UNIVERSITI TEKNOLOGI MARA

UNDERGRADUATE STUDENT HANDBOOK

FACULTY OF CHEMICAL ENGINEERING

UNIVERSITI TEKNOLOGI MARA

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1.0 INTRODUCTION TO FACULTY

1.1 Message From The Dean

Assalamualaikum and Good Day,

On behalf of the Faculty of Chemical Engineering I would like to welcome all of you on board and I would like to take this opportunity to congratulate all of you for making a wise decision to join UiTM in your journey to shape up your career path. We are proud to have you, such fresh and young minds that are full of potential to be part of this vibrant and dynamic faculty and we are more than happy to share with you the unique discovery and learning experiences that we have to offer.

The faculty has come a long way since its inception. Experienced and well qualified staff, coupled with a conducive learning environment, high class lecture rooms and halls, well-equipped laboratories and state-of-the-art facilities are the keys to ensuring a high quality teaching and learning process. The up to date curriculum which incorporating hands on projects are some of the highlights of the program that being offered. To the great advantage of current students, the faculty has received international recognition from EAC on the programmed offered thus ensuring a high quality teaching and learning experience is being delivered. The combined strength of teaching and research create a distinctive learning environment thus offers a great opportunity for you to groom yourselves to become a fine scholars and professionals. Nonetheless, our relentless effort in ensuring a high quality education to our students would not be successful without your effort to make it happen. Your commitment or active participation in the learning activities that really matters. We are here to guide and assist you in this exciting journey.

You are the emerging leaders who will contribute to shape tomorrow's world and allow us to be part of it. Let us do this together towards a promising and successful future.

ASSOC. PROF. DR AYUB MD SOM

Dean of Faculty of Chemical Engineering

1.2 Faculty of Chemical Engineering in Brief

Welcome to the Faculty of Chemical Engineering. The faculty was established on 16th June 2003 in Universiti Teknologi MARA, Shah Alam. The faculty may be relatively young but chemical engineering has existed in UiTM since 1972. Increasing demand for chemical engineers along with the nation's economic growth has contributed to the launching of Bachelor of Chemical Engineering programme at the Faculty of Mechanical Engineering in the year 2000.

The academic programmes offered at the faculty are in line with science and technology developments and current industrial needs to provide the highest level of chemical engineering courses. The programmes provide students with powerful problem solving skills comprising a high level of synthesis of mathematics, computation, chemistry, physics, and molecular biology with the engineering core of thermodynamics, transport, control, and design.

Apart from producing graduates at the diploma and first degree levels, the faculty also offers postgraduate programmes. The MSc. And PhD in chemical engineering began its intake in May 2003. Our research interests cover a wide range of topics from Green Technology and Sustainable Development, Novel Material Processing, Industrial Biotechnology, Process System and Oil and Gas Engineering.

1.3 What is Chemical Engineering

A chemical engineer is involved in the design, development, construction and operation of industrial processes for the production of a diverse range of products, as well as in commodity and specialty chemicals. Relevant industries include oil and gas, pharmaceuticals, energy, water treatment, food and drink, plastics and toiletries. Modern chemical engineering is also concerned with pioneering valuable new materials and techniques, such as nanotechnology, fuel cells and biomedical engineering.

The field of chemical engineering may focus on one of the following: researching new products from trial through to commercialization; managing scale-up processes from plant to full industrial-scale manufacturing; improving product lines; modifying the processing plant that produces the products; and designing and commissioning new plants.

1.4 Job Description and Responsibilities of a Chemical Engineer

The activities as chemical engineers are extremely diverse, depending on the role and the sector, which include:

- working closely with process chemists and control engineers to ensure the process plant is set up to provide maximum output levels and efficient running of the production facility.
- designing plant and equipment configuration so that they can be readily adapted to suit the product range and the process technologies involved, taking environmental and economic aspects into account.
- instituting scale-up and scale-down processes including appropriate changes to equipment design and configuration.
- assessing options for plant expansion or reconfiguration by developing and testing process simulation models.
- designing, installing and commissioning new production plants, including monitoring developments and troubleshooting.
- optimising production by analysing processes and compiling de-bottleneck studies;
- applying new technologies.
- ensuring that potential safety issues related to the project operator, the environment, the process and the product are considered at all stages.

Chemical engineers from the faculty can engage their skills across these many apparently disparate industries because of the breadth and depth of their training in the engineering core and the enabling sciences. Chemical engineers can tackle a range of problems based on their solid foundation in quantitative logical thinking and problem solving. It is not surprising, therefore, that chemical engineers can have promising careers in the following areas:

Absorption & Adsorption Engineer, Anatomist, Biochemist, Biophysicist, Botanist, Brewery Processing, Chemical Design Engineer, Chemical Equipment Sales Engineer, Chemical Test Engineer, Cytologist, Environmental Epidemiologist, Facilities Design Engineer, Food Technologist, Geneticist, Histopathologist, Microbiologist, Nuclear Engineer, Petroleum Engineer, Pharmacologist, Physiologist, Polymer Engineer, Process Engineer, Public Health, Research Engineer and Technical Director

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1.7 UNIVERSITY MOTTO, PHILOSOPHY, VISION, MISSION AND OBJECTIVES

MOTTO

Endeavour, Religious, Dignified

PHILOSOPHY

Every individual has the ability to attain excellence through the transfer of knowledge and assimilation of moral values so as to become professional graduates capable of developing knowledge, self, society and nation.

VISION

To establish UiTM as a premier university of outstanding scholarship and academic excellence capable of providing leadership to Bumiputeras's dynamic involvement in all professional fields of world-class standards in order to produce globally competitive graduates of sound ethical standing.

MISSION

To enhance the knowledge and expertise of Bumiputeras in all fields of study through professional programmes, research work and community service based on moral values and professional ethics

OBJECTIVES

1. To provide maximum opportunities for Bumiputeras to pursue professionally-recognised programmes of study in science, technology, industry, business, arts and humanities.
2. To provide quality and innovative programmes of study relevant to current market needs and customer demands, and in line with policies of national development.
3. To establish a human resource development programme as a tool for the assimilation of a value system within the university community.
4. To ensure that UiTM graduates are adequately prepared to join the local as well as the global workforce.
5. To establish UiTM as a centre of excellence that is accountable for the effective and efficient management of its human resources, finances and assets in order to achieve its educational objectives, while playing its role as a catalyst in community development..

1.8 FACULTY OF CHEMICAL ENGINEERING'S VISION, MISSION AND QUALITY OBJECTIVES STATEMENT

VISION

To be the leader in providing the highest standard of learning towards producing ethical and professional chemical engineers.

MISSION

To impart knowledge to students by offering comprehensive chemical engineering programmes through effective teaching and training in line with global technological advancement.

QUALITY OBJECTIVES STATEMENT

Faculty of Chemical Engineering, UiTM is committed to providing quality programmes and ensuring continuous improvement in teaching and learning with the aim of producing excellent professional chemical engineers to meet customers' demand and in line with UiTM'S vision. In supporting the vision and mission, the faculty's quality objectives are as follows:

1. To achieve full time students enrolment according to the Centre of Strategic Planning by the year 2015.
2. To achieve excellence in teaching and learning by:
    a) Ensuring all curriculums (course work) to be reviewed every 3 years.\
    b) Ensuring at least 90% of full time students for Diploma and Bachelor Degree level to graduate within the stipulated time.
    c) Ensuring at least 70% PhD students to graduate on time.
    d) Ensuring Graduate Employability which is more than 80% (Bachelor),95% (diploma) and 2.2% (self employed).
3. To increase excellence in research through:
    a) Achieving 250 publications by 2015.
    b) Achieving RM10 million grants by 2015.
4. To ensure excellence in knowledge transfer and commercialization of at least 2 research products by 2015.

2.0 DEFINITION OF TERMS

	Programme	A programme is an arrangement of modules that are structured for a specified duration and learning volume to achieve the stated learning outcomes, which usually leads to an award of a qualification.
	Accredited Programme	An engineering programme whose graduates are acceptable for graduate registration with BEM and for admission to Graduate membership of IEM
	Course	Subject offered in the programme.
	Graduate Engineer	A person registered under Section 10(1), Registration of Engineers (Amendment) Act 2002.
	Professional Engineer	A person registered under Section 10(2). Registration of Engineers (Amendment) Act 2002.
OBE	**Outcome-Based Education**	Outcome-Based Education is an approach that focuses on outcomes, i.e. the achievements of students that are measurable, proven, and can be improved.
PEO	**Programme Educational Objectives**	Programme Educational Objectives are statements that describe the knowledge skills and attitude acquired 3 – 5 years after graduation.
PO	**Programme Outcomes**	Programme Outcomes are statements that describe what students are expected to know and be able to perform or attain by the time of graduation. These relate to the skills, knowledge, and behaviours that students acquire through the programme.
CO	**Course Outcome**	What students will be able to do upon the completion of a course
LO	**Learning Outcomes**	Learning outcomes are statements on what a learner should

		know, understand and can do upon the completion of a period of study.
MOHE-LOKI	**MOHE Soft Skill Learning Outcomes (LOKI)**	Are observable indicators or evidence of actual students' learning (with direct measures – through students' knowledge and performance [test papers, projects, demonstrations etc.] or indirect measures – students' behaviors, attitudes or values [alumni, interviews, focus groups etc.]) The learning outcomes are: 1. Knowledge 2. Practical Skills 3. Thinking and scientific skills 4. Communication skills 5. Social skills, teamwork and responsibility 6. Values, ethics, moral and professionalism 7. Information management and lifelong learning skills 8. Managerial and entrepreneurial skills 9. Leadership skills
SLT	**Student Learning Time**	Amount of time available per week for learning and teaching activities. These activities include lecture, tutorial, seminar, practical, self-study, retrieval of information, research, fieldwork, as well as preparing for and sitting for an examination The recommended SLT per week varies according to student band and it can range between 40-55 hours.
SLE	**Student Learning Experience**	Student Learning Experience comprises the entire educational experience of a student whilst studying for a programme.
SCL	**Student-Centered Learning**	Student-Centered Learning in OBE means students will be equally responsible for their own learning. Engagement of both students and lecturers will be visible in the teaching and learning process.

3.0 PROGRAMMES OFFERED

3.1 Bachelor of Engineering (Hons) Chemical (EH220)

Chemical engineering is the synergy of science and engineering. This programme develops skills enabling students to analyse, assess and solve engineering problems using modern engineering tools through the provision of the robust fundamental background in the fields of engineering-chemistry, mathematics and physics, which underpin this engineering discipline. This programme is accredited by both the Board of Engineering Malaysia (BEM) and the Institution of Chemical Engineers (IChemE), United Kingdom.

3.2 Bachelor of Engineering (Hons) Chemical and Process (EH241)

Chemical and Process Engineering focuses on the design, development, operation and optimization of sustainable physical and chemical processes, which convert raw and lower value materials into consumer specified products of higher value. Students pursuing this programme can expect to receive a fully encompassing chemical engineering course, which provides the opportunity to specialise in one of these four fields: Environmental-, Polymer-, Petrochemical- and Palm Oleochemical-Technology. This is a BEM (Board of Engineers of Malaysia) approved programme. Graduates from the Bachelor of Chemical and Process Engineering programme can expect to be able to adapt a multitude of challenges, whether they are in the fields of chemical, petrochemical or oleochemical, whilst acting in the capacity of a Process Engineer, Chemical Engineer.

3.3 Bachelor of Engineering (Hons) Chemical and Bioprocess (EH 242)

The Bachelor of Chemical Engineering (Hons.) and Bioprocess was established in UiTM in July 2009 session. The duration of this programme is four years divided into eight semesters. The programme is structured in such a way that the courses offered fall into three categories apart from the University requirements. They are the common engineering courses, core chemical engineering courses and a selection of managerial courses. The programme has a total of 138 credit hours. This programme is sub-divided into three streams which are food technology, pharmaceutical technology and industrial biotechnology. Application areas associated with bioprocess engineering include the production of biofuels, design and operation of fermentation systems, development of food processing systems, application and testing of product separation technologies, design of instrumentation to monitor and control biological processes, and many more. The programme structure in all courses contains lectures, tutorials and practical work laboratories. Assessment for every course is based on tests, quizzes, assignments, mini projects and examinations. Lectures and tutorial classes are conducted by experienced lecturers. The number of students in each class is restricted to about 30 to ensure effective teaching and learning processes.

3.4 Bachelor of Engineering (Hons) Oil and Gas (EH243)

Oil and Gas Engineering is the first of its kind to be introduced in a Malaysian university to cater for the ever-demanding oil and gas industry. The Oil and Gas Engineering programme is a unique programme that combines petroleum, gas and exploration engineering in the study and is specially designed to produce graduates who wish to take advantage of the exciting and highly rewarding career prospects in this area. This programme prepares individuals to apply engineering principles to the design, development and operation of systems for locating, extracting of crude petroleum and natural gas, drilling systems, processing systems and facilities, storage facilities, transportation systems, and related environmental and safety systems. The programme also exposes the students to latest technologies in enhanced oil recovery (EOR), exploration and to global contemporary issues related to geopolitics and economics of oil and gas industry. This programme received its pioneer batch of students in July 2008. The courses are conducted via lectures, tutorials, open-ended practical work laboratories and simulation laboratories where appropriate based on “Outcome-Based

Education" (OBE). Assessment for the courses includes tests, quizzes, assignments, research projects, and examinations. The courses sum up to 133 credit units, spreading over a four-year study period of eight semesters.

4.0 FACULTY OF CHEMICAL ENGINEERING, UITM PROGRAMME EDUCATIONAL OBJECTIVES

4.1 Programme Educational Objectives

Programme Educational Objectives are statements that describe the knowledge skills and attitude acquired 3 to 5 years after graduation.

To produce graduates who, during the first several years of engineering practice:

1. Are able to carry out chemical engineering tasks as individuals or team members.
2. Are capable to undertake R & D related activities.
3. Possess effective communication skills, leadership quality, and entrepreneurship.
4. Recognise the importance of life-long learning and are aware of contemporary global issues.

