting multiple graphs in the same plot , Formatting a plot, Plots with logarithmic axes, Plots with error bars, Plots with special graphics , Histograms, Plotting multiple plots on the same page , Multiple figure windows Graphics.	4 hr
2	**Three-Dimensional Plots :** Line plots, Mesh and surface plots, Plots with special graphics, The view command.	2hr
3	**Using Script Files:** The MATLAB workspace and the workspace window, Input to a script file, Output commands, The save and load commands, Importing and exporting data.	1 hr
4	**Functions And Function Files:** Creating a function file, Structure of a function file, Local and global variables , Saving a function file, Using a user-defined function, Examples of simple user-defined functions, Comparison between script files and function files , Function functions, Sub-functions	4 hr
5	**Numerical Analysis:** Solving an equation with one variable, Finding a minimum or a maximum of a function, Numerical integration, Ordinary differential equations.	4 hr

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.224**	Credits hr				Units
Course Title	Material Eng. (II)					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	general chemistry	2	2	1	5	3

Course Description

Imperfection in solid. diffusion and atomic movement in solid. Solid solution and phase diagram for different alloys. Ceramic materials and composite materials.

Course Text

1-Donaled R. Askeland, The science and engineering of materials, international student edition, 2006 .
2-William D. Callister, Jr. , Materials science and engineering, Fifth edition, 2000.
3-Lawrence H. Vanvlack , Elements of materials science and engineering, Fifth edition, 1987.

Course Objectives : at the end of the semester the student should be able to :-

1. Describe the geometry of imperfections
2. Calculate the extent of diffusion- driving composition changes based upon composition, time and temperature.
3. Predict the equilibrium microstructure of a material given the binary phase diagram, thermal history of the materials.
4. Describe the types and properties of ceramic and composite materials.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Imperfections in solids:** Point defects, line defects, interfacial imperfections, Macroscopic defects	**6hr**
2	**Atomic and ion movements in materials:** Stability of atoms and ions, mechanisms for diffusion, rate of diffusion (Fick's first law), factors affecting diffusion, non-steady state diffusion (Fick's second law) .	**6hr**
3	**Solid solutions and phase diagrams:** Basic concepts, solubility and solid solution, phase and phase diagram, unary phase diagram, binary Iso-morphous system, binary eutectic system.	**6hr**
4	**The Iron-Carbon system:** The Iron-Iron carbide phase diagram, development of microstructures in Iron-carbon alloys	**6hr**

5	**Ceramic materials:** Crystal structure, mechanical properties of ceramic, classification of ceramic materials on the basis of its application	2hr
6	**Composites**: Material combination, Reinforced composites, structural composites.	4hr

Practical Material Eng. (II)

No.	Exp. Name.
1	**Tension test**
2	**Hardness Testing**
3	**Bending Test**
4	**Creep Test**
5	**Abrasion Test**
6	**Impact Test**
7	**Moisture Measurement in Engineering Materials**
8	**Determination of Linear Thermal Expansion for a Solid**
9	**Microstructure Examination of pb-Sn alloys using the metallurgical microscope**

Universityof Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering.*					
Course Code	**CES.E.238**	Credits hr				Units
Course Title	Fundamental of Environmental Engineering					
Term	2ndt Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physics for Environment.	2	0	0	2	2

Course Description

This course involves:

Define of environment pollution and pollutants, type of pollutants and the pollutants allowable limits in the environment. Source of water, Utilization, and definition of water and wastewater treatment. Classification of air pollutants, Sources and type of air pollution, Greenhouse effect and global warming, Acid rain. Air pollution control equipment: types of equipment, Classification of solid waste, source of solid waste and solid waste disposal. Hazardous waste, classification and waste minimization.

Course Text

1) C.S.Rao, "Environmental Pollution Control Engineering", 2ndEdition , New Age International(P) Limited, Published, 2006, Reprint 2007.
2) R. K. Sinnott, Chemical Engineering Design, Vol. 6. 4th edition, Chemical Engineering Design, 2005, pp. 450-457.
3) M.L.Davies and D.A.Cornwell "Introduction to Environmental Engineering", 4th Edition, 2009, ppublished by McGRAW.Hill companies, Inc., New York.

Course Objectives : at the end of the semester the student should be able to :-

1- Understand the concept of the environment and environmental pollution and global problems resultingfrom environmental pollution, such as global warming and the depletion of the ozone layer.
2- Provide the students with basic information about the air water pollution such as type of pollutants and their effects on the environment and control these pollutants. Also solid waste treatment and disposal
3- Provider information about the devices that are used in the control of air pollution
4- Provide information about the solid and hazardous-waste treatment and disposal.

Topics Covered **(Syllabus)/ Course Title**

No.	Contents	Duration
1	**Introduction:** Definition: Environment, Human and Environment, Environmental Engineering, Environment and ecology, Environmental pollution, Pollutant, Particulate, Environmental pollution of petroleum industry, Pollutants allowable limits in the environment	**2hr**
2	**Water Pollution:** Sources of water pollution, Utilization of water, Major water pollutants	**4hr**

3	**Wastewater Treatment:** Source of wastewater, Wastewater pollutants, Wastewater treatment: Primary secondary and advanced treatment, Sludge treatment and disposal. .	**4hr**
4	**Air Pollution :** Type of air pollutants (Gaseous and Particulates pollutants), Source of air pollution and its effect. Atmosphere: The earth's atmosphere and its important layers, Ozone layer formation and depletion, Greenhouse gases, Climate change and greenhouse effects, Acid rain, Air pollution Control Equipment and design.	**8hr**
5	**Air Pollution Control :** Control of particulate pollutants (Settling Chamber, Cyclone, Fabric filter, Electrostatic precipitator, Wet scrubbers) and Control of gaseous pollutants, Control of sulfur oxides	**6hr**
6	**Solid and Hazardous Waste :** Definition of solid and hazardous waste, classification of solid waste, Disposal methods, Pollution prevention and waste minimization.	**4hr**

Universityof Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.225**	Credits hr				Units
Course Title	Eng.Statistics					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I, Mathematics II	2	2	1	5	3

Course Description

Theory, applications, deferent methods calculation, sample descriptive statistics and graphical representation of data.

Course Text

1- Murry R. Spiegel, Statistics, Mc Grow-Hill international book company 1st addition.
2- Michael Sullivan III, Statistics informed decision using data 3rd addition, pearson education international 2010.
3- Jones' instrument technology.
4- Butterworth and co. (publishers) 2nd addition 1987.

Course Objectives: at the end of the semester the student should be able to :-

Use all the methods of statistical calculations to solve problems in chemical engineering and others applications.

Topics Covered (Syllabus)/Eng. Statistics

No.	Contents	Duration
1	Introduction: Statistics, population and sample descriptive and inductive statistics and graphical representation of datas	**2hr**
2	Frequency distribution table, raw data, arrays, types of frequencies.	**2hr**
3	Graphical representation of frequency distribution table..	**2hr**
4	Measures of central tendency.	**2hr**
5	Measures of dispersion	**2hr**
6	Curve fitting, Least squares method, Straight line forms, polynomial regression, variance and correlation coefficient.	**4hr**
7	Multiple and partial correlation: regression equation, normal equations for the least square regression, the coefficient for multiple correlation, relationship between multiple and partial correlation.	**4hr**
8	Probability distribution, continuous and discrete probability distribution, normal distribution.	**2hr**
9	The binomial distribution, the poisson probability distribution, approximation of standard distributions.	**2hr**
10	The chi-square test, confidence intervals, degree of significant, test of hypothesis, test for goodness of fit of probability distributions test of independence.	**4hr**
11	Companing three or more means (one-way analysis of variance (ANOVA), requirements of ANOVA test, ANOVA F-test, decision rule in ANOVA test.	**4hr**

Universityof Technology
Department of Chemical Engineering

PracticalEng. Statistics

No.	Contents
1	**The concept of statistical analysis, the important statistics to life, about the most important statistical programmes**
2	**Install Statistical ,About statistical analysis software, interfaces and quibbles**
3	**Working environment and Statistical data entry program**
4	**Using Statistica in statistical analysis with examples**
5	**Regression And Correlation (Curve Fitting)with Examples**
6	**How to finds With examples** **1- Find minimum and maximum and variance.** **2- Find standard deviation, mean, mode.** **3- Find second max frequency.** **4- Find max class mark and its frequency?** **5- Find max frequency.** **6- Find second class mark and its frequency.**
7	**Ways to validate the equation imposed with examples**
8	**Line (45) Method with examples**
9	**Correlation Coefficient Method with examples**
10	**Residual Plot Method with examples**
11	**Multiple Linear Regression liner model with examples**
12	**Multiple Linear Regression Non liner model with examples**

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.331**	Credits hr				Units
Course Title	Thermodynamics I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Material &Energy Balance, Physical Chemistry,Fluid Flow	2	2	1	5	3

Course Description

The course of chemical engineering thermodynamics I comprises the study of volumetric properties of pure fluids; Entropy and second law analysis of engineering systems; Thermodynamic properties of fluids; Applications of thermodynamics to flow processes.

Course Text

1- J. M. Smith,H.C.Van Ness, Introduction to chemical engineering thermodynamics, 6th edition (International Edition), Mc-Graw Hall, 2008.

Other support books :-

1-K.V.Narayanan, Atext book of chemical engineering thermodynamics, prentice Hall of India, New Delhi, 2011.

2- B.G.Kyle, Chemical and process thermodynamics ,(3rd Edition), prentice Hall Inc.New Jersey, 1984.

3-J. Rayner, Basic engineering thermodynamics inSI units, printed in great Britain,1971

Course Objectives : at the end of the semester the student should be able to :-

1- To familiarize the students with basic concepts of the first and second laws of thermodynamics and their applications in engineering problems.

2- Develop a practical ability to solve energy balance problems , minimum work.

3-Students will demonstrate basic understanding of basics and definitions of thermodynamics and properties of pure substances.

4-Describe the reversible and irreversible processes (macroscopic description of an ideal and real processes).

Universityof Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Volumetric properties of pure fluids** Review on virile equation of state, cubic equation of state, generalized correlations for gases and for liquids.	**6 hr**
2	**The 2nd law of thermodynamics** Review on the 2nd law and Carnot heat engine, entropy balance for open system, calculation of ideal work, lost work.	**9 hr**
3	**Thermodynamic properties of fluids** Review on the property relations ($\Delta H, \Delta S, \Delta U and \Delta G$) residual properties, two phase systems, thermodynamic diagrams and tables, generalized property correlations for gases.	**6 hr**
4	**Applications of thermodynamics to flow processes** Duct flow of compressible fluids, pipe flow, nozzles, throttling process, turbines, compression processes compressors, ejectors.	**9 hr**

Practical Thermodynamics I

No.	Exp. Name.
1	Measurement of the solar irradiation
2	Alternating current solar installation
3	Refrigeration
4	Hydrolysis of methyl acetate
5	Pressure and Temperature relationship for steam
6	Liquid -vapor equilibrium Isotropic Mixtures
7	Boyles' law
8	Regulating and charging battery
9	Measurement of the solar irradiation

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.**321	Credits hr				Units
Course Title	Numerical Analysis					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Computer Programming II , III	2	2	1	5	3

Course Description

This course introduces students to: Error analysis; Finding roots of a non-linear function; Approximation and interpolation; Numerical integration and differentiation; direct and indirect solution of systems of linear equations; Solution of systems of nonlinear equation; solving ordinary differential equations and partial differential equations. All examples within the course concerning with principles of chemical engineering.

Course Text

1- "Numerical Methods for Engineers", Steven C. Chapra, Raymond P. Canale, McGraw Hill, 6th edition, 2010.
2- "Numerical Methods for Engineers and Scientists", Joe Hoffman, McGraw-Hill Book Company,1993.
3- "Applied Numerical Analysis", Gerald,C.F. and Wheatley, P.O., 6th Edition, Pearson Education, 2006.
4- "Numerical Methods for Chemical Engineers with MATLAB Applications", Alkis Constantinides, Navid Mostoufi, Prentice Hall, 1999.

Course Objectives: at the end of the semester the student should be able to:-

To solve chemical engineering problems with numerical analysis techniques.

Topics Covered (Syllabus)/Numerical Analysis

No.	Contents	Duration
1	**Introduction to Numerical Analysis:** Numerical Solution, type of errors; relative error, absolute error, percentage error, truncation error, round off error. Floating point.	2hr
2	**Root Finding:** Roots of polynomials, Bisection method, Secant method, Newton-Raphson method.	4hr
3	**Interpolation and Polynomials Approximation:** Lagrangian Polynomials, Divided differences, Cubic spline interpolating polynomials, Newton's forward and backward difference formulas.	4hr
4	**Numerical Differentiation and Numerical Integration:** Forward, backward and central difference approximation. Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules. Double integrals using trapezoidal and Simpson's rules.	6hr

5	**Solving System of Equations:** Solution of linear system of equations by direct methods (Gaussian elimination and Gauss-Jordon). Solution of linear system of equations by Iterative methods (Jacobi and Gauss-Seidel). Solution of non-linear system of equations by Newton-raphson.	4hr
6	**Solution of ordinary Differential Equations:** Initial value problems. Solution of first-order ordinary differential equations using Taylor', Eular, Runge-Kutta and Predictor-corrector methods. Solution of simultaneous ordinary differential equations.	4hr
7	**Solution of Partial Differential Equations:** Types of Partial Differential Equations: Elliptic (Poisson) equation, Parabolic (heat) equation, Hyperbolic (wave) equation. Finite difference solution of Partial Differential Equations. Numerical solution of partial differential equations using explicit, implicit and Crank-Nicolson methods elliptic (Laplace) equation.	6hr

Practical Numerical Analysis

No.	Contents
1	**Review of properties of Matlab programming language.**
2	**Bisection method and Secant method.**
3	**Newton-raphson method.**
4	**Lagrange interpolation.**
5	**Newton's forward and backward difference formulas.**
6	**Trapezoidal rule.**
7	**Simpson's 1/3 and 3/8 rules.**
8	**Solution of linear system of equations by direct methods (Gaussian elimination and Gauss-Jordon).**
9	**Solution of linear system of equations by Iterative methods (Gauss-Seidel and Jacobi).**
10	**Solution of differential equation using Euler's method.**
11	**Solution of differential equation using Runge-Kutta method.**
12	**Solution of partial differential equations using explicit and implicit methods.**
13	**Solution of partial differential equations using Crank-Nicolson method.**
14	**Solution of steady state diffusion through catalyst**
15	**Solution of un-steady state diffusion through catalyst**

Universityof Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.333**	Credits hr				Units
Course Title	Mass Transfer					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemical engineering principles, thermodynamics, fluid flow	2	2	1	5	3

Course Description

This course covers diffusion and mass transfer in binary& multi-components, molecular diffusion in fluids, convective mass transfer, mass transfer coefficients, mass transfer correlations, interphase mass transfer, mass transfer theories.

Course Text

1- Coulson, J. M & Richardson J. F. (2006). “Chemical engineering, Volume 1”, 3rd Edition, Robert Maxwell. M. C.
2- Dutta Binary K. (2007), “Principles of Mass Transfer & Separation Process”, Bvt. Ltd. Prentice Hall, ISPN 8-1203-2990-2.

Other support books:-

1- Treybal Robert E. (1975), “Mass transfer Operation” 2ed Edition, Mc-Graw-Hill Book.
2- McCabe, W., Smith, J., Harriott, P. (2004), “Unit Operations of Chemical Engineering”, Mc-Graw-Hill Co., 7th Edition, ISBN0072848235.

Course Objectives: at the end of the semester the student should be able to:-

1- Understand the basics of diffusion as applicable to mass transfer phenomena.
2- Estimate Molar fluxes in convective and inter phase mass transfer.
3- Explain the concept of diffusion theories.
4- Applying the convective mass transfer correlations to calculate mass transfer rates in many units operation.

Topics Covered (Syllabus)/ Mass transfer

No.	Contents	Duration
1	**Introduction** Fundamentals of mass transfer processes, concentrations, velocities, mass & molar fluxes.	**2 hrs**

2	**Diffusion in binary gaseous** Fick's first law of diffusion. Diffusion in gas mixtures, Equimolecular diffusion, diffusion in stationary layer. Correlations to calculate diffusivity, correcting diffusivity	6 hrs
3	**Diffusion in multi component mixtures** Multi-component gas phase systems, effective diffusivity. Maxwell's law of diffusion	4 hrs
4	Diffusion in liquids.	2 hrs
5	Diffusion in solids.	2 hrs
6	**Diffusion theories** Diffusion across phase boundary, Film theory, two film theory, Mass transfer coefficients (individual & overall) in laminar and turbulent flow.	4 hrs
7	**Diffusion resistances** Calculating the resistance to mass transfer in both phases. Calculating intermediate concentrations.	4 hrs
8	**Unsteady state mass transfer** Introduction to unsteady state mass transfer, mass transfer accompanied by a chemical reaction.	6 hrs

Practical Mass Transfer

No.	Experiment Name
1	**Liquid-Liquid diffusion**
2	**Absorption**
3	**Batch Distillation Column**
4	**Fluid Mechanics of Packed Bed**
5	**Sieve Analysis**
6	**Gas Solid Fluidization**

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.335**	Credits hr				Units
Course Title	Chemical reaction kinetics					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Physical chemistry	2	-	-	2	2

Course Description

Theory,Kinetic parameters and rate law, multiple reactions, yield and selectivity, stoichiometric considerationsand collection and analysis of rate data
.

Course Text

1-Octave Levenspiel (1999),*CHEMICAL REACTOR ENGINEERING*, 3rd edition, John Wiley & Sons Inc., USA ISBN: 9780471254249.

2-J.M. Smith (1987), *CHEMICAL ENGINEERING KINETICS*, 3rd edition, McGraw-Hill International Editions, Singapore. ISBN: 9780070587106

Other support books :-

1-Ronald W. Missen; Charles A. Mims; Bradley A. Saville (1999), *INTRODUCTION TO CHEMICAL REACTION ENGINEERING AND KINETICS*,1stedition, John Wiley & Sons Inc.,USA.

Course Objectives : at the end of the semester the student should be able to :-

This course aims to establish fundamental knowledge for the students in chemical reaction kinetics. At the end of this course, students should be able to:

(i) interpret and analyse chemical reaction kinetics data.
(ii) apply reaction kinetics principles in chemical reaction.
(iii) identify and formulate problems in chemical reaction kinetics and find appropriate solutions**.**

Universityof Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Kinetic parameters and rate law** L1: Definition in terms of reacting compounds and reaction extent; irreversible and reversible reactions, homogeneous catalyticreactions L2: Symbols and relationships between concentration and conversion L3: Introduction to rate laws, stoichiometry. L4: Reaction order and elementary reactions. L5: Reaction rate constants, Arrhenius equation, Van't Hoff equation L6: Temperature and pressure effects on reaction rates. L7: Thermal effects due to heat of reaction.	10hr
2	**Multiple reactions, yield and selectivity** L8: Types of multiple reactions. L9: Definitions of yield and selectivity. L10: Analysis of parallel, series, consecutive reactions. L11: Effect of pressure and temperature on multiple reactions L12: The Denbigh reaction and its special cases	10hr
3	**Stoichiometric considerations** L13: Stoichiometric considerations in batch systems (constant and variable density). L14: Stoichiometric considerations in flow systems (constant and variable density). L15: Examples: batch, semi-batch reactors, flow reactors, and Industrial reactors.	6hr
4	**Collection and Analysis of rate data** L16: Differential and integral methods. L17: Initial rate and half-life methods.	4hr

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*				
Course Code	**CES.E.337**	Credits hr				Units
Course Title	Heat transfer I					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Fluid flow &Math	2	0	1	3	2

Course Description

To introduce and develop an understanding the modes of heat Transfer (conduction, convection and radiation).Derive and discusses all types of equation in these modes of heat transfer. Analyze heat transfer rate data in different modes. Derive the necessary equations for hydrodynamics and thermal boundary layer. Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

Course Text

1- J.P.Holman, Heat Transfer, Ninth edition.
2- Frank P. Incropera & David P. Dewitt, Fundamentals of Heat and Mass Transfer, Fifth Edition.

Other support books :-

- Coulson ,J.M and Richardson J.F. "Chemical Engineering , volume 1",3rd edition.

Course Objectives: at the end of the semester the student should be able to:-

1. Develop a deep understanding of issues related to the heat and energy balance for different chemical process
2. Define and solve problems in heat transfer mechanism in various engineering applications.
3. Explain and derive heat equations for the conduction and convection heat transfer.
4. Apply the analytical equations and correlations in convection heat transfer problems.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Modes of Heat Transfer** Conduction, Convection and Radiation**.**	**4 hrs**
2	**Steady State Heat Conduction in One Dimension** General heat conduction equation in different coordinates, Plane wall, Radial systems, heat source systems, Boundary surrounded by fluids, Overall heat transfer coefficient, Conduction convection systems and fins.	**10 hrs**
3	**Unsteady State Heat Transfer** Temperature as a function of time, lumped capacity system, quenching of small bodies and heating of tank.	**4 hrs**
3	**Principles of Convection** Transport equations, Fluid mechanism aspect of convection, laminar boundary layer, The turbulent portion of boundary layer, The laminar sub-layer. Thermal boundary layer, Empirical and practical relations for pipe and tube flow and flow normal to single and tube banks. Reynolds analogy.	**12 hrs**

University of Technology
Department of Chemical Engineering

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code-	**CES.E.339**	Credits hr				Units
Title	Air Pollution Control Engineering					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	General Chemistry, Fundamental of Environmental Eng.	2	-	-	2	2

Course Description

Introduction to sources of air pollution, basic meteorological processes, air quality modeling. Technology for air pollution control (Equipment of unit operation). Understanding of air pollution control and health problems, risk assessment, and global atmospheric changes.