4.2 PROGRAMME OUTCOMES FACULTY OF CHEMICAL ENGINEERING

PO1	Ability to identify and apply knowledge of mathematics, basic and applied science, engineering fundamentals and specialization to solve including complex engineering problems.
PO2	Ability to identify, formulate and solve engineering problems, including complex engineering problems, using the principles of mathematics, basic and applied science and engineering fundamentals.
PO3	Ability to perform research, design and conduct experiments, as well as to analyze, interpret, conclude and validate data of research-based fundamental and complex engineering problems.
PO4	Ability to utilize modern science, engineering or IT tools and systems to solve common engineering problems, including complex system.
PO5	Ability to utilize system approach to design and evaluate operational performance with appropriate consideration on health, safety, society and environment.
PO6	Ability to acquire in-depth technical knowledge in chemical and related engineering principles.
PO7	Ability to communicate effectively not only with engineers but also with the community at large.
PO8	Ability to apply the knowledge of safety, health and the environment, and sustainable development issues in specific engineering scenarios
PO9	Ability to function effectively as an individual and in a group with the capacity to be a leader or manager as well as an effective team member.
PO10	Ability to demonstrate knowledge and understanding of project management and finance.
PO11	Ability to recognize and apply the importance of social, cultural and global contemporary and ethical issues and professional conducts in engineering practice.
PO12	Ability to recognize the necessity for lifelong learning and actively practice it in their professional activities.

4.3 PROGRAMME OBJECTIVES (PEO)

No	Programme objectives:	Performance Indicator
1	Established career progression in specific engineering field or relevant organization	Involved in decision making process within its own capacity
		Involved in planning and execution of specific engineering or related tasks
		Attained senior engineer role in line engineering level
2	Engaged in providing solution to specific engineering problems/ organizational challenges/ R&D related works	Identified or defined problems, challenges, opportunities and projects
		Contributed towards creation, innovation and production of new products/ methods/patents/processes, etc.
		Provide solution to overcome/address organizational challenges or produce/improve design, etc.
3	Attained sound interpersonal and communication skills and team work	Demonstrated the ability to handle interpersonal relationship in multi-level position across organization.
		Collate ideas and contributions from various people/organization and multi-disciplinary.
		Good team player contributing to successful winnings/completion of projects
		Have awareness on the needs for technical knowledge across other engineering disciplines (multidisciplinary)
4	Engaged in lifelong learning, professional and personal development	Embarked on the candidacy towards acquiring professional engineer status
		Committed to high standard of ethics and conduct
		Participated in continuing professional development and acquiring competency skill
		Engaged in sustainable development and contemporary issues of the multi-cultural society and nation at large.

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*** On Study Leave**
**** Seconded to Pasir Gudang Campus, UiTM Johor**

5.2 Programme Structure: Bachelor of Engineering (Hons) Chemical (EH 220)

Study Plan EH220 Package 7 (ID 5483)

This study plan is used by Semester 1 and Semester 3 students (from Diploma EH110) started from Semester 1 2013/2014 Session. The following are the details on the courses offered:

Number of Faculty courses: 38
Number of Faculty courses with final examination: 24
Number of Faculty courses with continuous assessment: 14

YEAR	SEMESTER	CODE	COURSE	CREDIT
1	1	KKR1	Co-curriculum I	1
		ELC400	Preparatory College English	2
		CPE414	Engineering Drawing	1
		CHE434/CPE435	Process Chemistry	3
		CHE503	Fluid Flow	3
		CPE420	Introduction to Chemical Engineering	3
		MAT435	Calculus For Engineers	3
		CHE485	Chemistry Laboratory	1
	2	KKR2	Co-curriculum II	1
		BKE1	Third Language I	2
		CTU551	Tamadun Islam dan Tamadun Asia 1	2
		CHE433	Thermodynamics (BL)	3
		CHE471	Chemical Process Principles I (BL)	3
		CHE495	Hydrocarbon Chemistry (BL)	3
		CHE465	Chemical Engineering Laboratory I	1
		MAT455	Further Calculus for Engineers	3
2	3	KKR3	Co-curriculum III	1
		ELC501	English for critical academic reading	2
		BKE2	Third Language II	2
		CHE463	Heat Transfer	3
		CHE545	Mass Transfer	3
		CHE523	Chemical Engineering Laboratory II	1
		CHE531	Chemical Process Principles II	3
		CTU555	Sejarah Malaysia	2
	4	BKE3	Third Language III	2
		CHE515	Instrumental Chemistry for Engineers	3
		CHE574	Chemical Engineering Laboratory III	1
		CHE594/CHE584	Chemical Reaction Engineering	3
		CHE555	Numerical Methods and Optimization	3
		CHE553	Chemical Engineering Thermodynamics	3
		CHE544	Separation process	3
3	5	CHE625	Advanced Chemical Reaction Eng	3
		CPE642	Process Control and Instrumentation	4
		CPE613	Process Simulation Laboratory	1
		CPE604	Plant Design and Economics	4
		CPE680	Leadership and Professional Ethics For Engineers	3
	6	CHE572	Particle Technology	3
		CPE639/CHE641	Mechanical Design of Process Equipment	3
		CHE692	Process Modeling and Simulation	3

		CHE645	Advanced Process Control	2
		CHE620	Project Management	3
		CPE615	Process Safety	3
4	7	CPE644	Design Project I	3
		CHE675	Environmental Engineering	3
		CHE687	Research Project I	3
		ACC166	Financial and Cost Accounting	3
			Elective I	3
		CPE644	Design Project I	3
	8	CPE664	Design Project II	3
		CHE697	Research Project II	3
		LAW299	Business Law	3
			Elective II	3

ELECTIVE COURSES							
SEM	**CODE**	**COURSE**	**PRE-REQUISITE**	**CREDIT**	**L**	**T**	**LAB**
7		**ELECTIVE I**					
	CBE689	Pharmaceutical Material Processing	-	3	3	1	-
	CBE658	Food Preservation Technology	-	3	2	-	3
	CGE616	Enhanced Oil Recovery	-	3	3	1	-
	CGE668	Material Codes and Standards	-	3	3	1	-
	CHE751	Occupational Safety And Health Management	CPE615	3	3	1	-
	CPE655	Solid Waste Management		3	3	1	-
8		**ELECTIVE II**					
	CPE666	Petrochemical Process Engineering	-	3	3	1	-
	CPE668	Oleochemical Process and Application	-	3	3	1	-
	CBE659	Introduction to Industrial Pharmacy	-	3	3	1	-
	CHE685	Fuel and Energy Technology	-	3	3	1	-
	CBE697	Biorefineries		3	3	1	-
	CHE653	Particle Processing Operations	CHE572	3	3	1	-

Study Plan EH220 Package 6 (ID 4057)

This study plan is used by Semester 1 and Semester 3 students (from Diploma EH110) started from Semester 1 2010/2011 Session. The following are the details on the courses offered:

Number of Faculty courses: 37
Number of Faculty courses with final examination: 24
Number of Faculty courses with continuous assessment: 13

YEAR	SEMESTER	CODE	COURSE	CREDIT
1	1	KKR1	Co-curriculum	1
		CTU551	Tamadun Islam dan Tamadun Asia I	2
		CHE414	Engineering Drawing	2
		CPE435	Process Chemistry	3
		CHE433	Thermodynamics	3
		CPE421	Chemical Processes and Sustainability	**3**
		MAT435	Calculus For Engineers	**3**
	2	KKR2	Co-curriculum	1
		CHE471	Chemical Process Principles I	3
		CHE463	Heat Transfer	3
		CHE465	Chemical Engineering Laboratory I	1
		MAT455	Further Calculus for Engineers	3
		CHE495	Hydrocarbon Chemistry	3

		CHE485	Chemistry Laboratory	1
2	3	KKR3	Co-curriculum III	1
		BEL422	Report Writing	2
		BKE1	Third Language I	2
		CHE531	Chemical Process Principles II	3
		CHE523	Chemical Engineering Laboratory II	1
		CHE542	Mass Transfer and Unit Operations	3
		MAT565	Advanced Differential Equations	3
		CHE503	Fluid Flow	3
	4	BEL499	Communication and Interpersonal Skills	2
		BKE2	Third Language II	2
		CHE515	Instrumental Chemistry for Engineers	3
		CHE574	Chemical Engineering Laboratory III	1
		CHE594	Chemical Reaction Engineering	3
		CHE555	Numerical Methods and Optimization	**3**
		CPE553	Chemical Engineering Thermodynamics	**2**
3	5	CPE624	Advanced Chemical Reaction Eng	**2**
		BKE3	Third Language III	**2**
		CHE623	Advanced Heat Transfer	3
		CHE675	Environmental Engineering	3
		CHE612	Chemical Engineering Laboratory lV	1
		CHE604	Plant Design and Economics	4
		CHE680	Leadership and Professional Ethics For Engineers	3
	6	CHE572	Particle Technology	3
		CHE 641	Mechanical Design of Process Equipment	**3**
		CHE692	Process Modeling and Simulation	3
		CHE642	Process Control and Instrumentation	4
		CHE620	Project Management	3
		CPE615	Process Safety	3
4	7	CHE690	Industrial Training	5
		CHE686	Design Project I	3
		CTU553	Ethnic Relationship	2
		CHE687	Research Project I	3
		ACC166	Financial and Cost Accounting	3
			Elective I*	3
	8	CHE696	Design Project II	3
		CHE697	Research Project II	3
		LAW299	Business Law	3
			Elective II*	3

5.3 Learning Outcome and Soft Skill (LO-KI) Matrix For Programme EH 220 Courses

Course Code	Course	Credit	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9
University Courses											
KKR1	Co-curriculum 1	1				√	√	√			√
ELC400	Preparatory College English	2	√				√	√	√		
CTU551	Tamadun Islam dan Tamadun Asia 1	2				√	√	√			√

KKR2	Co-curriculum II	1				√	√	√			√
BKE1	Third Languange 1	2	√	√	√	√	√	√	√		√
ELC501	English for Critical Academic Reading	2				√	√				
BKE2	Third Languange II	2	√	√		√	√	√			
CTU555	Sejarah Malaysia	2				√	√				
KKR3	Co-curriculum II	1				√	√				
BKE3	Third Language III	2	√				√	√	√		√
	Number of courses		4	2	1	8	10	7	3	0	5
Core Courses											
CPE414	Engineering Drawing	1	√	√	√				√		
CHE434	Process Chemistry	3	√		√						
CPE421	Chemical Processes and Sustainability	3	√		√	√		√	√		
CHE503	Fluid Flow	3	√		√						
CHE485	Chemistry Laboratory	1		√	√	√	√				√
MAT435	Calculus For Engineers	3	√	√	√				√		
CHE471	Chemical Process Principles I	3	√		√						
CHE465	Chemical Engineering Laboratory I	1		√	√	√	√				√
CHE495	Hydrocarbon Chemistry	3	√		√						
MAT455	Further Calculus for Engineers	3	√	√	√					√	√
CHE433	Thermodynamics	3	√		√						
CHE463	Heat Transfer	3	√		√						
CHE531	Chemical Process Principles II	3	√		√						
CHE523	Chemical Engineering Laboratory II	1	√	√	√	√	√				√
CHE542	Mass Transfer and Unit Operations	3	√		√						
CHE544	Separation Process	3	√	√	√				√		
CHE515	Instrumental Chemistry for Engineers	3	√	√	√						
CHE574	Chemical Engineering Laboratory III	1	√	√	√	√	√				√

CHE594	Chemical Reaction Engineering	3	√		√						
CHE555	Numerical Methods and Optimization	3	√	√	√				√		
CHE 553	Chemical Engineering Thermodynamics	3	√		√						
CHE625	Advanced Chemical Reaction Eng	3	√		√						
CPE642	Process Control and Instrumentation	4	√		√						
CPE613	Process Simulation Laboratory	1	√	√	√				√		
CPE604	Plant Design and Economics	4	√		√						
CPE680	Leadership and Professional Ethics For Engineers	3				√	√	√	√		√
CHE645	Advanced Process Control	2	√		√						
CPE639	Mechanical Design of Process Equipment	3	√		√						
CHE692	Process Modeling and Simulation	3	√	√	√				√		
CHE620	Project Management	3				√	√				√
CHE572	Particle Technology	3	√		√						
CPE615	Process Safety	3	√		√			√			
CHE690	Industrial Training	5	√		√	√		√	√	√	
CHE675	Environmental Engineering	3	√		√			√			
CPE644	Design Project I	3	√	√	√	√	√	√	√	√	√
CHE687	Research Project 1	3	√		√				√		
ACC166	Financial and Managerial Accounting	3							√	√	
CPE664	Design Project II	3	√		√	√	√	√	√	√	√
LAW299	Business Law	3						√	√		
CHE697	Research Project II	3	√	√	√			√	√		
JUMLAH	Number of courses		34	14	36	10	8	9	15	5	9
Elective Courses											
CBE689	Pharmaceutical Material	3				√	√		√		√

	Processing										
CBE658	Food Preservation Technology	3				√			√	√	
CGE616	Enhanced Oil Recovery	3							√	√	
CGE668	Material codes and standards	3	√		√			√	√		
CHE751	Occupational Safety And Health Management	3	√		√			√			
CPE655	Solid Waste Management	3	√	√	√						
CPE666	Petrochemical Process Engineering	3	√		√	√					
CPE668	Oleochemical Process and Application	3	√		√						
CBE659	Introduction to Industrial Pharmacy	3	√		√			√			
CHE685	Fuel and Energy Technology	3	√		√						
CBE697	Biorefineries	3	√		√	√	√				√
CHE653	Particle Processing Operations	3	√	√	√			√			
	Number of courses		9	2	9	4	2	4	4	2	2
	Number of courses		47	18	46	22	20	19	22	7	16
	Total		76%	29%	74%	35%	32%	31%	35%	11%	26%
Course Code	Course	134	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9
Course Code	Course	Credit	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9