Course Text

Textbook:-
K. Wark, C.F. Warner & W.T. Davis,"Air Pollution Control: its Origin and Control. Addition-Wesley, (1998)
Other support books :-
1. De Vevers, N., "Air Pollution Control Engineering", MC, Graw-Hill, Inc. (200)
2. D. Vallero, "A fundamental of Air Pollution "Amesterdam, 4th edition, (2008).
3. L. Theodore, " Air Pollution Control Equipment Calculation" Willy, (228).

Course Objectives : at the end of the semester the student should be able to :-

1- To apply your knowledge of mathematic engineering, science and unit operation to identify and to solve air pollution problems.
2- To describe effect of air pollution on environment and dispersion..
3- To present group project report in the class in order to develop communication skills.

Topics Covered (Syllabus)

No.	Contents	Duration
1	**Introduction** Air pollution definition, Effect on human beings and environmental, Classification of air p0ollutants, Sources of air pollutants, Particulate, Air born particulate, The atmosphere, Atmosphere structure, greenhouse gases.	**2hr**
2	**Regional and Global Issue** Global warming and greenhouse effects, Stratospheric Ozone layer depletion. Hazardous, Hazardous air pollution, Urban smog, Acid rain.	**2hr**

3	**Meteorological Factors Influencing Dispersion of Air Pollutants** Introduction, wind direction and speed, Atmospheric stability, Dry adiabatic lapse rates, Temperature inversion. Plume behavior, The Gaussian plume model, Estimation of plume rise. Stack height.	**6hr**
4	**Particulate Control Methods and Equipment** Collection efficiency, Mechanisms to remove particulates from gas stream, Gravitational settling chamber, Centrifugal separators (cyclone separators). Wet scrubbers, Fabric filters, Electrostatic precipitators, Selection of particulate collector.	**8hr**
5	**Control of Gaseous Emission** Mechanisms to remove gaseous contamination from gas stream, Absorption by liquids, Adsorption by solids, Combustion.	**8hr**
6	**Control of Specific Gaseous Pollutants** Control of sulfur dioxide emission, Control of nitrogen oxide, Control of carbon monoxide, Mobile source.	**4hr**

University of Technology

Department of Chemical Engineering

<table>
<tr><td>Program</td><td colspan="6">Industrial and Petroleum Pollution Engineering</td></tr>
<tr><td>Course Code</td><td>CES.E.3311</td><td colspan="4" rowspan="2">Credits hr</td><td rowspan="3">Units</td></tr>
<tr><td>Course Title</td><td>Industrial Safety</td></tr>
<tr><td>Term</td><td>1st semester</td><td>Theoretical</td><td>Practical</td><td>Tutorial</td><td>Total</td></tr>
<tr><td>Prerequisite(s)</td><td>Chemistry, equipment design, Fluid flow</td><td>2</td><td>-</td><td>-</td><td>2</td><td>2</td></tr>
</table>

Course Description

.Introduction to industrial safety, Risk Assessment & Hazard IdentificationFire and explosion, Toxicology, Leaks and leakage , Safety in process design

Course Text

1- Crowl D.A. and Louvar J.F., “Chemical Process Safety: Fundamentals with Applications”, 2nd Ed., Prentice Hall.2001.
2. Fawcett, H..and Wood, “Safety and Accident Prevention in Chemical Operations” Wiley inters, Second Edition.
3. David B., “Engineering Safety”, McGraw-Hill UK, Copyright 1992.

Course Objectives : at the end of the semester the student should be able to :-

1. The course attainted to give the student the knowledge about the risk of chemical processes
2. The student be capable to use safety policy to eliminate accidents

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction to industrial safety** Important of industrial safety, History and development of safety movement, Need for safety, Safety legislation: Acts and rules, Safety standards and codes, Safety policy: safety organization and responsibilities and authorities of different levels.Accident sequence theory, Causes of accidents, Accident prevention and control techniques, Plant.	**6hr**
2	**Risk Assessment & Hazard Identification** Risk definition, Risk analysis, Major hazard control, Identification of hazard, Categorization methods for elimination of hazard, Mechanical hazards, machine guarding, Pressure vessel hazards and their control, Safety in material handling: hazards and safe Practices, safety with storage of materials, Electrical hazards: classification, safe work practices, Chemical hazards: laboratory safety, bulk handling of chemicals,	**4hr**

3	**Fire and explosion** Introduction-Industrial processes and hazards potential, mechanical electrical, thermal and process hazards. Safety and hazards regulations, Industrial hygiene. Shock wave propagation, vapour cloud and boiling liquid expanding vapours explosion , mechanical and chemical explosion, multiphase reactions, transport effects and global rates. Fire and explosion hazards, Fire detection, Prevention ,control, and extinguishments, Industrial layout, Industrial waste management.	6hr
4	**Toxicology** Hazards identification-toxicity, fire, static electricity, noise and dust concentration; Material safety data sheet, hazards indices- Dow and Mond indices, hazard operability (HAZOP) and hazard analysis (HAZAN).	4hr
5	**Leaks and leakage** Spill and leakage of liquids, vapors, gases and their mixture from storage tanks and equipment; Estimation of leakage/spill rate through hole, pipes and vessel burst; Isothermal and adiabatic flows of gases, spillage and leakage of flashing liquids, pool evaporation and boiling; Release of toxics and dispersion.	4hr
6	**Safety in process design and pressure system design** Design process, conceptual design and detail design, assessment, inherently safer design chemical reactor, types, batch reactors, reaction hazard evaluation, assessment, reactor safety, operating conditions, unit operations and equipments, utilities. Pressure system, pressure vessel design, standards and codes- pipe works and valves- heat exchangers- process machinery- over pressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations, disposal- flare and vent systems failures in pressure system.	6hr

Program	*Industrial and Petroleum Pollution Engineering*					
Course Code	**CES.E.3313**	Credits hr				Units
Course Title	Equipment Design					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Basic Principles of chemical ,fluid flow,	2	---	1	3	2

Course Description

.The course content process planning, piping and pumps network , gas-gad separation ,solid handling, hear and mass transfer equipments

Course Text

.Sinnott R. and Towler C; 2013 " chemical Engineering Design" 5th edition Butterworth-Heinemann
Coke,A.K ;2007"Ludwig s Applied Process Design of Chemical and petrochemical Plant" vol. 1 4th edition Gulf professional Publisher

Course Objectives : at the end of the semester the student should be able to :-

The ability to apply the design equation and equipments specifications as practical

To prepare students to be able to read and understand chemical engineering plants drawing

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Process planning:** Introduction, Nature of design ,the organization of a chemical engineering projects Scheduling .Standards and codes. Flow sheet design, flow sheet types and designation .Block diagram .Process flow sheet .Piping and instrumentation diagram .Utilities, Computer aided drafting ,process simulation programs .Layout and plot plan .Project evaluation and cost estimation	**6hr**
2	**Piping network and Pumps** Valves selection . Piping design standards and codes . Pipe size selection .Mechanical design of piping system. Pump type, pump specifications, and pump data sheet	**4hr**

3	**Vessels and tanks** Types of vessels. Criteria in vessel design ,stress considerations . Materials of construction commonly used in vessels tanks. Design of tall vertical vessels . Pressure vessels Design. Vessels supports and foundations	**4hr**
4	**Solid Handling** Screening Classification with Streams of Air or Water Air Classifiers . Size Reduction. Equipment for Size Reduction Particle Size Enlargement Extrusion Processes	**4hr**
	Heat Transfer Equipments Heat exchanger types and applications. Basic design procedure and theory. Overall heat transfer coefficient. Heat exchanger data sheet. Furnaces convection and radiation zone. Steam boilers	**6hr**
	Mass Transfer Equipments Columns types . Plate Types. Packing types . Pressure drops in columns . Column data sheets	**6hr**

University of Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.332**	Credits hr				Units
Course Title	Thermodynamics II					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mass Transfer, Unit Operation I, Equipment Design	2	-	1	3	2

Course Description

The course discuss the study of Power cycles; Refrigeration and liquefaction process; Theory and application of solution thermodynamics ;Vapor/liquid equilibrium in both: binary and multi-components; Ideal and non-ideal solutions are discussed using Raoult's and modified Raoult's law; Fugacity and fugacity coefficient definitions; Chemical reaction equilibriumandThermodynamic analysis of processes.

Course Text

1- J. M.Smith,H.C.Van Ness, Introduction to chemical engineering thermodynamics, 6th edition (International Edition), Mc-Graw Hall, 2008.

Other support books :-

1-K.V.Narayanan, Atext book of chemical engineering thermodynamics, prentice Hall of India, New Delhi, 2011.

2- B.G.Kyle, Chemical and process thermodynamics ,(3rd Edition), prentice Hall Inc.New Jersey, 1984.

3-J. Rayner, Basic engineering thermodynamicsinSI units, printed in great Britain,1971.

Course Objectives : at the end of the semester the student should be able to :-

6- Apply the laws of thermodynamics to power, refrigeration and liquefaction cycle.
7- Establish thermodynamic constraint that apply to VLE, and explain qualitatively the VLE diagram.
3. Apply thermodynamics to VLE of pure components and solutions in terms of fugacity and fugacity coefficients.
4. Apply equilibrium criteria to chemical reactions and evaluate the effect of temperature.
5. Revision for thermodynamic analysis of processes.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Production of power from heat** The steam power plant, Rankin cycle, the regenerative cycle, internal combustion engines Otto engine, diesel engine, gas turbine engine.	4 hr
2	**Refrigeration and liquefaction** The Carnot refrigerator, the vapor compression cycle, the choice of refrigerant, absorption refrigeration, the heat pump, liquefaction processes.	6 hr
3	**Vapor\liquid equilibrium; introduction** The nature of equilibrium, the phase rule, Duhem,s theorem, diagrams for vapor liquid equilibrium, simple models for VL equilibrium: Rault,s law, dew point and bubble point calculations, Henrys law, VLE by modified Raults law, VLE from K value correlations, flash calculations.	9 hr
4	**Solution thermodynamics: theory** Fundamental property relations, the chemical potential and phase equilibrium, ideal gas mixtures, fugacity and fugacity coefficient, the fundamental residual property relations, the ideal solutions.	2 hr
5	**Chemical Reaction equilibrium** The reaction coordinate, standard Gibbs energy change and equilibrium constant, effect of temperature on equilibrium constant, evaluation of equilibrium constant, liquid phase reactions, equilibrium conversion for single reactions.	6 hr
6	**Thermodynamic analysis of processes** Second law relation for steady state flow processes, calculation of ideal work, thermodynamic analysis of steady state flow processes.	3 hr

University of Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.322**	Credits hr				Units
Course Title	Applied Mathematicsin Environmental Engineering					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I, II	2	-	1	3	2

Course Description

This course introduces students to: Solve ordinary differential equations: apply Laplace transform to solve various systems of ordinary differential equations: Solve different types of partial differential equations. At the end of the course students should be able to apply these methods to tackle all kinds of problems that appear in chemical engineering.

Course Text

1- “Mathematical Methods in Chemical Engineering”, Jenson. V.J. and Jeffereys, G.V, 2nd Edition, Academic Press New York, 1977.
2- “Applied Mathematics and Modeling for Chemical Engineers”,Rice R G. and. Do, D. D., John Wiley and Sons, New York, 1995.
3- “Applied Mathematical Methods for Chemical Engineers”,Loney, Norman W., 2^{nd} edition, CRC Press – Taylor & Francis Group, Boca Raton, 2007.

Course Objectives: at the end of the semester the student should be able to:-

Apply different analytical methods to solve chemical engineering problems.

Topics Covered (Syllabus)/Applied Mathematics in Environmental Engineering

No.	Contents	Duration
1	**Ordinary Differential Equations** First-order differential equations, Linear and nonlinear first-order equations, Formation of differential equations, Solutions of linear differential equations, Initial and Boundary value problems, Separable first-order ode’s, Exact differential equations, Differential operator, Integrating factors, Solutions of second order linear homogenous equations, Coupled first order equations, Method of reduction of higher order differential equations, Solutions of higher order homogenous linear equations. Chemical engineering applications: Application of the law of conservation of mass, First-order chemical reaction in a batch reactor, Heating a closed	**10 hr**

	kettle, Cooling of a hot object, Dilution of a salt solution in a stirred tank, Consecutive reaction system in a batch reactor, Radial heat transfer through a cylindrical conductor, Reaction in a spherical and cylindrical catalyst, Flow of heat from fin. Simultaneous diffusion and chemical reaction in a tubular reactor, Solvent extraction in N stages.	
2	**Laplace transform**: Laplace transforms, Laplace transform of the derivatives, Laplace transform of Integral, Laplace Transform of t.f (t) (multiplication by t), Properties of Laplace transform, Laplace transform of special functions (step, pulse, Impulse, ramp and periodic functions), Convolution theorem, Initial value problems (multiplication by s), Final value problems (division of s), First shifting properties, second shifting properties, Inverse of Laplace transform, Inverse Laplace transform of derivatives, Inverse Laplace Transform of Integrals, Partial Fraction, Solution of differential equations, Solution of simultaneous ordinary differential equations, Application of Laplace transform to solve chemical engineering problems.	**10 hr**
3	**Partial differential equations** Classification of partial differential equations, Formulation of partial differential equations, Continuity equation, Unsteady-state component mass transfer with axial symmetry, Unsteady-state heat conduction with axial symmetry, Boundary conditions, Solution of partial differential equation by direct Integration, General and particular solutions, superposition of solutions, Complementary solution, Particular solution, Solution using separation of variables method, Solution using Laplace transforms method, Solution using combination of variables method. Chemical engineering applications: i. Heat conduction in a semi-infinite slab. ii. Unsteady conduction/diffusion in one dimension. iii. Steady-state heat conduction in two-dimensions.	**10 hr**

University of Technology
Department of Chemical Engineering

Program	***Industrial & Petroleum Pollution Engineering***					
Course Code	**CES.E.334**	Credits hr				Units
Course Title	Unit Operations I					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mass transfer	2	0	1	3	2

Course Description

This course covers two main operations, gas absorption, stripping and distillation for binary and multi component mixtures. Concepts to design mass transfer equipment.

Course Text

- Coulson, J. M & Richardson J. F. (2006). "Chemical engineering", Volume 2, 3^{rd} Edition, Robert Maxwell. M. C.
- Dutta Binary K. (2007), "Principles of Mass Transfer & Separation Process", Bvt. Ltd. Prentice Hall, ISPN 8-1203-2990-2.

Other support books:-

- Treybal Robert E. (1975), "Mass transfer Operation" 2^{nd} Edition, Mc-Graw-Hill Book.
- McCabe, W., Smith, J., Harriott, P. (2004), "Unit Operations of Chemical Engineering", Mc Graw-Hill Co., 7^{th} Edition, ISBN0072848235.

Course Objectives: at the end of the semester the student should be able to:-

1- Understand the basics of gas absorption, stripping and distillation.

2- Design absorbers, strippers and distillation columns.

3- Find Operating lines, feed line and No. of trays or amounts of packing required.

4- Calculate columns efficiency.

Universityof Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Unit Operation I

No.	Contents	Duration
1	**Introduction to separation processes** General separation techniques. The mechanism of absorption and stripping processes. Flow regimes.	4 hrs
2	**Absorption in packed bed columns** Constructions, mass transfer coefficients & specific area, capacity, height of columns based on gas film, liquid film, and based on overall conditions, operating line, the transfer units, the importance of gas and liquid flow rates.	4 hrs
3	**Absorption in Tray towers** Types of trays, number of trays analytically and graphically. How to calculate the tray and column efficiency.	4 hrs
4	**Introduction to distillation process** Partial pressure, Dalton's, Raoult's & Henry's laws. Relative volatility, non ideal systems. Method of diffusion, binary mixtures, batch distillation, flash distillation, steam distillation. Fractionating column.	3 hrs
5	**Fractionating process** Number of plates required importance of reflux ratio, location of feed point, multiple feeds and side streams.	3 hrs
6	**Multi-component Distillation** Key components. Components distributions, equilibrium data, feed & product compositions, minimum reflux ratio, calculation number of trays required, relation between reflux ratio & number of plates.	4 hrs
7	**Plate & packed distillation columns** General designed methods, column efficiency	4 hrs
8	**Reynolds Analogy** Mass transfer with bulk flow, flow over a plane surface, flow in a pipe.	4 hrs

Universityof Technology
Department of Chemical Engineering

Program	***Industrial & Petroleum Pollution Engineering***					
Course Code	**CES.E.336**	Credits hr				Units
Course Title	BioChemical Reaction Eng.					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemical Reaction Kinitics	2	-	-	-	2

Course Description

To introduce and develop an understanding of reaction rate kinetics and apply this understanding to design a Fermenter(Batch, CSTR,PFR ,) for a certain duty either single or multiple once.

Course Text

4- Octave Levenspiel (1999),*CHEMICAL REACTOR ENGINEERING*, 3rd edition, John Wiley & Sons Inc., USA ISBN: 9780471254249.

Other support books :-

1- Smith, J. Chemical Engineering Kinetics. 3rd ed. New York, NY: McGraw-Hill, 1981. ISBN: 9780070587106
2- H. S. Fogler, Elements of Chemical Reaction Engineering, 4th Ed (2006), Prentice Hall,NewYorK.

Course Objectives : at the end of the semester the student should be able to :-

This course aims to establish fundamental knowledge for the students in biochemical reactor engineering. At the end of this course, students should be able to:
(i) Develop a deep understanding of issues related to the reaction step(s) in a chemical process and important role it plays in the success of the process both economically and environmentally.

(ii) Apply quantitative methods to Specify and size reactors for simple chemical reaction schemes (isothermal, non-isothermal and adiabatic operation) to achieve production goals for processes involving homogeneous or heterogeneous reaction systems.
(iii)Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction :** The reaction rate and reaction mechanisms: Definition in terms of reacting compounds and reaction extent; rate laws, Arrhenius equation, elementary, reversible, non-elementary, catalytic reactions.Reaction mechanisms and rate laws: Reactive intermediates and steady state approximation in reaction mechanisms. Rate-limiting step.Chainreactions.Pyrolysis reactions. Reaction stoichiometry, lumped stoichiometries in complex systems such as bioconversions and cell growth (yields); extent of reaction, independence of reactions, measures of concentration. Single reactions and reaction networks, bioreaction pathways.	6hr
2	Enzyme Fermentation: MICHAELIS-MENTEN KINETICS (M-M KINETICS), Batch or Plug Flow Fermenter, Mixed Flow Fermenter, INHIBITION BY A FOREIGN SUBSTANCE-COMPETITIVE AND NONCOMPETITIVE INHIBITIO	6hr
3	**Isothermal reactors for homogeneous reactions:** Design procedure: Batch reactor (constant volume and constant pressure) Design procedure: Continuous stirred-tank reactors (Single and multiple reactions) Design procedure: Tubular-flow reactors Comparison of stirred-tank and tubular-flow reactors.	6hr
4	**Non-isothermal reactors:** L11: Energy conservation equations L12: Batch stirred-tank reactors L13: Continuous stirred-tank reactors	6hr
5	**Multiple reactor System:** L14: Plug flow reactors in series and/or parallel L15: Equal- size mixed flow reactors in series (first order and second order reactions) L16: Mixed Flow Reactors of different sizes in series. L17: Best arrangement of a set of ideal reactors	6hr

University of Technology
Department of Chemical Engineering

Program	*Industrial & Petroleum Pollution Engineering*					
Course Code	**CES.E.338**	Credits hr				Units
Course Title	Heat transfer II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Heat transfer I	2	2	1	5	3

Course Description

Characterization the design procedures for different heat transfer equipments as heat exchanger. Discuss the heat transfer in boiling and condensation processes .Characterization the design procedures for furnace. Give a new knowledge in renewable energy systems. Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

Course Text

1- J.P.Holman ,Heat Transfer, Ninth edition.
2- Frank P. Incropera & David P. Dewitt, Fundamentals of Heat and Mass Transfer, Fifth Edition.

Other support books :-

- Coulson, J.M. , Richardson, J.F., Backhurst, J.R.and Harker, J.H., “Chemical Engineering” Volume(1) 6th Edition.

Course Objectives: at the end of the semester the student should be able to:-

1. Design heat exchanger equipments.
2. Define and solve problems in boiling and condensation heat transfer.
3. Design the furnace and understand the radiation heat transfer.
4. Solve problems in heat transfer applications.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Heat Exchangers** Various types and their general characteristics, Overall heat transfer coefficient, fouling factor, Heat exchangers mean temperature differences and Co-current and counter current flow.	**10 hrs**
2	**Shell and Tube Exchanger** Types and various specifications, design calculations by conventional and by effectiveness (NTU) methods and optimum design calculation.	**6 hrs**
3	**Condensation and Boiling Heat Transfer** Condensation of single vapors, Laminar film condensation Design calculations for condenser, Pool and flow boiling, Boiling regime, General aspects, Boiling correlations.	**6 hrs**
4	**Radiation and Furnace design** Radiation properties, shape factor, heat exchange for non black bodies, parallel planes, shields, gas tradition.	**4 hrs**
5	**Renewable Energy** Solar radiation, Solar water heater, Solar air heaters, Heat exchangers for ocean thermal energy, Heat storage and transmits.	**4 hrs**

Practical: Heat Transfer II

No.	Experiment Name
1	**Conductive Heat Transfer in Steady State.**
2	**Coil Heat Exchanger.**
3	**Determination of Overall Heat Transfer Coefficient on Air Velocity**
4	**Performance of Cooling Tower**
5	**Graphite Heat Exchanger**
6	**Extended Surface Heat Transfer**

University of Technology
Department of Chemical Engineering

Program	*Industrial & Petroleum Pollution Engineering*					
Course Code	**CES.E.3310**	Credits hr				Units
Course Title	Solid WasteTreatment					
Term	2^{nd} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Fundamental of Env. Engineering	2	-	--	2	2

Course Description

Solid wastes arising from all kind of industrial and human activities, their impacts on human health and environment, their classification and handling, as well as international concerns on solid wastes will be elaborated.