LO 1 Knowledge in Specific Area-Content
LO 2 Practical Skills
LO 3 Thinking and Scientific Skills
LO 4 Communication Skills
LO 5 Social skills, teamwork and responsibilities
LO 6 Values, Ethics and Professionalism (A)
LO 7 Information Management and Life Long Learning
LO 8 Management and Entrepreneurship
LO 9 Leadership Skills

5.4 Programme Core Courses: Bachelor of Engineering (Hons) Chemical (EH 220)

SEMESTER 1

CPE414	**ENGINEERING DRAWING**
Course Description	This course deals with the application of technical drawing to engineering design. Students are first introduced to the principles in drawing such as orthographic projection, sectioning, isometric drawing and geometrical constructions using drawing instruments. In addition, basic plant layout techniques and process flow diagram standard symbols important in chemical process plants are included. Finally, Basic AutoCAD skills are introduced to the students keeping in mind the future usage of the software in other relevant courses.
Course Outcomes	At the end of the course students are able to: • Have basic knowledge of Technical Drawing using various types of Drawing Tools and AutoCAD software. • Understand different types of drawing methods used in Technical Drawing. • Prepare students with knowledge of Technical Drawings for contemporary industrial requirement.
CHE434	**PROCESS CHEMISTRY**
Course Description	This course is an advanced course in chemistry. The topics covered include acid-base reactions, chemical equilibrium, thermochemistry, electrochemistry, kinetics and organic chemistry.
Course Outcomes	At the end of the course students are able to: • Discuss basic physical chemistry principles in everyday life • Analyze theoretical basis for application in chemical engineering field • Evaluate concept of electrochemistry, thermochemistry and chemical equilibrium and kinetics in chemical engineering.
CPE421	**CHEMICAL PROCESSES AND SUSTAINABILITY**
Course Description	This course emphasizes knowledge on processing of important natural resources such as petroleum, gas and palm oil. Topics on utilities and current issues related to sustainability of industrial processes are also discussed. Processing of materials of other relevant chemical industries such as cement, rubber, textile, glass and palm oleo- chemicals are also included as topic of discussion
Course Outcomes	At the end of the course students are able to: • Develop extensive knowledge in major chemical processing industries and to describe the environmental impact of those industries. • Explain the utilities requirement in chemical industries. • Understand the concepts of sustainability and its challenges in chemical industries.
CHE503	**FLUID FLOW**
Course Description	The course is designed to provide the student with the principles of flow of fluid through conduits, bends, valve, etc., pumping of fluid in laminar and turbulence flows. Also included is the agitation and mixing of liquids.
Course Outcomes	At the end of the course students are able to: • Identify the concept of fluid flows in industries • Practice various concept of fluid flow to solve industrial problems • Propose a system to solve industrial problem using fluid flow concept

CHE485 **CHEMISTRY LABORATORY**

Course Description

This course provides a complimentary practical experience to the theoretical work studied in the physical, inorganic and organic chemistry courses. The course comprises of open-ended laboratory investigations, which require effective communication, delegation and time-management skills to achieve experimental aims.

SEMESTER 2

Course Outcomes

At the end of the course students are able to:

- Perform experiments, which is complimentary to the theoretical work covered in the physical, inorganic and organics chemistry courses.
- Develop well-structured experimental methodologies for open ended investigations.
- Relate the procedures and theories incorporated in the laboratory work to present.

CHE471 **CHEMICAL PROCESS PRINCIPLES I**

Course Description

This course presents an introduction to mass and energy balances. Conversion between various systems such as SI, American and British are discussed. Fundamental of steady state mass balance on single and multiple unit operations, along with by-pass and recycle systems, will be stressed and elaborated. Basic steady state energy balance will also be taught.

Course Outcomes

At the end of the course students are able to:

- Explain basic and illustrative techniques for expressing the values of system variables and for setting up and solving equations that relate these variables.
- Apply various physical properties of the process materials to derive additional relations among the system variables.
- Evaluate the unit operations involved in a process by solving material balance problems for non-reactive and reactive system

CHE465 **CHEMICAL ENGINEERING LABORATORY I**

Course Description

This course involves series of experiments that deals with the principles of water analysis, properties of certain liquids and gasses and fluid mechanics unit.

Course Outcomes

At the end of the course students are able to:

- Handle an environmental apparatus for determining of chlorine, sulfate, phosphorus and chromium content in waste water.
- Carry out the experiment of determining the most important properties of fluids such as density and viscosity by using the Armfield Properties of Gases and Liquids apparatus, also determining three types of regions in flow using Osbourne Reynolds apparatus.
- Demonstrate the use of Basic Weir apparatus and demonstrate a particular aspect of hydraulic theory in terms of velocity through time using Filter Press equipment.

CHE495 **HYDROCARBON CHEMISTRY**

Course Description

This course provides a chemical background of sufficient depth to facilitate an understanding of the organic chemical processes, which occur in industry. Topics covered include organic nomenclature, reaction types and biomolecules.

Course Outcomes

At the end of the course students are able to:

- Explain the concept of hybridization in describing bonding between atoms in organic molecules.
- Analyse and distinguish the reactions of organic compounds based upon their functional activity.
- Design chemical reactions and propose plausible chemical reaction mechanisms.

CHE433 **THERMODYNAMICS**

Course Description

This course includes the following topics; an introduction to thermodynamics, properties of pure substances, First Law of Thermodynamics and its application in closed and open systems, Second Law of Thermodynamics, heat engine and reversed heat engine, entropy, Carnot and Rankine cycles**.**

Course Outcomes

At the end of the course students are able to:

- Describe the basic principles of thermodynamics related to energy, heat, work and phase change processes
- Apply the laws of thermodynamics in energy analysis for closed and open system
- Interpret the energy analysis based on laws of thermodynamics

SEMESTER 3

CHE463 **HEAT TRANSFER**

Course Description

The syllabus introduce topics on the different kinds of heat transfer i.e. conduction, convection and radiation. Types and designs of heat exchangers which are important to chemical process industries are included. In addition, the introduction on boiling and condensation is also discussed.

Course Outcomes

At the end of the course students are able to:

- Explain the theories and basic principles of heat transfer
- Analyze problem related to heat transfer by applying the theories or basic principles of heat transfer.
- Evaluate real case study problem and relate it to the principles of heat transfer.

CHE531 **CHEMICAL PROCESS PRINCIPLES II**

Course Description

This course is a continuation of Chemical Process Principle I. The students are exposed to advanced material and energy balance concepts to solve problems of unit operations in chemical processing for both steady and unsteady state systems. The students are also exposed to the application of specific chemical engineering software to solve material and energy balances.

Course Outcomes

At the end of the course students are able to:

- Employ and solve material and energy balances on non-reactive processes.
- Employ and solve material and energy balances on reactive processes.
- Formulate and solve material and energy balances to processes that are in transient state

CHE523	**CHEMICAL ENGINEERING LABORATORY II**
Course Description	The experiments carried out in this course support the theory on heat transfer, mass transfer and fluid flow. Mass and energy balance calculation are carried out. Fluid properties and flow measurements are also conducted.
Course Outcomes	At the end of the course students are able to: • Perform the operations and performance of fluid flow and analyze the problems associated with the operations. • Apply the concepts and principles of separation process. • Perform the operations and performance of fluid flow and analyze the problems associated with the operations. • Understand the concept of mass and heat transfer.
CHE542	**MASS TRANSFER AND UNIT OPERATIONS**
Course Description	This subject introduces the students to one of the fundamental knowledge that the students must acquire in mass transfer and mass transfer operations. The topics covered include the concepts of mass transfer and equipment design for distillation, gas absorption, extraction and leaching. In addition special topic(s) on mass transfer would also be introduced to the students.
Course Outcomes	At the end of the course students are able to: • Explain the concept of diffusional, convective and interphase mass transfer • Apply chemical engineering calculations involving design principles to mass transfer in various unit operations • Compare various types of unit operations based on mass transfer and fluid interactions principles

SEMESTER 4

CHE544	**SEPARATION PROCESS**
Course Description	This subject introduces the students to one of the fundamental knowledge that the students must acquire in separation theory with respect to mass transfer principles in various unit operation i.e membrane, dryer, crystallizer, fixed or packed bed adsorption.
Course Outcomes	At the end of the course students are able to: Describe various types of unit operations based on mass transfer principles Apply chemical engineering calculations in various unit operations Compare the mechanisms of mass transfer in various unit operations
CHE515	**INSTRUMENTAL CHEMISTRY FOR ENGINEERS**
Course Description	This course comprises of topics designed to provide a comprehensive fundamental understanding of analytical chemistry and introduce students to the techniques available in chemical compound determination. This course also incorporates experimental work, which exposes students to practical application of the analytical techniques taught.
Course Outcomes	At the end of the course students are able to: • Identify the most appropriate analytical method for structural determination and environmental heavy metal pollution assessment. • Interpret spectra and determine the functionality and structure of an unknown substance • Perform experiments to achieve a predetermined goal.

CHE574 **CHEMICAL ENGINEERING LABORATORY III**

Course Description

Chemical Engineering Laboratory III is a continuation of the previous chemical engineering laboratory works. The emphasis here would be on the operation of continuous stirred tank reactors and combustion chamber. The operations of equipment handling solid particles would also be dealt with. Besides that, this laboratory has additional experiments that consist of filter press, tray dryer and gas absorption column.

Course Outcomes

At the end of the course students are able to:

- Perform the operations using fluidized bed, deep bed filter, CSTR, CSTR in series, filter press, tray dryer and gas absorption column; and analyze the problems associated with the operations.
- Apply the concepts and principles on the characterization of particles.
- Analyze and interpret data from experimental works into graphical forms.

CHE594 **CHEMICAL REACTION ENGINEERING**

Course Description

The subject deals with the engineering activity concerned with the exploitation of chemical reactions on a commercial scale. Its goal is the successful design and operation of chemical reactors which sets the chemical engineering apart as a distinct branch of the engineering profession. Thus, to produce good chemical reactors, important topics include strengthening the fundamentals of chemical kinetics; types of reactors and simple design approach to more complex design are also discussed.

Course Outcomes

At the end of the course students are able to:
Explain the principles of chemical reaction kinetics.
Ability to apply basic design equations of chemical reactors applicable for isothermal and ideal conditions.
Ability to evaluate the design problems related to reactor systems.

CHE555 **NUMERICAL METHODS AND OPTIMIZATION**

Course Description

This course provides basic knowledge of numerical methods including root-finding, elementary numerical linear algebra, solving systems of linear equations, curve fitting, and numerical solution to ordinary and partial differential equations. The numerical techniques acquired in this course will enable students to solve chemical engineering problems.

Course Outcomes

At the end of the course students are able to:

- Identify and describe the most common techniques from the various numerical methods of mathematical problems.
- Analyze and solve the numerical methods outlined manually and using high programming language as MATLAB and MS
- Excel to solve chemical engineering problems.
- Develop formulation and evaluate the numerical methods outlined to chemical engineering problems.

CPE553 **CHEMICAL ENGINEERING THERMODYNAMICS**

Course Description

This course discusses thoroughly the principles of thermodynamics and details their application to the chemical engineering processes.

Course Outcomes

At the end of the course students are able to:

- Identify the composition of the species at equilibrium
- Analyse the phase equilibria thermodynamic properties of specific mixture using appropriate models
- Evaluate the chemical reactions system product at equilibrium

SEMESTER 5

CHE625 ADVANCED CHEMICAL REACTION ENGINEERING

Course Description

The course deals with some advanced topics in chemical reaction engineering. Topics covered include heterogeneous and catalytic reactions, non-ideal and bioreactors, polymerisation and multiphase reactions.

Course Outcomes

At the end of the course students are able to:

- Explain the principle features of conventional and complex reactions and their application.
- Apply the principles and knowledge of heterogeneous reaction, catalytic reaction and complex reaction.
- Evaluate reactors and reaction mechanism for heterogeneous and catalytic reaction.

CPE642 PROCESS CONTROL AND INSTRUMENTATION

Course Description

This course begins with a discussion of principle concept, theory and terminologies of process control. It moves on to discuss the product hardware and software that implement the theory, and then proceeds to describe instrumentation examples and the system-design approaches suitable for variety of production processes.

Course Outcomes

At the end of the course students are able to:

- Identify the suitable instrumentations for particular control system
- Analyse the control system for a given chemical process
- Propose control system for a given chemical process.

CPE613 PROCESS SIMULATION LABORATORY

Course Description

Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical & Process (EH 241) Semester 6

Course Outcomes

Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical & Process (EH 241) Semester 6

CHE604 PLANT DESIGN AND ECONOMICS

Course Description

This course amalgamates the knowledge acquired by the students in preceding core courses in Chemical Engineering. It is divided into two parts i.e. Plant Design and Economics. Starting from general considerations in plant design; and process equipment design; the topics also include selection, design and optimization of individual equipment for specific application through integrated design of process plants. Topics in economics include, Estimation of capital and operating costs of process plant, followed by economic analysis.

Course Outcomes

At the end of the course students are able to:

- Recognize the necessary initial steps for preliminary plant design
- Perform calculations related to the preliminary design of process equipments and heat exchanger network.
- Evaluate the feasibility of chemical or process plant through heat integration and economic analysis.

CHE680 **LEADERSHIP AND PROFESSIONAL ETHICS FOR ENGINEERS**

Course Description

This course is designed to contain two (2) parts. The first part concentrates on the "Thoughts and Policies of Tun Dr. Mahathir Mohamed" as outlined by UiTM whilst the second part incorporates "Engineers in Society" syllabus of Institute of Engineers (Malaysia). Topics on various thoughts and policies of Malaysian premiers especially Tun Dr. Mahathir that has significantly contributed to the nation's success shall be emphasized. In addition, students will be exposed to the professional ethics concepts that can be applied in real engineering world.