Course Text

Srinivasan D ; Environmental Engineering " PHI learning 2012
Ramachaudra T V " Management of Municipal Solid Waste ' Commonwealth of learning Canada 2006 .

Course Objectives : at the end of the semester the student should be able to :-

1. Under stands waste classification that involve students in the management and treatment of waste for disposal ,take in consider the environmental and human health risks.
2. .Provide steps for effective new applications technology to reduce waste disposal

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Solid Waste Generation and resources** Definition ,composition ,and classification of solid waste .The physical chemical and biological properties of solid waste	6hr
2	**Treatment and Disposal of SolidWastes from Industry**	6hr
3	**Source Reduction Product Recovery and Recycling** Basic source reduction .significance of recycling ,planning of recycling program, commonly recycled materials and processing	4hr
4	**Land filling with solid waste design and operation**	4hr
5	**Incineration and Energy Recovery** Planning of Incineration facility, Incineration technology, energy recovery	8hr
6	**Hazardous waste characterization and treatment** Identification and classification ,hazardous waste treatment ,pollution presentation and waste minimization	٢hr

Program	*Industrial & Petroleum Pollution Engineering*					
Course Code	**CES.E.**3312	Credits hr				Units
Course Title	Environmental instrumentation& Analysis					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	**Fundamental of Env. Engineering**	2	2	-	4	3

Course Description

Brief introduction to the treatment of analytical data, spectroscopic methods , chromatography methods , Electro and radio analytical method, continuum monitoring instruments .

Course Text

1-Willard, H, Merritt, L, Dean, D.A. and Settle, F.A, "instrumental method of analysis" 7th ed. worlds, 2004
2-Ewin, "instrumental method of analysis" 5th ed Me Craw-Hill 1995.
3-Randy D.Down, Jay H. Lehr, "Environmental instrumentation and analysis Handbook" ,John Willy and Sene ,Inc.2005

Course Objectives: at the end of the semester the student should be able to :-

1- To find out accuracy the nearness of a measurement to the standard or true value, noise /signal. To understand the measurement methods of physical, chemical and biological of water.
2- To provide an understanding of monitoring instrument which analyze gases like CO2,NOX,SOX.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Brief introduction to treatment of analysis data** Instrumental methods, Precision and accuracy ,errors in measuring signals ,noise/signal, baseline drifty industrial tubes	2hr
2	**Spectroscopic methods** Electromagne ticradiation,color imetricand electrometric,fluorimeter,nephelometry and Turbidimetry,flame photometry , atomic absorption spectrometry (AAS) ,Mass spectrometry (MS).	8hr
3	**Chromatography methods** Classical methods , column, paper and thin layer chromatography (TLC) gas chromatography (GC),GC- MS ,high performance liquid chromatography (HPLC) , ion chromatography (IC).	8hr
4	**Electro and radio analytical methods.**	6hr
5	**Continuum monitoring instruments** Non –dispersive infra-red (NDIR) Analyzer for CO2, Chemiluminescent analyzer for NOx , fluorescent analyzer for SOX.	6hr

Laboratoryof Experiments

No.	Experiment Name
1	Determination of a mixture of heavy metals such as cobalt and nickel(UV/V is Spec.)
2	IR absorption spectra(study of aldehydes and ketones).
3	Determination of calcium,Iron and copper in for example food by atomic absorption.
4	Determination of solid in wastewater such as TS,TSS and TDS.
5	Determination of some physical properties in river water: conductivity, PH, Turbidity.
6	Quantitative analysis of mixture by carbon tetrachloride.
7	Determination of caffeine in beverages by HPLC.
8	Carbon test by TOC.
9	Determination ions by selective electrode such as NH^{-}_{4},CL^{-},NO^{-}_{3}.
10	Determination of sulfonateSO^{-2}_{4} by UV-Spectrophotometer.

Universityof Technology
Department of Chemical Engineering

Program	***Industrial & Petroleum Pollution Engineering***					
Course Code	**CES.E.3314**	Credits hr				Units
Course Title	Equipment Designin Environmental Engineering Using CAD					
Term	2 nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Thermodynamics, heat and mass transfer	2	2	1	5	3

Course Description

. The aim of the subject is to engaged students with chemical plants by explain to them the main items of plant design and teach them procedures to design different equipments with computer programs

Course Text

.Sinnott R. and Towler C; 2013 " chemical Engineering Design" 5th edition Butterworth-Heinemann
Coke,A.K ;2007"Ludwig s Applied Process Design of Chemical and petrochemical Plant" vol. 1 4th edition Gulf professional Publisher

Course Objectives : at the end of the semester the student should be able to :-

1- 1-Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.
2- The student be able to use computer software packages to perform design activity beside the conventional methods
3- 3- The student should have the necessary skills to design equipments

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	Applied Design for Pressure vessels ,pumps and compressors flash drum, gas-liquid separator, liquid-liquid separator, gas movers and compressors manually and with computer aided	**12 hr**
2	Applied Design for heat equipments (shell And tube heat exchanger, plate heat exchanger , coil type exchanger, condenser, vaporizer, air cooler …….etc) manually and with computer aided	**12 hr**
3	Applied Design for mass transfer equipments (distillation column, absorber column, leaching equipment, scrubber…………..etc) manually and with computer aided	**6 hr**

Laboratories

No.	Experiment Name
1	Introduction
2	Equation of state & stream
3	Rotating Equipment (3.1 Compressor, 3.2 Expander, 3.3 pump)
4	Separation Operations (Separator , 3-Phases Separator , 4.3 Tank)
5	Heat Transfer Equipment (Heater & Cooler, Heat Exchanger, LNG,Air Cooler)
6	Column distillation (Column Installation, Column Property View, Column-Specific Operations and Running the Column)
7	Reactors(CSTR, General Reactor, Gibbs, Equilibrium, conversion)
8	Logical Operations (Adjust, Balance, Recycle, Set)
9	process plant involving reaction and separation
10	Examination lab

University of Technology
Department of Chemical Engineering

Program	***Industrial & Petroleum Pollution Engineering***					
Course Code	**CES.E.421**	Credits hr				Units
Course Title	Project I					
Term	1^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	19. Basic Principles of chemical engineering I 20. Basic Principles of chemical engineering II 21. Material &Energy Balance. 22. Thermodynamics I & II	1	2	---	3	2

Course Description

The course includes the design aspects and design considerations for plant of chemical industry.

Course Text

Sinnott R.K. "Chemical Engineering Design", Coulson and Richardson's. Chemical Engineering, Volume 6, Fourth edition, (2005).

Other support books :-

1-Peters M. S.,Timmerhaus K.D. and West R.E. Plant Design and Economics for Chemical Engineering, Fifth edition, (2003).

Course Objectives: at the end of the semester the student should be able to:-

To learn the students the basic information's of designing the chemical plants and the economic and engineering aspects

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction to Design** The anatomy of chemical manufacturing process, general overall design considerations, development of design data base, process creation, types of process design.	**5 hr**
2	**Design Information and Data** Source of information of physical properties , predication of physical properties (density, viscosity, thermal conductivity , etc)	**5 hr**
3	**Material and Energy Balance** Review of material and energy balance, flow sheet symbols, PFD information in flow diagram	**5 hr**

Project Requirements

No.	Contents	Duration
1	**Chapter One** Introduction, Historical Profile, Physical and Chemical Properties, Applications for chemical material production.	4 hr
2	**Chapter Two** Production Methods, Comparison between Processes, Selected the optimum Process, Physical properties of raw materials and by products, Production Capacity.	4 hr
3	**Chapter Three** Material balance for the plant process.	10 hr
4	**Chapter Four** Energy balance for the plant process, Process flow diagram (PFD).	10 hr
5	**Poster and Oral Presentation**	2 hr

Universityof Technology
Department of Chemical Engineering

Program	***Industrial & Petroleum Pollution Engineering***					
Course Code-	**CES.E. 431**	Credits hr				Units
Course title	Unit Operation II					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics I**I,** Engineering Mathematics I , II, Numerical Analysis, Energy Balance, Material &Energy Balance, Fluid FlowI, II, Thermodynamics I, II, Mass Transfer, unit operation I , II, Heat treansfear I, II,	2	2	1	5	3

Course Description

Theory, applications and design of unit operations which are mostly employed in the chemical industry, drying of solid, humidification, dehumidification and cooling tower and liquid evaporation and crystallization.

Course Text

1- Coulson ,J.M and Richardson J.F. "Chemical Engineering , Volume 1, 3rd edition ,Robert Maxwell.M.C.
2- Coulson J.M, and Richardson J.F. "Chemical Engineering, Volume 2, 3rd edition, Robert Maxwell.M.C.

Other support books :-

- Perry,J.H, "Chemical engineering handbook ",Mc-Graw –Hill Bookcom.1975.
- Binay.K.Dutta "Mass transfer and separation process" 2007.
- Trebal Robert E., "Mass transfer operation"2nd edition, Mc-Graw –Hill Book com.1975.

Course Objectives: at the end of the semester the student should be able to:-

1- To provide an understanding of the general principles of separation processes to allow students to make sensible options given a separation task (Humidification, Dehumidification and Cooling tower, Evaporation, crystallization, and Wet Solid Drying).
2- A comprehensive understanding of the transport processes related to chemical engineering operations, with focus on both theory and applications.
3- Ability to select of appropriate equipment for the separation of materials in process plant.
4- Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.

Topics Covered (Syllabus)

No.	Contents	Duration
1	**Drying of Solids** Introduction Drying of Solids....General Principles. Wet Solid Group.Terminology and Definitions. Humidity Measurement. Humidity Data for Air – Water system. Temperature –Humidity Chart (Psychometric Chart). Uses of Humidity Chart. Rate of Drying. Calculation method of Drying Rate and Time. Drying Rate. Drying Time. Mechanism of Moisture Movement in Wet Solid. Material and Heat Balance for Continuous Dryers. Rate of Drying for continuous Direct Heat Driers. Drying at High Temperature. Drying at Low Temperature. Drying Equipment.	6 hrs
2	**Humidification, dehumidification and Cooling towers** Introduction. Humidification Operations. Adiabatic Operations. Non-Adiabatic Operations. Mixing of Humid Streams. Mixing of Two Stream of Humid Gas. Addition of Liquid or Vapor to a Gas. Humidification Processes Theory. Cooling Tower Principles and Operations. Cooling Tower Classification. Design Cooling Tower. Adiabatic Humidification — Cooling. Dehumidification Tower	9 hrs
3	**Evaporation** Introduction, Types of Evaporations, Evaporation Equipment, Heat transfer in Evaporation Process, single, double and Multi effect Evaporators, Design of evaporators, Comparison of Forward, backward and Parallel effect evaporators, boiling Point rise.	9 hrs
4	**Crystallization** Crystallization fundamentals, cooling crystallizer, Evaporating crystallizer, Batch and continuous crystallization Crystallizer selection.	6 hrs

Universityof Technology
Department of Chemical Engineering

Practical Unit Operation II

No.	Experiment Name
1	Tray Dryer
2	Plate and Frame Filtration
3	Rotary Drum Filtration
4	Design of Cooling Tower
5	Sedimentation
6	Liquid - Liquid Extraction

University of Technology
Department of Chemical Engineering

Program	***Industrial & Petroleum Pollution Engineering***					
Course Code	**CES.E. 433**	Credits hr				Units
Course Title	Process Dynamics					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	1.Heat and Material balance 2.Applied Mathematics	2	-	1	3	2

Course Description

Study of dynamics characteristics of open-loop Chemical Engineering processes to formulate transfer function and analysis response of the system to design and select closed-loop controlscheme.