Course Outcomes

At the end of the course students are able to:

- Identify the most appropriate methods for structural determination and heavy metal pollution assessment.
- Analyze spectra and determine the functionality and structure of unknown substances.
- Design and perform experiments to achieve a pre-determined goal

SEMESTER 5

CHE645 **ADVANCED PROCESS CONTROL**

Course Description

This course is a continuation of the fundamentals of chemical process control, it which begins with the principle concept, theory, terminologies of advanced system of process control. The advanced control strategies will be applied to case studies and the tuning of the systems will be carried out using a software simulation

Course Outcomes

Upon completion of this module, students should be able to:

- Identify the control objectives of a process and control algorithms.
- Compare and contrast the control strategies of chemical process equipment.
- Design advanced control strategies to industrial case studies

CPE639 **MECHANICAL DESIGN OF PROCESS EQUIPMENT**

Course Description

This course imparts the knowledge of the mechanical properties of materials needed for the design of process engineering equipment. Topics covered include theories of failure and finally the mechanical design of pressure vessel, other process equipment and supports.

Course Outcomes

At the end of the course students are able to:

- Describe the structure of various types of engineering materials
- Demonstrate engineering calculations related to the mechanical properties of materials
- Evaluate the mechanical design of pressure vessels and supports

CHE692 **PROCESS MODELING AND SIMULATION**

Course Description

This course is to study the dynamic of chemical processes by deriving mathematical models through mass and energy balances. Numerical solutions for the correlations are also carried out which cover iteration and simulation methods.

Course Outcomes

At the end of the course students are able to:

- Identify various types of mathematical model for different applications in chemical processes

- Develop and/or simulate mathematical models for common chemical engineering processes
- Develop and/or simulate mathematical models for complex chemical engineering processes

CHE620 **PROJECT MANAGEMENT**

Course Description This course will take a comprehensive view of project management, addressing both the technical and the social or human sides of the field. Furthermore, the course will provide intensive coverage of management in a wide range of project applications from concept through operations. Planning, scheduling, controlling, economic analysis,quality control and customer satisfaction are stressed in this course.

Course Outcomes At the end of the course students are able to:

- Apply the knowledge and function effectively as a project manager and team member
- Ability to demonstrate the communication skills gained through oral and writing
- Interpret the principles and practice of project management in chemical engineering application

CHE572 **PARTICLE TECHNOLOGY**

Course Description The syllabus introduces basic topics on processing and handling of particles and powders. The topics included have been selected to give coverage of broad areas within particle technology: characterization, powder processing, particle formation fluid- particle separation, bulk solid handling and powder transport.

Course Outcomes At the end of the course students are able to:

- Differentiate properties involving particle and principles of particle technology
- Distinguish the principles of equipment designs involving solid particles
- Propose equipment used in industries involving bulk solid handling

CPE615 PROCESS SAFETY

Course Description The course offers a detailed study on applications of engineering principles to process safety and hazards analysis and mitigation. It covers issues relevant to chemical process safety covering Occupational Safety and Health laws and regulations, the regulatory process and methods and techniques for proactively identifying, assessing and eliminating or controlling hazards to acceptable levels. The course also discusses the national and international safety and health regulatory provisions, and principles and techniques for identifying, analyzing and controlling hazards which are required on any process plant to ensure safe and efficient operation. The course also emphasizes on risk assessment and management, maintenance program, emergency response planning, occupational safety and health management system and relevant case studies.

Course Outcomes **:** At the end of the course students are able to:

- Describe and explain the main principles of safety, health, accident prevention and relevant safety and health legislation and regulations.
- Apply the various hazard identification and risk assessment methodologies (HAZOP, ETA, FTA and QRA)
- Prepare effective safety and health management system, and emergency response plan.

- Assess causes, consequences, control and preventive measures and management system of several case studies

CHE690 INDUSTRIAL TRAINING

Course Description

Industrial training is an important component in engineering curriculum. Theories learnt in all the core and non-core courses will have to be applied into the real working environment in chemical industries. Prior to the actual training in industries, students are trained to make job applications before stepping into the real working environment.

Course Outcomes

At the end of the course students are able to:

- Identify the types of work that chemical engineers do in real engineering world and appreciate the theoretical knowledge learned.
- Perform basic engineering practices, including technical report writing, communication with colleagues, project handling and proposal generation.
- Obtain higher level of integrity, ethics and accountability in engineering.

SEMESTER 7

CHE675 **ENVIRONMENTAL ENGINEERING**

Course Description

Topics covered include process wastes and their effect on the environment, pollutant transport, environmental impact assessment, disposal and waste treatment, waste minimisation, environmental audit, alternative uses and recycling of wastes. The nature of pollution, major sources and effects of pollutants are also discussed. In addition students will be introduced to Environmental-related legislation and policy. Faculty of Chemical Engineering Student Handbook 40

Course Outcomes

At the end of the course students are able to:

- Explain the environmental engineering principles in pollution control and waste management.
- Analyze the basic principle to solve problems on waste treatment.
- Justify the waste treatment to comply with the environmental regulation and monitoring requirements.

CPE644 **DESIGN PROJECT I**

Course Description

The Design Project course is the pinnacle of the Chemical Engineering program. The course is spread out into two semesters, named Design Project I and Design Project II. Students are required to carry out a project on related topic to chemical engineering. Although this course is designed as a team work, much emphasis is given to the Faculty of Chemical Engineering Student Handbook 44 individual effort in carrying out of the task. Design project I focuses on the literature study of the project including process background, market analysis, site selection, environmental & safety consideration, detailed mass & energy balances and process simulation.

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Course Outcomes

At the end of the course students are able to:

- Demonstrate, identify, justify and analyse the knowledge in designing the designated equipment and process control technologies by using appropriate methods.
- Justify and apply process for economic evaluation and relevant Acts for environment and waste treatment.
- Carry out material and energy balances on the overall system.
- Simulate the selected process using HYSIS and adapt the safety procedures and aspects for a safer plant

CHE687 **RESEARCH PROJECT I**

Course Description

In this course each student will be required to prepare and deliver an oral and written report. A series of lectures on research methodology will be given as guidance for the students. The sequence of the report is based on a systematic development of the thesis. The subjects of these reports are:
- An introduction to the general topic - A literature review of the specific topic of the project or thesis
- A thesis proposal that should include the detailed scope and plan of the research.
- Each of these reports should contain primary material that will be included in the final thesis report, which will be delivered at the conclusion of the research.

Course Outcomes

At the end of the course students are able to:

- Design the research methodology in terms of experimental set up and the procedures in order to achieve the objectives of the research.
- Ability to carry out the research works according to the outlined procedures and obtain data.
- Analyze and interpret data and drawing conclusion based on the findings.

SEMESTER 8

CPE664 **DESIGN PROJECT II**

Course Description

The Design Project II is a continuation from Design Project I. This course compliments all the tasks that has been planned and executed in Design Project I. Each group is required to submit a documented plan and report within the given time frame. In general, the Design Project II is mainly focusing on the individual work in carrying out the prescribed task including equipment design, process control and instrumentation, process economic analysis, plant safety, process integration and environment & waste treatment.

Course Outcomes

At the end of the course students are able to:

- Demonstrate, identify, justify and analyse the knowledge in designing the designated equipment and process control technologies and pinch technology by using appropriate methods.
- Justify and apply process for economic evaluation and relevant Acts for environment and waste treatment.
- Carry out material and energy balances on the overall system.
- Simulate the selected process using HYSIS and adapt the safety procedures and aspects for a safer plant.

CHE697 **RESEARCH PROJECT II**

Course Description

This course develops knowledge on the use of specific methods to determine the most cost-effective and efficient solution to a problem or design for a process. A wide variety of problems in the design, construction, operation and analysis of chemical plants can be resolved by identifying features that desirable (also undesirable) in the formulation of an optimization problem. Several detailed studies illustrating the application of various optimization techniques will be discussed.

Course Outcomes

At the end of the course students are able to:

- Design the research methodology in terms of experimental set up and the procedures in order to achieve the objectives of the research.
- Carry out the research works according to the outlined procedures and obtain data.
- Analyze and interpret data and drawing conclusion based on the findings.

ELECTIVE COURSES PART 7

CBE689 **PHARMACEUTICAL MATERIAL PROCESSING**

Course Description

This course introduces steps in a chain of events leading to the development and production of new drugs. In this module, the identification, characterisation and selection of the chemical and physical nature of drug compounds intended for delivery in the solid form will be discussed. Throughout this course, three characteristics of drugs compounds will emerge as being the fundamental importance: aqueous solubility, partition coefficient and stability (both chemical and physical). Much of the science and engineering within this module is concerned with understanding, controlling and tailoring these properties.

Course Outcomes

At the end of the course, students should be able to:

- Ability to explain the importance of formulation in solid state form
- Ability to analyze the vital characteristics of solid state form and the processes in the formulation of new drugs.
- Ability to interpret the design of solid state form according to the fundamental knowledge in drug production, process and equipments.

CBE658 **FOOD PRESERVATION TECHNOLOGY**

Course Description

The syllabus of this course introduces the factors that can cause food spoilage and the different techniques of food preservation which are commonly applied in the food industry, ranging from conventional to the most current technologies. The course also covers the principles, the description of the processes and equipment involved for these different techniques.

Course Outcomes

At the end of the course, students should be able to:

- Ability to define food preservation and factors of food spoilage.
- Ability to distinguish the different principles and mechanisms of various food preservation techniques.
- Ability to recommend and justify appropriate equipment to solve industrial problem in food processing.

CGE616 **ENHANCED OIL RECOVERY**

Course Description

This course aims to introduce the students the fundamentals knowledge of enhanced oil recovery (EOR) processes used or proposed to be used in the petroleum industry. Basic concepts and theories of enhanced oil recovery, such as water flooding, polymer flooding, surfactant flooding, miscible and immiscible gas flooding and thermal recovery processes and strategies will be taught in this course.

Course Outcomes

At the end of the course, students should be able to:

- Explain the principles of EOR and to describe the miscible and immiscible displacement processes
- Compare different mobility-control processes
- Compare the environmental concerns of different chemical and thermal EOR processes.

CGE668 **MATERIAL CODES AND STANDARDS**

Course Description

This course covers principles of materials codes and Standards by American Society of Mechanical Engineers (ASME), American Petroleum Institute (API), National Association of Corrosion Engineers (NACE), Ingress Protection Code (IP), British Standard (BS), National Fire Protection Association (NFPA) and International Conventions for Maritime Safety (SOLAS and MARPOL) for oil and gas facilities engineering.

Course Outcomes

At the end of the course, students should be able to:

- Describe and recognize material codes and Standard used for oil and gas facilities engineering.
- Apply and differentiate the principles of codes and standards to design engineering facilities.
- Evaluate and justify the codes and standards to design engineering facilities.

CHE751 **OCCUPATIONAL SAFETY AND HEALTH MANAGEMENT**

Course Description

The emergence of voluntary standards and codes of practices, together with the requirement to manage costs has resulted in an inclination to go beyond regulatory compliance in ensuring safety and health at the workplace.
Significance changes are seen through the use of occupational safety and health (OSH) management systems and integration of OSH into key business processes. The syllabus is divided into several areas of emphasis: Legal Aspects of Safety and Health, Safety And Health Management Systems, Occupational Safety and Health Performance Measurements, Organizational Theory and Behavior, Analysis Techniques in Occupational Health and Safety, Risk Communication, Decision-making Analysis, Risk Communication and OSH Seminar. The course is designed to provide graduates with solid grounding in both technical and managerial aspects of leading practices in OSH management.

Course Outcomes

At the end of the course students are able to:

- Identify and leverage the regulatory, voluntary, and business drivers for occupational safety and health programs.
- Integrate business knowledge, analytical skills, managerial skills and technical knowledge into effective actions.

- Organize data and information, prepare technical reports, and give oral presentations on recognition, evaluation, management and control of occupational safety and health exposures.
- Design and implement performance measurement processes to verify occupational safety and health effectiveness

CPE655 **SOLID WASTE MANAGEMENT**

Course Description

The course gives an introduction to management of solid wastes. Collection, separation, thermal and biological treatment and construction, operation and monitoring of sanitary landfills is in focus. The course concerns alternative strategies for waste management and recycling of different types of solid waste. These methods include incineration, composting and anaerobic digestion. Environmental assessment of the different waste management options with respect to energy and resource consumption as well as environmental pollution is also included in the course.

Course Outcomes

At the end of the course students are able to:

- Develop an awareness of professional responsibility towards protecting the environment.
- Acquaint oneself with the pertinent legislation and methodology.
- Study environmental issues involved integrated solid wastes management.

CPE666 **PETROCHEMICAL PROCESS ENGINEERING**

Course Description

This course provides study of the petrochemical processes. This module will be assist by the research work which will be completed by the students. The research will act as an aid for the student to understand more about the latest technology on the petrochemical processes.

Course Outcomes

At the end of the course students are able to:

- Explain the importance and growth of petrochemical industry in Malaysia and describe the principles of raw materials and their sources.
- Apply and integrate knowledge of chemical process engineering in various petrochemical processes.
- Describe the latest technology and future market trends in petrochemical industry.

CPE668 **OLEOCHEMICAL PROCESS AND APPLICATION**

Course Description

Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical & Process (EH 241) Semester 8

Course Outcomes

Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical & Process (EH 241) Semester 8

CBE659 **INTRODUCTION TO INDUSTRIAL PHARMACY**

Course Description

This course introduces the students to the pharmaceutical industry. The topic covered includes the introduction to conception of drugs, development strategies and the specific aspects of R&D of health products: orphan drugs, cosmetics and products of biotechnological origin. In addition, the fundamental principles of pharmaceutical laws, the licensing procedures and the leading principles in quality control and quality assurance will be covered.

Course Outcomes

At the end of the course students are able to:

- Obtain a general understanding of the pharmaceutical industry.
- Explain specific aspects of R&D of drugs and other pharmaceutical products.