Course Text

1. D.R. Coughanowr and S. LeBlanc, Process Systems Analysis and Control, McGraw-Hill, 3rd edition, 2008.

2. Stephanopoulos G., "Chemical Process Control-An Introduction to Theory and Practice, "Prentice -Hall, New Jersey, 1984.

Other support books :-

1. Luyben W. L., "Process Modeling, Simulation and Control for Chemical Engineers," McGraw-Hill, New York, 2nd Ed., 1990 .

2. *Process Dynamics: Modeling*, *Analysis and Simulation*, *by Wayne Bequette.*

Course Objectives : at the end of the semester the student should be able to :-

1. Study of dynamic analysis of chemical processes to allow students to identify the system under different operating conditions.

2. Understanding of formulate transfer function of the system.

3. Testing and selecting of critical process variables.

4. Developing of skills, solving open ended problems and to work in teams.

Universityof Technology
Department of Chemical Engineering

Topics Covered (Syllabus)/ Process Dynamic

No.	Contents	Duration
1	**Linear Open-Loop Systems** Transfer function**,** Transient Response,Forcing Functions:Step Response ,Impulse Response Ramp Response Sinusoidal Response.	10hr
2	**Applications of First Order Systems** Liquid –level system, heating system, Mass transfer system, Reactors, absorber, pressure vessel, Linearization.	8hr
3	Response of First-Order Systems in Series Non-interacting System, Interacting System.	4hr
4	**Higher-Order Systems** Second-Order: Under-damped, Critical and over-damped, Transportation Lag	8hr

University of Technology
Department of Chemical Engineering

Program	*Industrial & Petroleum Pollution Engineering*					
Course Code	**CES.E 435**	Credits hr				Units
Course Title	**Water and wastewater treatment Eng.I**					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Air Pollution Control Eng.	2	-	1	2	2

Course Description

1- Classification,significance and concentration ranges of impurities in water and wastewater.
2- Physical and chemical treatment methods.

Course Text

1. Metcalf & Eddy, "Wastewater Engineering, Treatment & Reuse" McGraw-Hill, 4th Ed. 2003.

Other Support Boks:

1. Vesilind, P.A., & Jeffrey, J.P., "Environmental Engineering" Ann Arbor As. Publishers, 1982.
2. Hammer, M. J., " Water& Wastewater Technology", John Wiley & Sons, 1977.
3. Mackenzie, L.D., "Water & Wastewater Engineering, Desighn Principles & Practice", McGraw-Hill INTERNATIONAL Ed., 2011.

Course Objectives : at the end of the semester the student should be able to :-

8- Understand the nature of impurities in water and wastewater, their concentrations.
9- Understand the basic principle of conventional chemical and physical treatment processes.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction:** terminology inwastewater,constituents'wastewater,characteristics of wastewater,component of wastewater flow.	6hr
2	**Physical treatment** principle of physical treatment screening and grit removal, sedimentation and filtration,flotation, aeration system.	12hr
3	**Chemical treatment:** principle of chemical treatment, precipitation, coagulation and flocculation, chemical oxidation, disinfection.	12hr

Program	***Industrial & Petroleum Pollution Engineering***					
Course Code	**CES.E 423**	Credits hr				Units
Course Title	**Industrial and Petroleum Pollution Control**					
Term	1^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Fundamentals of Environmental Engineering, Environmental Engineering Management, Air Pollution Control Engineering	2	-	1	3	2

Course Description

The course contents Petroleum refinery and petrochemicals, Soap and detergents, Paint and dyes, Soap and detergents, Pesticide

Course Text

1. Nanley , N., and Bhatia, S.C.,"Pollution control in Chemical and Allied Industries", CBS Publisher and Distributors Pvt. Ltd. 1^{st} ed. 2010.
2. Rao C.S.," Environmental Pollution and Control engineering", Willy Eastern Limited 1993.

Course Objectives : at the end of the semester the student should be able to :-

1. The course attainted to give the student the knowledge about the different chemical processes flow sheets
2. The student be capable to eliminate or reduce the negative environmental effects of chemical process

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Petroleum refinery and petrochemicals:** Refining of petroleum, Waste generation in petroleum refinery, Wastewater from refinery, Control of air emissions in refinery, Petrochemical and allied products, Solid waste pollution in petrochemical industries, Control of air emission in petrochemicals.	**10hr**
2	**Soap and detergents:** Classification of surfactants, Source of detergent in water and	**4hr**

	wastewater, Impact on wastewater treatment processes, Industrial operation and wastewater, Soap manufacture and processing, detergent manufacture and waste stream, wastewater control and treatment, Airemissions	
3	**Paint and dyes:** Manufacture process, Air pollution, Wastewater generation, Dye and dye intermediates.	**4hr**
4	**Sugar, Distiller and Fermentation products:** Sugar, Distillery industry, Fermentation products.	**4hr**
	Textile: Water pollution from Boilers, Water pollution from water treatment plants, Operations involved in finishing characteristics of texture wastewater treatment of textile wastewaters.	**4hr**
6	**Pesticide:** Classification of pesticides, Pollution prevention and control, wastewater generation and treatment technique.	**4hr**

University of Technology
Department of Chemical Engineering

Program	*Industrial & Petroleum Pollution Engineering*					
Course Code	**CES.P. 437**	Credits hr				Units
Course Title	CatalysisandCatalytic Engineering					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Chemical reaction kinetics, Reactor Design	2	-	-	2	2

Course Description

Theory, Heterogeneous catalysis (Classification of solid catalyst, types of catalyst carrier, physical properties of solid catalyst (solid density, bed density, macro-pore, micro-pore, phase holdups, types of diffusivity), Overview of transport and reaction steps, Rate equations for fluid-solid catalytic reactions, External transport process in heterogeneous reactions, Internal transport processes-reaction and diffusion in porous catalysts (Thiele module and effectiveness factor), Isothermal and adiabatic heterogeneous catalytic reactors, Isothermal reactors with multiphase system

Course Text

1-Levenspiel, O. Chemical Reaction Engineering. 3rd edition, New York, NY: Wiley, 1999. ISBN: 9780471254249.

2-Smith, J. Chemical Engineering Kinetics. 3rd edition, New York, NY: McGraw-Hill, 1981. ISBN: 9780070587106

Other support books :-

1-Fogler, H.S., Elements of Chemical Reaction Engineering, 3rd edition, Prentice-Hall of India, New Delhi , 1997

Course Objectives : at the end of the semester the student should be able to :-

This course aims to establish fundamental knowledge for the students in Heterogeneous Reactors and Catalysis. At the end of this course, students should be able to:
(1) gain fundamental knowledge on solid catalysts and transport phenomena.
(2) apply reaction kinetics principles in Heterogeneous Reactors.
(3) identify and formulate problems in Heterogeneous Reactors and Catalysis and find appropriate solutions**.**
(4) Specify and size the most common industrial chemical reactors to achieve production goals for processes involving heterogeneous reaction systems.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Heterogeneous Catalysis** L1: Classification of solid catalyst, types of catalyst carrier, physical properties of solid catalyst (solid density, bed density, macro-pore, micro-pore, phase holdups, types of diffusivity- bulk, Knudsen and effective-) L2: Overview of transport and reaction steps, L3: Rate equations for fluid-solid catalytic reactions L4: External transport process in heterogeneous reactions L5: Internal transport processes-reaction and diffusion in porous catalysts (Thiele module and effectiveness factor) L6: Catalyst deactivation: definition, types, and simple rate equation	15hr
2	**Isothermal and adiabatic heterogeneous catalytic reactors** L7: Classification, Performance equation for isothermal fixed bed reactorreactors containing porous catalyst L8: Design of a single adiabatic packed bed reactor	7hr
3	**Isothermal reactors with multiphase system** L9: Design of a slurry reactor L10: Design of a trickle bed reactor	8 hr

University of Technology
Department of Chemical Engineering

Program	***Industrial & Petroleum Pollution Engineering***					
Course Code	**CES.E 438**	Credits hr				Units
Course Title	**Environmental Engineering Management and Ethics**					
Term	1st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Equipment design	2	-	1	3	2

Course Description

The course contents the important environmental national and international laws and legislations, engineering ethics ,environment audits and the course contents plant economy

Course Text

1-Dhamaja S; ' Environment Engineering and Management " 2000 1st edition S.K,Kataria& Sons
2-Bnhatia S C "Environmental pollution in Chemical process Industries " 2012 2nd edition Khama publication
3-Towler G. and Sinnott R " Chemical Engineering Design " 2nd edition 2013 Elesvier
4- Peters M. , Timmerhaus D. and West R. " Plant Design and Economics for chemical Engineers " 5th edition 2005 McGraw-Hill

Course Objectives: at the end of the semester the student should be able to :-

1. Provide knowledge to the concept of environment management laws and national obligations
2. Understand the characterization of ISO 1400 fundamental basics ,and EIA
3. How to prepare feasibility study and methods to estimate project cost

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**National and international Laws and Legislation** Explain the main national and international laws which concern with environment and international protocols.	4hr
2	**Environmental Audit** Defines environmental audit and concept of ISO, ISO 14000.	4hr
3	**Engineering Ethics** Explain the basic concepts and obligations of ethics	4hr
4	**Environmental Impact Assessment** Define the basic concept and principle of (EIA)	6hr
5	**Sustainable development Engineering** Introduction to sustainable development, Social dimensions	4hr
6	**The basic principles of plant economy Fixed and working investment** Planning and preparation, economic feasibility study, plant layout, cost (fixed cost, working cost, cost index, project cash flow diagram, tax, budgetary control	8hr

University of Technology
Department of Chemical Engineering

Program	*Industrial & Petroleum Pollution Engineering*					
Course Code	**CES.E. 422**	Credits hr				Units
Course Title	Project II					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	23. Mass Transfer 24. Unit OperationI and II 25. Heat Transfer I and II 26. Equipment Design 27. Catalysis Eng. AndReactor Design	1	2	---	3	2

Course Description

The course includes the design aspects and design considerations for plant of chemical industry.

Course Text

Sinnott R.K. "Chemical Engineering Design", Coulson and Richardson's. Chemical Engineering, Volume 6, Fourth edition, (2005).

Other support books :-

3. Peters M. S.,Timmerhaus K.D. and West R.E. Plant Design and Economics for Chemical Engineering, Fifth edition, (2003).

Course Objectives: at the end of the semester the student should be able to:-

To learn the students the basic information's of designing the chemical plants and the economic and engineering aspects

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Choice of Plant Location and Layout Standard**	3 hr
2	**Piping and Instrumentation** Pipes, valves, Pumps, Mechanical design and control	4hr
3	**Cost and Project Evaluation**	3hr
4	**Safety and Loss Prevention**	2 hr
5	**Design with Computer Aided**	3 hr

Project Requirements

No.	Contents	Duration
1	**Chapter Five** Design main equipment by design equation with mechanical design, cost evaluation, control andcomputer aided using Hysys software	14hr
2	Design supported equipment with mechanical design, cost evaluation and control.	6 hr
3	**Chapter Six** Environmental effect for raw materials, products and by products	6hr
3	**Poster and Oral Presentation**	4hr

Universityof Technology
Department of Chemical Engineering

Program	*Industrial & Petroleum Pollution Engineering*					
Course Code-	**CES.E. 432**	Credits hr				Units
Course title	Unit Operation III					
Term	2 nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Mathematics II, Engineering Mathematics I , II, Numerical Analysis, Energy Balance, Material &Energy Balance, Fluid FlowI, II, Thermodynamics I, II, Mass Transfer, unit operation I , II, Heat treansfearI, II,	2	0	1	3	2

Course Description

A comprehensive understanding of the transport processes related to chemical engineering operations with focus on theory, design and applications ofSolid–liquid filtration, Sedimentation, liquid - liquid extraction, Leaching and Washing.

Course Text

- Coulson ,J.M and Richardson J.F. “Chemical Engineering” , Volume 1, 3rd edition, Robert Maxwell.M.C.
- Coulson,J.M and Richardson J.F. “Chemical Engineering” , Volume 2, 3rd edition , Robert Maxwell.M.C.

Other support books :-

- De Sinha and Parameswar De “Mass Transfer: Principles and Operations”, Parameswar De , New Delhi, 2012
- Binay.K.Dutta “Mass transfer and separation process” 2007.
- Trebal Robert E., “Mass transfer operation”2nd edition, Mc-Graw –Hill Book com.1975.

Course Objectives: at the end of the semester the student should be able to :-

1- Basic information, concepts and terminology of the general principles of separation processes of Solid –liquid filtration, Sedimentation, liquid - liquid extraction, Leaching and Washing.
2- Demonstrating a broad and integrated knowledge and a deep understanding of issues related to separation processes in a chemical process and important role it plays in the success of the process both economically and environmentally.
3- Ability to select of appropriate equipment for the separation of materials in process plant.
4- An ability to apply effective, creative and innovative solutions, both independently and cooperatively, to current and future problems in separation processes and transport phenomena.

Topics Covered (Syllabus)

No.	Contents	Duration
1	**Filtration** Type of Filters, Filtration theory, Plate and frame filter press, leaf filter, filtration at Constant ΔP, Filtration at Constant rate, washing Time, centrifugal filtration	9 hrs
2	**Sedimentation** Introduction, Settling and Sedimentation in particle fluid separation, Sedimentation and thickening design, equipment for settling and Sedimentation.	6 hrs
3	**Liquid - Liquid Extraction** Definition, Extraction process, Equilateral Triangular coordinates (Ternary Diagram), system of three liquid _ one pair partially soluble, choice of solvent, Equipment in extraction cross _ current extraction, multi stage Cross Current extracting cross current for insoluble Liquid , Continuous Counter current extraction , Continuous Counter Current in Soluble , Liquid , Minimum Solvent .	12 hrs
4	**Leaching** General principles, Equipment for leaching, Mass transfer in leaching, continuous operation, Equilibrium-stage model for leaching and washing.	3 hrs

Universityof Technology
Department of Chemical Engineering

Program	*Industrial & Petroleum Pollution Engineering*					
Course Code	**CES.E. 434**	Credits hr				Units
Course Title	Process Control and Instruments					
Term	2st Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Process Dynamic	2	2	1	5	3

Course Description

Analysis ofclosed-loop Chemical Engineering processes system to design and select closed-loop controlscheme that will operate the plant with stable conditions.

Course Text

1. D.R. Coughanowr and S. LeBlanc, Process Systems Analysis and Control, McGraw-Hill, 3nd edition, 2008.

2. Stephanopoulos G., "Chemical Process Control-An Introduction to Theory and Practice, "Prentice -Hall, New Jersey, 1984.

Other support books :-

1. Luyben W. L., "Process Modeling, Simulation and Control for Chemical Engineers," McGraw-Hill, New York, 2nd Ed., 1990 .

2. *Process Dynamics: Modeling*, *Analysis and Simulation*, *by Wayne Bequette.*

Course Objectives : at the end of the semester the student should be able to :-

1- To enhancement the ability of students for the analysis of closed-loop system and response of controlled system under different operating conditions.
2- Construction of transfer function of the closed system for different schemes.
3- Provide practice of tuning of controller parameters and limiting of stable operating conditions.
4- Motivation and encourage the students for solving open ended problems.

Topics Covered (Syllabus)/ Process Control and Instrumentation

No.	Contents	Duration
1	**Instrumentation** Sensors: pressure, temperature, level, flow and concentration. Control valve. Dynamics characteristics of Instruments.	6hr
2	**Linear Closed-Loop Systems** The Control System, Controllers and Final Control Elements, Block Diagram of Controlled System, Overall Closed-Loop Transfer Functions.	4hr
3	Characteristics of the Closed Loop System Transient Response of Simple Control Systems, Stability	7hr
4	**Frequency Response Methods** Introduction to Frequency Response Bode Diagrams, Control System Design by Frequency Response, Ziegler-Nichols Controller Settings.	7hr
5	**Computer Control of Chemical process** Analog Computer, Digital Computer, Computer Control Loops.	3hr
6	**Control of Complex Processes** Distillation Column, Absorber, Chemical Reactor.	3hr

Practical Process Control and Instrumentation

No.	Experiment Name
1	**Feedback Control**
2	**Dynamic Behavior of Second order under Damped System (Orifice)**
3	**Flow rate Control**
4	**Level Control in the Tank**
5	**Pressure Control**
6	**Dynamic Behavior of Second order over Damped System (Stirred Tanks)**
7	**Dynamic Behavior of Second order over Damped System (Stirred Tanks Heater)**
8	**Temperature Control**
9	**PH Control**
10	**Control of Water Treatment Unit**

Universityof Technology
Department of Chemical Engineering

Program	*Industrial & Petroleum Pollution Engineering*					
Course Code	**CES.E.-436**	Credits hr				Units
Course Title	**Water and wastewater treatment Eng. II.**					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	**Water and wastewater treatment Eng. I**	1	2	1	4	2

Course Description

3- Biological processes for wastewater treatment.
4- Examples of flow sheet in treatment plants.

Course Text

1-Metcalf & Eddy, "Wastewater Engineering, Treatment & Reuse" McGraw-Hill, 4th Ed. 2003.

Other Support Books:

1-Vesilind, P.A., & Jeffrey, J.P., "Environmental Engineering" Ann Arbor As. Publishers, 1982.
2-Hammer, M. J., "Water & Wastewater Technology", John Wiley & Sons, 1977.
3-Mackenzie, L.D., "Water & Wastewater Engineering, Design Principles & Practice", McGraw-Hill International Ed., 2011.

Course Objectives : at the end of the semester the student should be able to :-

1-Understand the basic principle of biologicaltreatment methods.
2-Understand the advanced wastewater treatment methods.
3-Select appropriate process, depending in nature of the impurities to be removal.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Biological treatment:** principle of biological treatment,both aerobic and anaerobic, activated sludge treatment, trickling filter and sludge digestion.	6hr
2	**Advanced wastewater treatment:**membrane, adsorption,ion exchange, advanced oxidation process.	7hr
3	Examples of flow sheet and unit operation used in treatment plants	2hr

Laboratory of Experiments

No.	Experiment Name
1	Coagulation, Flocculation and sedimentation of river water treatment by jar-test
2	Sedimentation of suspended solid
3	Wastewater treatment
4	Ion -Exchange
5	Removal heavy metals by adsorption
6	Flotation
7	Desalination by membrane
8	Sludge- treatment

Universityof Technology
Department of Chemical Engineering

Program	***Industrial and Petroleum Pollution Engineering***					
Course Code	**CES.E.-424**	Credits hr				Units
Course Title	Optimization					
Term	2^{st} Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Eng.Mathematics1,2 ,Unit Operation.	2	-	1	3	2

Course Description

The subject is to be given in one semester. studying the formulation of objective the theory of optimization of single variable using analytical and numerical methods. Determination in the solution of multi variables problems .studying and solving the linear programming problems(LP).

Course Text

1) Optimization, Greirg D.M. Longmangroup limited London.
2) Optimization, converse A.O ,Holt, Reinhart, and Winston.

Other support books :-

1) Numerical methods for unconstrained optimization, Murrayw. Academic press.
2) Constrained optimization by direct search Swann, W.H. Gill and Murray.

Course Objectives : at the end of the semester the student should be able to :-

1- To formulate many problems arising in widely different situations.
2- Ability for finding optimum. Minimum, or maximum in unconstrained or constrained single or multi variables functions..
3- Deals with the special case of linear programing (functions and constraints are linear).
4- Provide practice to deal with industrial optimization problems.

Topics Covered (Syllabus)/ Optimization

No.	Contents	Duration
1	Introduction to optimization.	**2hr**
2	Recognizing an optimization problems and their solution. - Formulation of optimization problems. - Unconstrained and constrained problems.	**6hr**
3	Optimization methods for single variable problems. - Analytical methods; constrained and unconstrained. - Graphical method. - Numerical methods. e- Unconstrained functions; fixed step method, DSC method, Newton method. f- Constrained functions; sequential search, Dichotomous search; Fibonacci search, Golden ratio search.	**12hr**
4	Determining the solution to multivariable optimization problems. g- Unconstrained minimization and maximization strategy.	**10hr**

	- Solving linear and non linear equations using matrices. - Optimality conditions for unconstrained problems. - Lagrangian criteria. - Simplex method direction step length calculation. h- Solution of constrained multivariable problems. - Analytical solution. - Lagrangian duality. - Linearization of nonlinear optimization problems. - Simplex method. - Pivot table formulation. i- Linear programming (LP) formulation. - Solving linear system. - Basic solution of an (LP) problems. - Graphical interpretation.	

Universityof Technology
Department of Chemical Engineering

Program	***Industrial & Petroleum Pollution Engineering***					
Course Code	**CES.E.-439**	Credits hr				Units
Course Title	Corrosion and Degradation					
Term	2nd Semester	Theoretical	Practical	Tutorial	Total	
Prerequisite(s)	Material Engineering	2	-	-	2	2

Course Description

Definition of corrosion ,why metal corrode, classification of corrosion ,forms of corrosion ,polarization ,measurement of corrosion rate, protection methods.