CHE685 **FUEL AND ENERGY TECHNOLOGY**

Course Description

The course is a combination of two areas of studies namely fuel technology and energy technology. The fuel technology covers topics required in the conventional sources of energy such as types of fuel and combustion calculations involved in the energy production. The energy technology covers the present form of the world energy consumption and production. The current trends in the energy needs of the country are particularly highlighted including renewable sources of energy particularly solar energy.

Course Outcomes

At the end of the course students are able to:

- Acquire and apply the knowledge of present energy scenario, the basic energy fundamentals and principles to solve energy related problems
- Discuss and evaluate the various sources of fuel and renewable energy resources, properties and their applications
- Justify problems due to fossil fuels combustions and evaluate various alternative environmental friendly energy system for a sustainable future

CBE697 **BIOREFINERIES**

Course Description

This course focuses on the technological principles, as well as the economic aspects, green processes, plants, concepts, current and forthcoming biobased product lines. It starts with the description of various types of raw materials and their processing for the biorefineries and continues with the technologies in obtaining product such as microalgal system, biochemical process, thermochemical process and also integrated biorefinery process. Students will also be exposed to the related policies and considerations regarding to biorefinery.

Course Outcomes

At the end of the course, students should be able to:

- Ability to describe biorefinery concepts.
- Ability to distinguish the process involved in biorefinery.
- Ability to select the suitable processes in biorefinery.

CHE653 **PARTICLE PROCESSING OPERATIONS**

Course Description

The course introduces advance topics on processing and handling of particles and powders. The topics included have been selected to give coverage of broad areas within particle technology: crystallization, filtration, drying, three-phase fluidization and several types of particle processing.

Course Outcomes

At the end of the course students are able to:

- Differentiate between solid/gas and solid liquid system.
- Apply the principles of equipment designs involving solid particles
- Identify appropriate types of particle processing for particular chemical/physical process.
- Work as a team and deliver a topic related to particle technology system

6.0 BACHELOR OF ENGINEERING (HONS) CHEMICAL AND PROCESS (EH241)

6.1 Bachelor of Engineering (Hons) Chemical and Process: Academic Staff

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*** On Study Leave**

6.2 Programme Structure: Bachelor of Engineering (Hons) Chemical and Process (EH241)

Study Plan EH241 - Pakej 5 (ID 5548)

This study plan is used by Semester 1 and Semester 3 students (from Diploma EH110) started from Semester 1 2013/2014 Session. The following are the details on the courses offered:

Number of Faculty courses: 39
Number of Faculty courses with final examination: 26
Number of Faculty courses with continuous assessment: 13

YEAR	SEMESTER	CODE	COURSE	CREDIT
1	1	KKR1	Co-curriculum I	1
		ELC400	Preparatory College English	2
		CHE493	Fluid Mechanics	3
		CPE414	Engineering Drawing	1
		CHE434/CPE435	Process Chemistry	3
		CPE420	Introduction to Chemical Engineering	3
		MAT435	Calculus For Engineers	3
	2	KKR2	Co-curriculum II	1
		CTU551	Tamadun Islam dan Tamadun Asia I	2
		CHE469/CPE471	Materials and Energy Balance	4
		CHE433	Thermodynamics	3
		MAT455	Further Calculus for Engineers	3
		CHE495	Hydrocarbon Chemistry	3
		CHE485	Chemistry Laboratory	1
2	3	KKR3	Co-curriculum III	1
		ELC501	English for Critical Academic Reading	2
		BKE1	Third Language I	2
		CHE463	Heat Transfer	3
		CHE553	Chemical Engineering Thermodynamics	3
		CPE453	Process Engineering Laboratory I	1
		ENT600	Technopreneurship	3
		MAT565	Advanced Differential Equations	3
	4	BKE2	Third Language II	2
		CTU553	Ethnic Relationship	2
		CHE520/CPE521	Process Unit Operations	3
		CHE594	Chemical Reaction Engineering	3
		CPE554	Process Engineering Laboratory II	1
		CHE523/CPE523	Transport Phenomena	2
		CHE555	Numerical Methods and Optimization	3
		BKE2	Third Language II	2
3	5	BKE3	Third Language III	2
		CPE680	Leadership and Professional Ethics for Engineers	3
		CHE591/CPE591	Process Engineering I	3
		CPE562	Chemical Process Control	2
		CHE625	Advanced Chemical Reaction Engineering	3
		CPE604	Plant Design and Economics	4
		CPE613	Process Simulation Laboratory	1
	6	CPE639/CPE641	Mechanical Design of Process Equipments	3
		CHE692	Process Modeling and Simulation	3
		CPE615	Process Safety	3
		CPE622	Process Control Practices	2

		CHE572	Particle Technology	3
		CPE633/CPE43	Process Engineering II	3
4	**7**	CHE690	Industrial Training	**5**
		CPE644	Design Project I	3
		CHE687	Research Project I	3
		CHE620	Project Management	3
			Specialisation Course 1	3
			Specialisation Course 2	3
	8	CPE664	Design Project II	3
		CHE697	Research Project II	3
			Specialisation Course 3	3
			Specialisation Course 4	2
			Specialisation Course 5	2

ELECTIVE COURSE							
SEM	**CODE**	**COURSE**	**PRE-REQUISITE**	**CREDIT HOURS**	**HOURS**		
					LECTURE	**TUTORIAL**	**LAB**
7	**Specialisation Course 1**						
	CPE655	Solid Waste Management	-	3	3	1	-
	CPE656	Petroleum Refining Engineering	-	3	3	1	-
	CPE677	Polymeric Materials, Rubber and Composites	-	3	3	1	-
	CPE658	Palm Oil Milling and Refining	-	3	3	1	-
	Specialisation Course 2						
	CPE665	Air Pollution Engineering	-	3	3	1	-
	CPE666	Petrochemical Process Engineering	-	3	3	1	-
	CPE667	Engineering Properties of Polymer	-	3	3	1	-
	CPE679	Quality Assurance in Palm Oil Industry	-	2	1	-	3
8	**Specialisation Course 3**						
	CPE675	Wastewater Engineering	-	3	3	1	-
	CPE671	Refinery and Petrochemical Equipment	-	2	2	1	-
	CPE659	Characterization of Polymers	-	2	1	-	3
	CPE668	Oleochemical Processes and Applications	-	3	3	1	-
	Specialisation Course 4						
	CPE635	Environmental Management System	-	2	2	1	-
	CPE681	Waste and Environmental Management in Petrochemical Industry	-	3	3	1	-
	CPE689	Waste and Environmental Management in Polymer Industry	-	3	3	1	-

	CPE688	Food and Non-Food Processing of Palm and Palm Kernel Oil	-	2	2	1	-
	Specialisation Course 5						
	CPE695	Environmental Impact Assessment (EIA)	-	2	2	1	-
	CPE696	Future Trends of Petrochemical Processes	-	2	2	1	-
	CPE697	Polymer Processing	-	2	2	1	-
	CPE699	Waste and Environmental Management in Palm Oil Industrial Sectors	-	3	3	1	-

Study Plan EH241 - Pakej 4 (ID 4608)

This study plan is used by Semester 1 and Semester 3 students (from Diploma EH110) started from Semester 1 2011/2012 Session. The following are the details on the courses offered:

Number of Faculty courses: 40
Number of Faculty courses with final examination: 27
Number of Faculty courses with continuous assessment: 13

YEAR	SEMESTER	CODE	COURSE	CREDIT
1	1	KKR1	Co-curriculum I	1
		CTU551	Tamadun Islam dan Tamadun Asia I	2
		CHE414	Engineering Drawing	2
		CPE435	Process Chemistry	3
		CHE433	Thermodynamics	3
		CPE421	Chemical Processes and Sustainability	3
		MAT435	Calculus For Engineers	3
	2	KKR2	Co-curriculum II	1
		CPE471	Materials and Energy Balance	4
		CHE463	Heat Transfer	3
		CHE493	Fluid Mechanics	3
		MAT455	Further Calculus for Engineers	3
		CHE495	Hydrocarbon Chemistry	3
		CHE485	Chemistry Laboratory	1
2	3	KKR3	Co-curriculum III	1
		BEL422	Report Writing	2
		BKE1	Third Language I	2
		CPE521	Process Unit Operations	3
		CPE523	Transport Phenomena	2
		CPE453	Process Engineering Laboratory I	1
		MAT565	Advanced Differential Equations	3
		CPE535	Electrical Technology	3
	4	BEL499	Communication and Interpersonal Skills	2
		BKE2	Third Language II	2
		CPE591	Process Engineering I	3
		CPE554	Process Engineering Laboratory II	1
		CPE553	Chemical Engineering Thermodynamics	2
		CHE555	Numerical Methods and Optimization	3
		CHE515	Instrumental Chemistry for Engineers	3
3	5	CHE594	Chemical Reaction Engineering	3
		BKE3	Third Language III	2
		ENT600	Technopreneurship	3

		CPE562	Chemical Process Control	2
		CHE692	Process Modeling and Simulation	3
		CHE604	Plant Design and Economics	4
		CPE612	Process Engineering Laboratory III	1
	6	CPE 641	Properties of Materials and Applications	3
		CPE624	Advanced Chemical Reaction Eng	2
		CPE615	Process Safety	3
		CPE622	Process Control Practices	2
		CPE633	Process Engineering II	3
		CHE680	Leadership and Professional Ethics for Engineers	3
4	**7**	CHE690	Industrial Training	5
		CPE644	Design Project I	3
		CHE687	Research Project 1	3
		CHE572	Particle Technology	3
		CTU553	Ethnic Relationship	2
			Specialisation Course I	3
			Specialisation Course 2	3
	8	CPE664	Design Project II	3
		CHE697	Research Project II	3
			Specialisation Course 3	3
			Specialisation Course 4	2
			Specialisation Course 5	2

6.3 Learning Outcome and Soft Skill (LO-KI) Matrix For Programme EH 241 Courses

PROGRAMME OUTCOMES– MOHE LEARNING OUTCOMES – SOFT SKILLS LEARNING OUTCOMES RELATIONSHIP MATRIX
FACULTY : FACULTY OF CHEMICAL ENGINEERING
PROGRAMME : BACHELOR OF ENGINEERING (HONS) CHEMICAL AND PROCESS
CODE : EH241

Programme Outcomes (PO)		Achievement of MOHE Learning Outcomes								Achievement of Soft Skills Learning Outcomes						
		(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
A	Ability to identify and apply knowledge of mathematics, basic and applied science, engineering fundamentals and specialisation to solve engineering problems, including complex engineering problems.	√					√				√					
B	Ability to identify, formulate and solve engineering problems, including complex engineering problems, using the principles of mathematics, basic and applied science, and engineering fundamentals.	√					√				√					
C	Ability to perform research, design and conduct experiments, as well as to analyze, interpret, conclude and validate data of research-based fundamental and complex engineering problems.		√				√				√					
D	Ability to utilize modern science, engineering or IT tools and systems to solve common engineering problems, including complex system.	√	√				√				√					
E	Ability to utilize system approach to design and evaluate operational performance with appropriate consideration on health, safety, society and environment.				√						√				√	
F	Ability to acquire in-depth technical knowledge in chemical and related engineering principles.	√						√				√				
G	Ability to communicate effectively not only with engineers but also with the community at large.			√		√				√						
H	Ability to apply the knowledge of safety, health, and the environment and sustainable development issues in specific engineering scenarios.			√	√										√	
I	Ability to function effectively as an individual and in a group with the capacity to be a leader or manager as well as an effective team member.			√	√	√			√				√			√
J	Ability to demonstrate knowledge and understanding of project management and finance,					√			√				√	√		√

K	Ability to recognize and apply the importance of social, cultural and global contemporary and ethical issues and professional conducts in engineering practice.			√	√										√	
L	Ability to recognize the necessity for lifelong learning and actively implement it in their professional activities.	√						√				√				

Ministry of Higher Education Learning Outcomes :-
(i) Knowledge
(ii) Practical Skills
(iii) Social Skills and Responsibilities
(iv) Values, Attitude and Professionalism
(v) Communication, Leadership and Team Skills
(vi) Problem Solving and Scientific Skills
(vii) Information Management and Lifelong Learning Skills
(viii) Managerial and Entrepreneurial Skills

Soft Skills Learning Outcomes :-
(i) Communication Skills
(ii) Critical Thinking and Problem Solving
(iii) Lifelong Learning and Information Management
(iv) Team Working Skills
(v) Entrepreneurial Skills
(vi) Ethiques and Professional Moral
(vii) Leadership Skills

6.4 Programme Core Courses: Bachelor of Engineering (Hons) Chemical and Process (EH241)

SEMESTER 1	
CPE414	**ENGINEERING DRAWING** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 1
CHE434	**PROCESS CHEMISTRY** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 1
CPE420	**INTRODUCTION TO CHEMICAL ENGINEERING** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 1.
CHE493	**FLUID MECHANICS**
Course Description	This course is a core subject in most engineering disciplines. The course is designed to provide the students with the principles of flow of fluid through pipes, bends and valves. Important equipment in fluid transport including different types of flow meters, notches and weirs are discussed.
Course Outcomes	At the end of the course students are able to: ·Ability to identify characterization of fluid static and fluid in motion. ·Ability to analyze the system involving fluids through friction in pipes, channels and fluid motion devices. ·Ability to appraise the system of fluid in motion.

SEMESTER 2	
CHE433	**THERMODYNAMICS** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 2.
CHE469	**MATERIALS AND ENERGY BALANCE**
Course Description	This course presents an introduction to mass and energy balances. The students are exposed to advanced material and energy balances concepts to solve problems of unit operation in chemical processing of reactive and non-reactive systems.
Course Outcomes	At the end of the course students are able to: ·Ability to identify the basic techniques for expressing the values of system variables and for setting up and solving equations that relate these variables. ·Ability to apply the known information about process variables, setting up material balance equation, and solving these equations for unknown variables for non-reactive and reactive system.

	·Ability to develop the known information about process variables, setting up energy balance equation, and solving these equations for non-reactive and reactive system.
CHE495	**HYDROCARBON CHEMISTRY**
	Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 2.
CHE485	**CHEMISTRY LABORATORY**
	Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 1.
	SEMESTER 3
CHE463	**HEAT TRANSFER**
	Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 3.
CHE553	**CHEMICAL ENGINEERING THERMODYNAMICS**
	Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 4.
CPE453	**PROCESS ENGINEERING LABORATORY I**
Course Description	This course involves series of experiments that deals with the principles of water analysis, properties of certain liquids and gasses and fluid mechanics unit.
Course Outcomes	At the end of the course students are able to: ·Perform the operations and performance of fluid flow and analyze the problems associated with the operations. ·Perform the operations and performance of thermodynamics principles and analyze the problems associated with the operations.
	SEMESTER 4
CHE520	**PROCESS UNIT OPERATIONS**
Course Description	This course introduces the students to one of the fundamental knowledge that the students must acquire in chemical engineering. The topics covered include the concepts of material balance and principle and equipment description for distillation, gas absorption, extraction and leaching. In addition special topic(s) on mass transfer would also be introduced to the students.
Course Outcomes	At the end of the course students are able to: ·Ability to identify various types of unit operations based on mass transfer and fluid interactions principles. · Ability to apply process design principles of distillation, absorption, liquid liquid extraction and solid liquid extraction unit ·Ability to design separation process equipment involving mass transfer in distillation, absorption, liquid liquid extraction and solid liquid extraction unit.
CHE522	**TRANSPORT PHENOMENA**
Course Description	This course introduces the topic of transport phenomena, which involves the development of mathematical models and physical understanding of the transfer of momentum, energy and mass. Transport phenomena define the skill set

	necessary for solving the challenging problems that arise in the chemical and process engineering profession.
Course Outcomes	At the end of the course students are able to: ·Ability to describe the conservation principles and analogies of momentum, energy and mass transport ·Ability to develop the momentum, energy and mass balance according to the system given ·Ability to justify the concept of transport phenomena
CPE554	**PROCESS ENGINEERING LABORATORY II**
Course Description	Process engineering laboratory II is a continuation of the previous process engineering laboratory works. The emphasis here would be on subjects such as reactor engineering, process heat transfer and mass transfer.
Course Outcomes	At the end of the course students are able to: ·Perform the operations and understand the problems during experiments based on reaction engineering process. ·Perform and understand the experiments regarding cooling tower operation and the concepts based on heat transfer. ·Perform and understand the experiments regarding membrane separation unit and the concepts based on mass transfer/separation.
CHE555	**NUMERICAL METHODS AND OPTIMIZATION**
	Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 4.
CHE594	**CHEMICAL REACTION ENGINEERING**
	Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 4
	SEMESTER 5
CHE591	**PROCESS ENGINEERING I**
Course Description	This course deals with more detailed concepts in mass transfer and enhanced theory in separation process principles. These comprise the applications of the theory and concept in several major unit operations of chemical engineering including evaporation, drying of process materials, adsorption, chromatography, crystallisation, ion-exchange, reverse osmosis, ultra-filtration, micro-filtration, nano-filtration, and electro-dialysis.
Course Outcomes	At the end of the course students are able to: ·Ability to identify various types of unit operations based on mass transfer and fluid interaction principles. ·Ability to apply mass transfer and separation process design principle in solving unit operations equipment. ·Ability to evaluate chemical design calculations for various separation process equipment.

CPE562	**CHEMICAL PROCESS CONTROL**
Course Description	This course introduces the technical theory of process control, starting with the objectives of control system. The mathematical tool is very important for designing control systems. Different types of responses can be analyzed using different types of analysis. This module covers SISO (single input-single output) system only.
Course Outcomes	At the end of the course students are able to: ·Explain the principle of various process instrumentations ·Select the appropriate system for a given chemical process ·Design a schematic P&ID for various control strategies
CPE604	**PLANT DESIGN AND ECONOMICS** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 5
CPE613	**PROCESS SIMULATION LABORATORY** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 5.
CHE625	**ADVANCED CHEMICAL REACTION ENGINEERING**
Course Description	The course deals with some advanced topics in chemical reaction engineering. Topics covered include heterogeneous and catalytic reactions, non-ideal and bioreactors, polymerisation and multiphase reactions.
Course Outcomes	At the end of the course students are able to: · Ability to explain the principle features of conventional and complex reactions and their application. · Ability to apply the principles and knowledge of heterogeneous reaction, catalytic reaction and complex reaction. · Ability to evaluate reactors and reaction mechanism for heterogeneous and catalytic reaction.
CPE680	**LEADERSHIP AND PROFESSIONAL ETHICS FOR ENGINEERS** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 5.
	SEMESTER 6
CHE692	**PROCESS MODELING AND SIMULATION** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 6.
CHE572	**PARTICLE TECHNOLOGY** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 6.
CPE639	**MECHANICAL DESIGN OF PROCESS EQUIPTMENTS** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 6.

CPE615	**PROCESS SAFETY**
	Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 6
CPE622	**PROCESS CONTROL PRACTICES**
Course Description	This course introduces the application of process control. The theoretical area of process control is being integrated with the practical area. This course exposed the students towards the problem solving using actual industrial control system. The current technology of control software is used so that the students can have an advanced knowledge of control prior going for the real situations of controlling the processes.
Course Outcomes	At the end of the course students are able to: · Ability to calculate process characteristic from an open loop process response. · Ability to calculate the optimum controller setting. · Ability to fine tune a PID controller toward the desired process response.
CPE633	**PROCESS ENGINEERING II**
Course Description	This module introduces the technical theory of heat exchanger, which is then followed by process integration. Using the heat integration technology, student must then design heat exchanger networks which can benefit the process in minimizing the energy created for one chemical process.
Course Outcomes	At the end of the course students are able to: · Ability to explain the scientific and engineering principles underlying process and heat intergration in solving energy efficiency issue. · Ability to determine the minimum utlity targets for process system · Ability to integrate knowledge of engineering with the economic tradeoffs
CHE690	**INDUSTRIAL TRAINING**
	Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 6.
	SEMESTER 7
CPE644	**DESIGN PROJECT I**
Course Description	The design project course is the pinnacle of the chemical & process engineering program. Students are required to carry out a project on related topic to chemical engineering. Although this course is designed as a team work, much emphasis is given to the individual effort in carrying out the task. This course focuses on the literature study of the project including process background, market analysis, site selection, safety aspects, detailed mass and energy balances and process simulation.
Course Outcomes	At the end of the course students are able to: ·Demonstrate, identify, justify and analyze the knowledge in designing the designated equipment and process control technologies by using appropriate method.

	·Justify and apply process for economic evaluation and relevant Acts for environmental management and waste treatment. ·Carry out mass and energy balances on the overall designed process. ·Simulate the designed process using HYSYS and adapt the safety procedures and aspects for a safer plant.
CHE687	**RESEARCH PROJECT 1**
Course Description	In this course each student will be required to prepare and deliver an oral and written report. A series of lectures on research methodology will be given as guidance for the students. The sequence of the report is based on a systematic development of the thesis. The subjects of these reports are: - An introduction to the general topic - A literature review of the specific topic of the project or thesis - A thesis proposal that should include the detailed scope and plan of the research - Each of these reports should contain primary material that will be included in the final thesis report, which will be delivered at the conclusion of the research.
Course Outcomes	At the end of the course students are able to: ·Design the research methodology in terms of experimental set-up and the procedures in order to achieve the objectives of the research. ·Carry out the research works according to the outlined procedures and obtain data. ·Analyze and interpret data and drawing conclusion based on findings.
CHE620	**PROJECT MANAGEMENT** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 6.
	Specialisation Course I
	Specialisation Course 2
	SEMESTER 8
CPE664	**DESIGN PROJECT II**
Course Description	The Design Project II is a continuation from Design Project I. This course compliments all the tasks that has been planned and executed in Design Project I. Each group is required to submit a documented plan and report within the given time frame. In general, the Design Project II is mainly focusing on the individual work in carrying out the prescribed task including equipment design, process control and instrumentation, process economic analysis, plant safety, process integration and environment & waste treatment.
Course Outcomes	At the end of the course students are able to: ·Demonstrate, identify, justify and analyze the knowledge in designing the designated equipment and process control technologies by using appropriate method.

	·Justify and apply process for economic evaluation and relevant Acts for environmental management and waste treatment. ·Carry out mass and energy balances on the overall designed process. ·Simulate the designed process using HYSYS and adapt the safety procedures and aspects for a safer plant.
CHE697	**RESEARCH PROJECT II**
Course Description	This course is the continuation from Research Project 1. Each student will be required to submit a report on the project.
Course Outcomes	At the end of the course students are able to: ·Utilize the knowledge of wastewater quality (physical, chemical and biological) characteristics. ·Analyze the characteristics of wastewater, flowrate and mass loading for the design of wastewater treatment plant and the relationship with related legislative requirements. ·Design physic-chemical plant for treatment of industrial wastewater ·Design a biological wastewater treatment plant and design a sludge treatment plant.
	Specialisation Course 3
	Specialisation Course 4
	Specialisation Course 5
Elective 1	
	Specialisation Course 1
CPE655	**SOLID WASTE MANAGEMENT**
Course Description	The course gives an introduction to management of solid wastes. Collection, separation, thermal and biological treatment and construction, operation and monitoring of sanitary landfills is in focus. The course concerns alternative strategies for waste management and recycling of different types of solid waste. These methods include incineration, composting and anaerobic digestion. Environmental assessment of the different waste management options with respect to energy and resource consumption as well as environmental pollution is also included in the course.
Course Outcomes	At the end of the course students are able to: ·Apply principles related to solid waste management. ·Select and justify the different methods of solid waste management. ·Design at least one method of waste disposal technique.
CPE656	**PETROLEUM REFINING ENGINEERING**
Course Description	This course introduces the process of refining petroleum into various valuable fractions for the downstream oil and gas industry. This module covers the processes and technologies used in the petroleum refining as well as health and safety as consideration.

Course Outcomes	At the end of the course students are able to: ·Explain the origin and occurance of crude oil and its important properties and composition. ·Describe the overall refinery operations of crude petroleum in converting raw materials to valuable major products. ·Describe and distinguish specific main processes in petroleum refining and explain the health and safety issues arises due to process operation and chemicals used.
CPE677	**POLYMERIC MATERIALS, RUBBER AND COMPOSITES**
Course Description	This course provides a basic knowledge of polymer engineering. It emphasizes on classification and naming of polymers, polymerization techniques, concept of polymer solubility, concept of amorphous and crystalline structures and future trends in polymers.
Course Outcomes	At the end of the course, students should be able to: · Explain the fundamentals of polymeric materials and their classification. · Discuss the different polymerization route. · Explain the relationship of polymer thermal properties, concept of polymer solubility as well as future trends in polymers.
CPE 658	**PALM OIL MILLING AND REFINING**
Course Description	This course discusses the palm oil milling start from handling the FFB to the mill, processing involves in the mill such as sterilization process, stripping process, digestion and pressing, oil clarification and purification. Refining methods also discusses here to give better understanding the types of refining and the refining losses.
Course Outcomes	At the end of the course, students should be able to: · Identify the processes involve in extraction of crude palm oil from the fresh fruit bunches (FFB). · Explain the refining process of the crude palm oil and palm kernel oil.
	Specialisation Course 2
CPE665	**AIR POLLUTION ENGINEERING**
Course Description	This course includes background materials on sources of air pollution and their effects, but the focus of the course is on technologies for quantifying emissions, reducing emissions from existing plants, and designing new plants and retrofits to reduce emissions. The regulatory environmental is covered, as well as the very basics of atmospheric dispersion.
Course Outcomes	At the end of the course students are able to: ·Identify the sources, types and characteristics of particulate and gaseous air pollutants, importance of engineering control, health considerations and proceedings related to the RMAQG and EQA 1974.

	·Apply scientific and engineering knowledge in the design and operation of particulate and gaseous emission control equipments such as cyclone, fabric filter, electrostatic precipitator (ESP), particulate scrubber, VOC incinerator and absorption tower. ·Utilize predictive tools in air dispersion modeling and impact assessment proceedings, particularly Gaussian dispersion model and its related atmospheric conditions.
CPE666	**PETROCHEMICAL PROCESS ENGINEERING**
Course Description	This course provides study of the petrochemical processes. This module will be assist by the research work which will be completed by the students. The research will act as an aid for the student to understand more about the latest technology on the petrochemical processes.
Course Outcomes	At the end of the course students are able to: ·Explain the importance and growth of petrochemical industry in Malaysia and describe the principles of raw materials and their sources. ·Apply and integrate knowledge of chemical process engineering in various petrochemical processes. ·Describe the latest technology and future market trends in petrochemical industry.
CPE 667	**ENGINEERING PROPERTIES OF POLYMER**
Course Description	This course is an introductory course on the engineering properties of polymer such as the mechanical properties, electrical properties, chemical resistance, degradation effects, flammability properties and rubber elasticity. A strong emphasis will be given on the mechanical properties which include viscoelastic behavior, tensile and impact properties. At the end of the course the student should be able to explain the interrelation between polymer properties, structures and applications. The students should also be able to describe the appropriate test and characterization for each property.
Course Outcomes	At the end of the course, students should be able to: · Discuss the important engineering properties of polymer. · Explain the interrelation between polymer properties, structures and applications. · Describe the appropriate test and characterization for each property.
CPE 679	**QUALITY ASSURANCE AND QUALITY CONTROL IN PALM OIL INDUSTRY**
Course Description	This course discusses both quality assurance and quality control to achieve maximum yield and consistent product quality. This course also discusses the application of HACCP and put into practice.
Course Outcomes	At the end of the course, students should be able to: · Identify the quality requirement aspects in palm oil industry · Analyze on how to achieve highest yield and consistent quality in palm oil industry

Elective 2

Specialisation Course 3

CPE675	**WASTEWATER ENGINEERING**
Course Description	The course is designed to provide the students with the principles of wastewater qualities, collection, treatment, storage, and disposal. Principles learned in the course will be applied through solving design problems, written reports and examinations.
Course Outcomes	At the end of the course students are able to: ·Utilize the knowledge of wastewater quality (physical, chemical and biological) characteristics. ·Analyze the characteristics of wastewater, flowrate and mass loading for the design of wastewater treatment plant and the relationship with related legislative requirements. ·Design physic-chemical plant for treatment of industrial wastewater. ·Design a biological wastewater treatment plant and design a sludge treatment plant.
CPE671	**REFINERY AND PETROCHEMICAL EQUIPMENT**
Course Description	This course emphasizes the study of equipment related to refinery and petrochemical processes. The course coverage includes the conception of the overall plant, special features of equipment the designing aspect.
Course Outcomes	At the end of the course students are able to: ·Identify the necessary and the most appropriate equipment for refinery and petrochemical process and able to explain the safety measures of plant operations and environment with emphasize on the sustainable development. ·Do conceptual design of major equipments used in refinery and petrochemical plants with the present of data and details of the process. ·Design control strategy of major equipment and describe safety features provided for each equipment.
CPE 659	**CHARACTERIZATION AND TESTING OF POLYMERIC MATERIALS**
Course Description	This examines the physical testing methods involved in polymer characterization. The course emphasizes polymer synthesis, characterization and structure-property relationships
Course Outcomes	At the end of the course students are able to: ·Apply and conduct experimental techniques involved in characterizing polymers. ·Emphasize on provision of a working knowledge of instrumental analysis. ·Analyze data based on the experimental result.
CPE 668	**OLEOCHEMICAL PROCESSES AND APPLICATIONS**
Course Description	This course discusses the production of basic oleochemicals such as fatty acids, fatty alcohols and glycerine from the various types of raw materials. This course also covers the application of the basic oleochemicals in various industries and as well as the environmental issues related to the production of this type of chemicals.