Course Text

1. Principles and Prevention of Corrosion (2nd Edition) By Denny A. Jones Prentice Hall, 1995.
2. Environmental Degradation of Materials, R Balasubramaniam, Cengage International, 2010.
3. Corrosion and Corrosion Control, H.H. Uhlig and W. Revie, Wiley, New York, 2007.
4. Corrosion Science and Technology, By David Talbot, James Talbot, CRC Press, 1998.
5. Corrosion Engineering By Mars. G. Fontana, Third ed., TMH.
6. Corrosion Basics: An Introduction By Pierre R. Roberge, 2nd Edition, NACE Press Book, 2 2006.

Additionalreadings

1. Electrochemical Techniques in Corrosion Science and Engineering By R. G. Kelly, CRC Press, 2002.
2. ASM Handbook Volume 13A: Corrosion: Fundamentals, Testing, and Protection, ASM International 2003

Course Objectives : at the end of the semester the student should be able to :-

1. To introduce and develop and understanding the material that are precious resources, how these resources are destroyed by corrosion and how they must be preserved by applying corrosion protection technology.
2. Inspect the corrosion process, and the form of corrosion.
3. Determine the corrosion rate, and electrochemical behavior of the metals.
4. Applying the corrosion prevention technology.

Topics Covered (Syllabus)/ Course Title

No.	Contents	Duration
1	**Introduction:** Definitions, Different forms of environmental degradation, Cost of corrosion, Electrochemical consideration.	2 hr
2	**Thermodynamics:** Process at interface, Free energy and electrode potential, EMF series, Nernst relationship, Cell potential, Reference electrodes, Advanced thermodynamics (E-pH) diagrams.	4 hr
3	**Kinetics of aqueous corrosion:** Current density and corrosion rate, Corrosion rate expressions, Exchange current density, Polarization, Experimental techniques.	4 hr
4	**Mixed potential theory:** Postulates, Applications to active metals.	2 hr
5	**Passivity:** Polarization behavior, Application of mixed potential theory environmental effects.	2 hr
6	**Forms of corrosion different factors:** Metal purity, Crystal defects, Grain structure, Concentration cells, Velocity, Temperature, Humidity, Stress, Microbial effect, Liquid metal effect.	2 hr
7	**Forms of corrosion:** Uniform, Galvanic, Intergranular, Crevice, Pitting, Dealloying, Erosion, Stress related corrosion.	2 hr
8	**Corrosion control:** Material selection, Coating, inhibitors, Cathodic protection, Anodic protection.	4 hr
9	**High temperature oxidation:** Reactions, Thermodynamics, Oxide structure, Oxide growth, Hot corrosion	2 hr
10	**Degradation of Polymeric materials:** Swelling and dissolution, Bond rupture, Weathering, Other processes, Polymer cycling and degradation	2 hr
11	**Pourbaix diagram** Equilibrium diagram, Advantage and Disadvantage of Pourbaix diagram.	2 hr
12	**Corrosion of composite materials:** Galvanic effects, Matrix nature, Reinforcement nature, Prevention	2 hr

المرحلة الاولى

فرع هندسة العمليات الكيمياوية

ت	الفصل الاول	الفصل الثاني
١	Iاللغة الانكليزية	IIاللغة الانكليزية
٢	Iرياضيات	IIرياضيات
٣	Iمبادئ الهندسة الكيمياوية	IIمبادئ الهندسة الكيمياوية
٤	Iالكيمياء	IIالكيمياء
٥	الفيزياء	الميكانيك الهندسي ومقاومة المواد
٦	الرسم الهندسي	الاوتوكاد
٧	Iبرمجة الحاسبات	تكنولوجيا الكهرباء
٨	Iالمعامل	IIالمعامل
٩		حقوق الانسان

فرع هندسة تكرير النفط والغاز

ت	الفصل الاول	الفصل الثاني
١	Iاللغة الانكليزية	IIاللغة الانكليزية
٢	Iرياضيات	IIرياضيات
٣	Iمبادئ الهندسة الكيمياوية	IIمبادئ الهندسة الكيمياوية
٤	الكيمياء	كيمياء البترول
٥	الفيزياء	الميكانيك الهندسي ومقاومة المواد
٦	الرسم الهندسي	الاوتوكاد
٧	Iبرمجة الحاسبات	تكنولوجيا الكهرباء
٨	Iالمعامل	IIالمعامل
٩		حقوق الانسان

فرع هندسة التلوث الصناعي والنفطي

ت	الفصل الاول	الفصل الثاني
١	اللغة الانكليزية I	اللغة الانكليزية II
٢	رياضيات I	رياضيات II
٣	مبادئ الهندسة الكيمياوية I	مبادئ الهندسة الكيمياوية II
٤	الكيمياء	الكيمياء الاحيائية
٥	فيزياء هندسة البيئة	الميكانيك الهندسي ومقاومة المواد
٦	الرسم الهندسي	الاوتوكاد
٧	برمجة الحاسبات I	تكنولوجيا الكهرباء
٨	المعامل I	المعامل II
٩		حقوق الانسان

المرحلة الثانية

فرع هندسة العمليات الكيمياوية

ت	الفصل الاول	الفصل الثاني
١	الرياضيات الهندسيةI	الرياضيات الهندسيةII
٢	موازنة الطاقة	موازنة المادة والطاقة
٣	جريان الموائعI	جريان الموائعII
٤	الكيمياء الفيزياويةI	الكيمياء الفيزياويةII
٥	برمجة الحاسباتII	برمجة الحاسباتIII
٦	هندسة الموادI	هندسة الموادII
٧	تكنولوجيا الوقود	الطاقة المتجددة
٨	الديمقراطية	الاحصاء الهندسي

فرع هندسة تكرير النفط والغاز

ت	الفصل الاول	الفصل الثاني
١	الرياضيات الهندسيةI	الرياضيات الهندسيةII
٢	موازنة الطاقة	موازنة المادة والطاقة
٣	جريان الموائعI	جريان الموائعII
٤	الكيمياء الفيزياويةI	الكيمياء الفيزياويةII
٥	برمجة الحاسباتII	برمجة الحاسباتIII
٦	هندسة الموادI	هندسة الموادII
٧	خواص الوقود البترولي	خواص منتجات البترول
٨	الديمقراطية	الاحصاء الهندسي

فرع هندسة التلوث الصناعي والنفطي

ت	الفصل الاول	الفصل الثاني
١	الرياضيات الهندسيةI	الرياضيات الهندسيةII
٢	موازنة الطاقة	موازنة المادة والطاقة
٣	جريان الموائعI	جريان الموائعII
٤	الكيمياء الفيزياوية وعلم الغرويات	الكيمياء الفيزياوية
٥	برمجة الحاسباتII	برمجة الحاسباتIII
٦	هندسة الموادI	هندسة الموادII
٧	تكنولوجيا الوقود	اساسيات هندسة البيئة
٨	الديمقراطية	الاحصاء الهندسي

University of Technology
Department of Chemical Engineering

المرحلة الثالثة

فرع هندسة العمليات الكيمياوية

ت	الفصل الاول	الفصل الثاني
١	ديناميك الحرارة I	ديناميك الحرارة II
٢	التحليلات العددية	الرياضيات التطبيقية في الهندسة الكيمياوية
٣	انتقال الكتلة	وحدات التشغيل I
٤	حركية التفاعل الكيميائي	تصميم المفاعل
٥	انتقال الحرارة I	انتقال الحرارة II
٦	العمليات الصناعية الكيميائية	العمليات الصناعية الكيميائية
٧	الهندسة الكيميائية الاحيائية	الدقائق وتكنولوجيا النانو
٨	تصميم المعدات	تصميم المعدات باستخدام الكاد (CAD)

فرع هندسة تكرير النفط والغاز

ت	الفصل الاول	الفصل الثاني
١	ديناميك الحرارة I	ديناميك الحرارة II
٢	التحليلات العددية	الرياضيات التطبيقية في الهندسة الكيمياوية
٣	انتقال الكتلة	وحدات التشغيل I
٤	حركية التفاعل الكيميائي	تصميم المفاعل
٥	انتقال الحرارة I	انتقال الحرارة II
٦	الاحتراق	عمليات معالجة النفط والغاز
٧	المواد الكيمياوية من البترول	هندسة تصفية البترول I
٨	تصميم المعدات	تصميم المعدات والخزانات باستخدام الكاد

فرع هندسة التلوث الصناعي والنفطي

ت	الفصل الاول	الفصل الثاني
١	ديناميك الحرارة I	ديناميك الحرارة II
٢	التحليلات العددية	الرياضيات التطبيقية في الهندسة البيئية
٣	انتقال الكتلة	وحدات التشغيل I
٤	حركية التفاعل الكيميائي	هندسة التفاعلات الكيميائية الاحيائية
٥	انتقال الحرارة I	انتقال الحرارة II
٦	هندسة السيطرة على تلوث الهواء	معالجة المخلفات الصلبة
٧	السلامة الصناعية	اجهزة التحليل البيئي
٨	تصميم المعدات	تصميم المعدات في هندسة البيئة باستخدام الكاد

المرحلة الرابعة

فرع هندسة العمليات الكيمياوية

ت	الفصل الاول	الفصل الثاني
١	المشروعI	المشروعII
٢	وحدات تشغيلII	وحدات تشغيلIII
٣	حركية العمليات	السيطرة على العمليات واجهزتها
٤	عمليات تصفية البترول	هندسة الصناعات البتروكيمياوية
٥	المفاعلات الغيرمتجانسة والعوامل المساعدة	طرق الاختيار الافضل
٦	الادارة الصناعية واخلاقيات المهنة	هندسة التأكل
٧	هندسة البيئة والسلامة الصناعية	

فرع هندسة تكرير النفط والغاز

ت	الفصل الاول	الفصل الثاني
١	المشروعI	المشروعII
٢	وحدات تشغيلII	وحدات تشغيلIII
٣	دينامية العمليات	السيطرة على العمليات والاجهزة في مصافي البترول
٤	هندسة تصفية البترولII	اقتصاديات مصافي البترول
٥	ادارة المصافي واخلاقيات المهنة	طرق الاختيار الافضل
٦	المفاعلات الغيرمتجانسة والعوامل المساعدة	هندسة التأكل في مصافي البترول
٧	التلوث البيئي والسلامة في مصافي النفط	

فرع هندسة التلوث الصناعي والنفطي

ت	الفصل الاول	الفصل الثاني
١	المشروعI	المشروعII
٢	وحدات تشغيلII	وحدات تشغيلIII
٣	حركية العمليات	السيطرة على العمليات واجهزتها
٤	هندسة معالجة المياهI	هندسة معالجة المياهII
٥	السيطرة على التلوث البترولي والصناعي	طرق الاختيار الافضل
٦	هندسة العوامل المساعدة	التأكل والتحلل
٧	الادارة واخلاقيات المهنة في الهندسة البيئية	