Course Outcomes	At the end of the course students are able to: ·Identify, describe and distinguish the various unit operation involved in downstream of palm oil industry as well as oleochemical industry. ·Apply and integrate the knowledge of chemical engineering in the production of oleochemical products and its application.
	Specialisation Course 4
CPE635	**ENVIRONMENTAL MANAGEMENT SYSTEM**
Course Description	This course examines principles, procedures, methods, and applications of ISO 14000 assessment and as a tool to improve environmental performance. Students will be introduced to environmental auditing, goals, objectives, procedures and practical aspects in auditing such as the flow processes in auditors planning, preaudit, site visit, data evaluation, audit report, action plans and also the evaluation of audit program.
Course Outcomes	At the end of the course students are able to: ·Utilize the knowledge of cleaner production (principles, benefits and applications). ·Explain the distinctive features between end-of-pipe and cleaner production approaches and apply it in environmental pollution control. ·Apply elements of EMS in engineering project management decision making processes. ·Explain how to conduct an environmental audit.
CPE 681	**WASTE AND ENVIRONMENTAL MANAGEMENT IN PETROCHEMICAL INDUSTRY**
Course Description	Topics covered include recognizing waste streams and its distribution, wastes effect to the environment and regulation involved, waste management and pollution prevention policy, physical, chemical, thermal treatments and disposal methods of wastes. Industry specific topics (petroleum and petrochemical) cover the major sources of pollution related and ways for mitigation.
Course Outcomes	At the end of the course students are able to: ·Explain types of waste streams, and techniques or methods used to treat the wastes and the reactions involved in the process. ·Identify the chemical use, handling processes and relate the processes involved with the appropriate environmental quality act (EQA). ·Apply regulations pertaining to the petrochemical production industries and analyze the pollution prevention options and critical environmental issues in petrochemical industries.
CPE 689	**WASTE AND ENVIRONMENTAL MANAGEMENT IN POLYMER INDUSTRY**
Course Description	Topics covered include recognizing waste streams in related industries & its distribution, wastes effect to the environment & regulation involved, waste management & pollution prevention policy, physical, chemical, thermal treatments & disposal methods of wastes. Industry specific topics (petroleum & chemical) cover the major sources of pollution related & ways for mitigation.

Course Outcomes	At the end of the course students are able to: ·Develop the awareness of professional responsibility towards protecting the environment. ·Acquaint oneself with the pertinent legislation & methodology. ·Study environmental issues involving engineering & resources.
CPE 688	**FOOD AND NON-FOOD PROCESSING OF PALM AND PALM KERNEL OIL**
Course Description	This course discusses the oil modification process of oils and fats to suit the food and non food uses. Raw materials property will also be discussed in details accordingly to their applications.
Course Outcomes	At the end of the course students are able to: ·Identify the oil modification process of oils and fats to suit the food and non food uses. ·Differentiate the raw materials property of oils and fats from palm and palm kernels.
	Specialisation Course 5
CPE695	**ENVIRONMENTAL IMPACT ASSESSMENT (EIA)**
Course Description	This course discusses principles, procedures, methods, and applications of environmental impact assessment (EIA) as a tool to improve environmental performance.
Course Outcomes	At the end of the course students are able to: ·Apply and utilize principles and methods in preparing the EIA ,concepts, requirements, scope, relevant laws, regulations, guidelines, procedures and expertise needed by the DOE. ·Review and critically analyze an environmental impact assessment. ·Evaluate EIA as a valuable tool in the engineering project management decision-making process. ·Apply mathematical models where appropriate for environmental impact prediction.
CPE696	**FUTURE TRENDS OF PETROCHEMICAL PROCESSES**
Course Description	This course introduces the experiences from the petrochemical industrial expertise. The industrial talks will provide the real experience from industries. Prior to the talk, students will be given tasks, which require them to do research and study on the topics given. Reports and involvement of the students in the talks will be taken as the assessments. Visits to the respective plant will enhance the knowledge and hence help the students in finding the suitable place for the internship program.
Course Outcomes	At the end of the course students are able to: ·Apply and integrate knowledge of petrochemical engineering with the real situation. ·Explain and describe the current safety and environment issues of petrochemical plants.

	·Explain and describe the future technology development and sustainability aspects in petrochemical plants operations.
CPE 697	**POLYMER PROCESSING**
Course Description	This course imparts the knowledge of major technology involve in polymer processing to give students better understanding of rheological concepts and their application in polymer processing
Course Outcomes	At the end of the course students are able to: ·Apply the rheological approach to the unit operations in the polymer processing. ·Discuss and apply different technologies involve in polymer processing. ·Describe and relates polymer resources and processing.
CPE 699	**WASTE AND ENVIRONMENTAL MANAGEMENT IN PALM OIL INDUSTRIAL SECTORS**
Course Description	This course discusses on the wastes generated from palm oil industries and the treatments involve in treating the wastes. In addition, topics on waste utilization and management would also be discussed
Course Outcomes	At the end of the course students are able to: ·Identify the waste treatment methods and by product utilization of oil palm / palm oil processing industries. ·Justify the management of palm oil industrial wastes.

7.0 Bachelor of Engineering (Hons) Chemical and Bioprocess (EH 242)

7.1 Bachelor of Engineering (Hons) Chemical and Bioprocess: Academic Staff

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*** On Study Leave**
**** Seconded to Pasir Gudang Campus, UiTM Johor**

7.2 Programme Structure: Bachelor of Engineering (Hons) Chemical and Bioprocess (EH242)

Study Plan EH242 Package 2 (ID 5484)

This study plan is used by Semester 1 and Semester 3 students (from Diploma EH110) started from Semester 1 2013/2014 Session. The following are the details on the courses offered:

Number of Faculty courses: 41
Number of Faculty courses with final examination: 25
Number of Faculty courses with continuous assessment: 16

YEAR	SEMESTER	CODE	COURSE	CREDIT
1	1	ELC400	Preparatory College English	2
		KKR1	Co curriculum I	1
		MAT435	Calculus for Engineers	3
		CPE414	Engineering Drawing	1
		CHE503	Fluid Flow	3
		CBE424/CBE432	Introduction to Chemical and Bioprocess Engineering	3
		CBE422/CBE421	Organic and Instrumental Chemistry for Engineers	3
	2	KKR2	Co-Curriculum II	1
		CTU551	Tamadun Islam dan Tamadun Asia I	2
		CHE434	Process Chemistry	3
		CHE469	Material And Energy Balance	4
		CBE450/CBE531	Microbiology for Bioprocess Engineer	3
		CBE541	Microbiology Lab	1
		CHE463	Heat Transfer	3
2	3	ENT600	Technopreneurship	3
		BKE1	Bahasa Ketiga I	2
		KKR3	Co-Curriculum III	1
		MAT455	Further Calculus for Engineers	3
		CBE451	Biochemistry and Metabolic Regulation	3
		CBE500/CBE461	Biochemistry Lab	1
		CPE453	Process Engineering Lab I	1
		CHE433	Thermodynamics	3
	4	BKE2	Bahasa Ketiga II	2
		ELC501	Critical Academic Reading	2
		CHE553	Chemical Engineering Thermodynamics	3
		CHE594	Chemical Reaction Engineering	3
		CBE552/CBE551	Genetic Engineering	3
		CBE582	Separation Processes I	3
		CBE561	Genetics lab	1
3	5	BKE3	Bahasa Ketiga III	2
		CBE682	Separation Processes II	3
		CHE555	Numerical Methods and Optimization	3
		CPE604	Plant Design And Economics	4
		CHE620	Project Management	3
		CPE554	Process Engineering Lab II	1
	6	CPE680	Leadership And Professional Ethics For Engineers	3
		CPE639	Mechanical Design of Process Equipment	3
		CBE663	Downstream Processing	2
		CBE686	Safety And Health In Chemical & Bioprocess Industries	3
		CBE654	BioReactor Enginering	3
			Specialization Course I	2
		CBE661	Bioprocess Engineering Lab	1

		CBE655	BioProcess Simulation Lab	1
4	7	CHE690	Industrial Training	5
		CBE685	Design Project I	3
		CBE645	Bioprocess Control And Instrumentation	4
		CHE675	Environmental Engineering	3
			Specialization Course II	3
		CBE684	Research Project I (Specialized area)	3
	8	CBE695	Design Project II	3
		CTU553	Ethnic Relationships	2
		CBE694	Research Project II (Specialized area)	3
			Specialization Course III	3
			Specialization Course IV	3

SPECIALIZATION COURSES

SEM	CODE	COURSE	PRE REQUISITE	CREDIT HOUR	Contact Hour		
					L	T	Lab
		FOOD TECHNOLOGY STREAM					
6	CBE668	Introduction To Food Science & Technology	Elective	3	3	-	-
7	CBE648	Food Preservation Technology	Elective	4	3	-	3
8	CBE688	Quality Management in Food Industry	Elective	2	2	-	-
8	CBE698	Food Process Engineering	Elective	3	3	1	-
		PHARMACEUTICAL TECHNOLOGY STREAM					
6	CBE659	Introduction To Industrial Pharmacy	Elective	3	3	1	-
7	CBE609	Particle Processing For Pharmaceutical Application	Elective	3	3	1	-
8	CBE689	Pharmaceutical Material Processing	Elective	3	3	1	-
8	CBE699	Biopharmaceutical Technology	Elective	3	3	1	-
		INDUSTRIAL BIOTECHNOLOGY STREAM					
6	CBE667	Industrial Bioprocess Technology	Elective	3	3	1	-
7	CBE647	Bioinformatics	Elective	3	2	2	-
8	CBE687	Biocatalysts	Elective	3	3	1	-
8	CBE697	Biorefineries	Elective	3	3	1	-

Study Plan EH242 Package 1 (ID 4531)

This study plan is used by Semester 1 and Semester 3 students (from Diploma EH110) started from Semester 1 2011/2012 Session. The following are the details on the courses offered:

Number of Faculty courses: 41
Number of Faculty courses with final examination: 26
Number of Faculty courses with continuous assessment: 15

YEAR	SEMESTER	CODE	COURSE	CREDIT
1	1	CTU551	Tamadun Islam dan Tamadun Asia I	2
		KKR1	Co curriculum I	1
		MAT435	Calculus for Engineers	3
		CHE414	Engineering Drawing	2
		CPE435	Process Chemistry	3
		CBE432	Industrial Chemical & Bio-Processes and Sustainability	3

		CBE421	Organic Chemistry	3
		CHE485	Chemistry Laboratory	1
	2	BKE1	Bahasa Ketiga I	2
		KKR2	Co-Curriculum II	1
		CHE433	Thermodynamics	3
		CPE471	Material And Energy Balance	4
		CBE451	Biochemistry and Metabolic Regulation	3
		CHE463	Heat Transfer	3
		CBE461	Biochemistry Lab	1
2	**3**	BKE2	Bahasa Ketiga II	2
		BEL422	Report Writing	2
		ENT600	Technopreneurship	3
		KKR3	Co-Curriculum III	1
		MAT455	Further Calculus for Engineers	3
		CBE531	Mircobiology and cell biology	3
		CHE503	Fluid Flow	3
		CBE541	Microbiology Lab	1
	4	BKE3	Bahasa Ketiga III	2
		BEL499	Communication & Interpersonal Skills	2
		MAT565	Advanced Differential Equation	3
		CBE551	Genetics and Molecular Biology	3
		CPE553	Chemical Engineering Thermodynamics	2
		CBE582	Separation Processes I	3
		CPE453	Process Engineering Lab I	1
		CBE56	Genetics lab	1
3	**5**	CBE682	Separation Processes II	3
		CHE555	Numerical Methods and Optimization	3
		CHE641	Mechanical Design of Process Equipment	3
		CBE686	Safety And Health In Chemical & Bioprocess Industries	3
		CHE594	Chemical Reaction Engineering	3
		CPE554	Process Engineering Lab II	1
	6	CHE680	Leadership And Professional Ethics For Engineers	3
		CHE604	Plant Design And Economics	4
		CBE653	Downstream Processing	2
		CBE654	BioReactor Enginering	3
			Specialization Course I	3
		CBE661	Bioprocess Engineering Lab	1
		CBE655	Process Simulation Lab	1
4	**7**	CHE690	Industrial Training	5
		CHE686	Design Project I	3
		CBE645	Bioprocess Control And Instrumentation	4
		CHE675	Environmental Engineering	3
			Specialization Course II	3
		CHE687	Research Project I (Specialized area)	3
	8	CHE696	Design Project II	3
		CTU553	Ethnic Relationships	2
		CHE697	Research Project II (Specialized area)	3
			Specialization Course III	3
			Specialization Course IV	3

7.3 Learning Outcome and Soft Skill (LO-KI) Matrix For Programme EH 242 Courses

Course Code	Course	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9
University Courses										
CTU551	Tamadun Islam dan Tamadun Asia I	√		√	√	√	√			√
KKR1	Co curriculum I	√	√	√	√			√		
BKE1	Bahasa Ketiga I				√	√		√		√
KKR2	Co-Curriculum II	√	√	√	√			√		
BKE2	Bahasa Ketiga II				√	√		√		√
ELC501	Critical Academic Reading				√			√		
ENT600	Technopreneurship							√	√	
KKR3	Co-Curriculum III	√	√	√	√			√		
BKE3	Bahasa Ketiga III					√		√		√
CTU553	Ethnic Relationships				√	√	√	√		√
Total	**Number of courses**	4	3	4	8	6	2	10	1	6
Core Courses										
CHE414	Engineering Drawing	√	√	√				√		
CHE434	Process Chemistry	√		√						
CBE424	Introduction to Chemical and Bioprocess Engineering	√		√	√		√			
CBE422	Organic and Instrumental Chemistry for Engineers	√		√						
MAT435	Calculus for Engineers	√	√	√				√		
CHE433	Thermodynamics	√		√						
CHE469	Material And Energy Balance	√		√						
CBE451	Biochemistry and Metabolic Regulation	√		√						
CHE463	Heat Transfer	√		√						
CBE450	Microbiology for Bioprocess Engineer	√		√						

CBE500	Biochemistry Lab	√	√	√	√	√				√
CHE503	Fluid Flow	√		√						
CBE541	Microbiology Lab	√	√	√	√	√				√
MAT455	Further Calculus for Engineers	√	√	√			√			
CBE552	Genetics Engineering	√		√						
CHE553	Chemical Engineering Thermodynamics	√		√						
CBE582	Separation Processes I	√		√						
CPE453	Process Engineering Lab I		√	√	√	√				√
CBE561	Genetics lab	√	√	√	√	√				√
CBE682	Separation Processes II	√		√						
CHE555	Numerical Methods and Optimization	√	√	√				√		
CHE641	Mechanical Design of Process Equipment	√		√						
CBE686	Safety And Health In Chemical & Bioprocess Industries	√		√			√			
CHE594	Chemical Reaction Engineering	√		√						
CHE620	Project Management				√	√				√
CPE554	Process Engineering Lab II		√	√	√	√				√
CPE680	Leadership And Professional Ethics For Engineers				√	√	√	√		√
CHE604	Plant Design And Economics	√		√						
CBE663	Downstream Processing	√		√						
CBE654	BioReactor Enginering	√		√						
CBE661	Bioprocess Engineering Lab		√	√	√	√				√
CBE655	Bioprocess Simulation Lab	√	√	√				√		
CHE690	Industrial Training	√			√		√	√	√	

CBE685	Design Project I	√	√	√	√	√	√	√	√	√
CBE645	Bioprocess Control And Instrumentation	√	√	√	√	√				√
CHE675	Environmental Engineering	√		√			√			
CBE684	Research Project I (Specialized area)	√		√				√		
CBE695	Design Project II	√		√	√	√	√	√	√	√
CBE684	Research Project II (Specialized area)	√	√	√			√	√		
Total	**Number of courses**	34	14	36	13	11	9	10	3	11
Elective Courses										
CBE678	Introduction To Food Science & Technology						√			
CBE640	Introduction To Industrial Pharmacy	√		√			√			
CBE641	Industrial Bioprocess Technology	√		√			√			
CBE658	Food Preservation Technology	√		√			√			
CBE609	Particle Processing For Pharmaceutical Application	√	√	√			√		√	
CBE647	Bioinformatics	√	√	√				√		
CBE690	Quality Management In Food Industry	√		√			√			
CBE698	Food Process Engineering	√		√			√			
CBE689	Pharmaceutical Material Processing	√		√			√		√	
CBE699	Biopharmaceutical Technology	√		√			√			
CBE687	Biocatalysts	√		√						
CBE697	Biorefineries	√		√						
Total	**Number of courses**	11	2	11	0	0	9	1	2	0
Total		49	19	51	21	17	20	21	6	17

7.4 Programme Core Courses: Bachelor of Engineering (Hons) Chemical and Bioprocess (EH242)

Programme Core Courses: Bachelor of Engineering (Hons) Chemical and Bioprocess (EH 222)

SEMESTER 1	
CHE414	**ENGINEERING DRAWING (BL)** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 1
CHE503	**FLUID FLOW (BL)** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 1.
CBE442/432/424	**INTRODUCTION TO CHEMICAL AND BIOPROCESS ENGINEERING (BL)**
Course Description	This course begins with an overview of chemical and biochemical industries. Basic knowledge is imparted on the state-of-art technologies in the processing of various important resources such as petroleum, gas, palm oil, rubber, textile, and other agricultural resources in order to produce various value-added products by chemical or biochemical route. In addition, topics on utilities and current issues related to the industrial processes would also be discussed.
Course Outcomes	At the end of the course students are able to: • Ability to describe the organic bonding theory with the application in the industry • Ability to distinguish the functional groups of compounds that commonly produced in the industry from organic chemistry reactions • Ability to appraise the organic chemistry reactions involved in relation to functional groups for industrial application
CBE421/422	**ORGANIC AND INSTRUMENTAL CHEMISTRY FOR ENGINEERS (BL)**
Course Description	The course introduces organic compounds, their structure, properties, nomenclature, reactions and applications. Also, this course also highlighted the study of the organic chemistry of biological molecules, with a special emphasis on chemical and bioprocess principles. In this course, we will consider the structure, properties and reactivity of biological molecules. We will also study their synthesis and their roles in biological processes. The main purpose of the course is to give the students insight into the chemical and bioprocess industry, which focus on the organic fine chemicals industry.
Course Outcomes	At the end of the course students are able to: • Describe the organic bonding theory with the application in the industry • Appraise the organic chemistry reactions involved in relation to functional groups for industrial application • Distinguish the functional groups of compounds that commonly produced in the industry from organic chemistry reactions

SEMESTER 2	
CHE434	**PROCESS CHEMISTRY (BL)** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 1.
CPE471/CHE469	**MATERIAL AND ENERGY BALANCE (BL)**

Course Description	This course presents an introduction to mass and energy balances. The students are exposed to advanced material and energy balances concepts to solve problems of unit operation in chemical processing of reactive and non-reactive systems
Course Outcomes	At the end of the course students are able to: • Perform a general mass balance and energy balances calculations for various unit operations in reactive and non-reactive systems • Develop systematic problem solving skills in the problems related to the chemical process engineering
CBE450	**MICROBIOLOGY FOR BIOPROCESS ENGINEER (BL)**
Course Description	This course provides an introduction of the microbiology and it application towards industrial practice. The course covered the basic fundamental concept in classification and taxonomy of the microbial, sterilization, media enrichment, metabolite pathway and fermentation technology. The course will also familiarize students with methods required in identification and screening the potential microorganism useful for industry as well as bioproduct development using microbial culture.
Course Outcomes	At the end of the course students are able to: • Ability to describe the diverse microorganisms group according to their physiological characteristics and their role in the evolution of life on earth. • Ability to differentiate the mechanism and metabolite of microbial in bioproduct development. • Ability to develop a basic industrial design in bioproduct development using microbiology concept and principle
CHE463	**HEAT TRANSFER** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 3.

SEMESTER 3

CBE451	**BIOCHEMISTRY AND METABOLIC REGULATION (BL)**
Course Description	The course imparts fundamental knowledge needed for bioprocess engineering in terms of chemical aspects of life from molecular point of view. The course provides the necessary knowledge of the structure, properties and metabolism of Biomolecules viz. Amino acids, Proteins, Carbohydrates, Fatty acids, Lipids, Nucleotides, Nucleic acids. It includes cell transport, energetics, membrane structure, DNA replication, Transcription, Translation, Regulation of gene expression and signal transduction.
Course Outcomes	At the end of the course students are able to: • Ability to describe the diverse microorganisms group according to their physiological characteristics and their role in the evolution of life on earth. • Ability to differentiate the mechanism and metabolite of microbial in bioproduct development. • Ability to develop a basic industrial design in bioproduct development using microbiology concept and principle
CBE461/500	**BIOCHEMISTRY LAB**
Course Description	This course provides the practical tools and techniques needed in analyzing the chemical aspects of life, which is a part of the fundamental knowledge needed for bioprocess engineering. This course provides hands on training to the students on the analysis of Biomolecules viz. Amino acids, Proteins, Carbohydrates, Fatty acids, Lipids, Nucleotides, Nucleic acids. It also trains the students in using the techniques for cell separation, protein separation and chromatography.

Course Outcomes	At the end of the course students are able to: • Perform experiment which related to the fundamental study of biochemistry. • Develop well-structured experimental methodologies for open ended investigations. • Analyze the experimental results and relate with theories.
CPE453	**PROCESS ENGINEERING LAB I** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical and Process (EH 221) Semester 3.
CHE433	**THERMODYNAMICS** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 2.

SEMESTER 4

CPE553/CHE553	**CHEMICAL ENGINEERING THERMODYNAMICS** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 4.
CHE594	**CHEMICAL REACTION ENGINEERING** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 4.
CBE551/552	**Genetic Engineering (BL)**
Course Description	This course presents the important concepts of classical, cytological and population genetics, the mechanisms of heredity and variations in animals, plants, and microorganisms, Mendelian inheritance, genotypes and phenotypes, crossing over, chromosomes and chromosomal modifications, linkage, nucleic acids, the principles of molecular genetics and genetic engineering, gene action, and the roles of genes in development and in populations.
Course Outcomes	At the end of the course students are able to: • Ability to generalize the fundamental knowledge of genetic engineering • Ability to distinguish nucleic acid structure to explain the basics of recombinant DNA technology • Ability to appraise basic level of competency in the practical skills, problem solving, data processing and analysis associated with the field of genetic engineering
CBE582	**SEPARATION PROCESSES I**
Course Description	This subject introduces the students to the fundamental concepts of mass transfer and separation processes. The topics covered include the basic equilibrium relationships and material balance on unit operations. In addition, equipment description and preliminary design of distillation, absorption, stripping and liquid-liquid extraction will be covered.
Course Outcomes	At the end of the course students are able to: • Identify suitable unit operations on mass transfer and fluid interaction principles • Demonstrate chemical engineering calculations involving mass and heat transfer in various unit operations. • Interpret the concepts of distillation, gas absorption and liquid-liquid extraction in chemical separation processes problems.

CBE561	**GENETIC LAB**
Course Description	This course plans to illustrate principles that are presented in Introduction to genetics lecture and to provide an opportunity for the presentation of scientific results and theories.
Course Outcomes	At the end of the course students are able to: • Perform experiments that related to genetics and molecular biology. • Explain the basic principles of genetics and molecular biology from the experiments. • Evaluate and present experimental results scientifically pertaining to molecular genetics theories.

SEMESTER 5

CBE682	**SEPARATION PROCESSES II**
Course Description	This course is a continuation of separation processes I. The topics covered include the fluid-solid separation principles, membrane separation processes, and mechanical-physical separation principles. The students will be exposed on various unit operations and the basic principles and calculation will also be introduced. In addition, special topic(s) on mass transferred would also be included. The subtopics suggested include crystallization processes.
Course Outcomes	At the end of the course students are able to: • Explain the mechanism of mass transfer, heat transfer and fluid interaction principles on the fluid-solid, membrane and mechanical – physical system. • Perform chemical engineering calculations involving mass and heat transfer in adsorption, ion exchange, leaching, drying, evaporation, crystallization, membrane separation, filtration, settling and sedimentation processes. • Develop a basic design for adsorption, ion exchange, leaching, drying, evaporation, crystallization, membrane separation, filtration, settling and sedimentation processes according to the conceptual design.
CHE555	**NUMERICAL METHODS AND OPTIMIZATION** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 4.
CHE604/CPE604	**PLANT DESIGN AND ECONOMICS** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical and Process (EH 221) Semester 5.
CHE620	**PROJECT MANAGEMENT** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical (EH 220) Semester 6.
CPE554	**PROCESS ENGINEERING LAB II** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical and Process (EH 221) Semester 4.

SEMESTER 6

CPE680	**LEADERSHIP AND PROFESSIONAL ETHICS FOR ENGINEERS** Please refer to Programme Core Courses, Bachelor of Engineering (Hons) Chemical and Process (EH 221) Semester 5.

CPE639 **MECHANICAL DESIGN OF PROCESS EQUIPMENT**

Please refer to Programme Core Courses, Bachelor of Engineering (Hons)
Chemical and Process (EH 221) Semester 6.

CBE653/663 **DOWNSTREAM PROCESSING (BL)**

Course Description

This course introduces downstream processing methods for bioproduct separation. The synthesis of bioprocess separation, unit operations and equipments used in the stages of downstream processes are explained covering the operations and applications. Case studies also being introduced to the students for in depth understanding of the downstream process. Finally, the students will be exposed to the concept of product formulation and packaging.

Course Outcomes

At the end of the course students are able to:

- Ability to explain the stages of downstream processes and its application.
- Ability to differentiate the stages of downstream processes according to the design and applications.
- Ability to evaluate the integration of the downstream processes based on the design and applications.

CBE686 **SAFETY AND HEALTH IN CHEMICAL & BIOPROCESS INDUSTRIES**

Course Description

This course offers a detailed study of safety in chemical and bioprocess industries that covering the concepts, methods and application of techniques with emphasize in the control of hazards. The syllabus covers biohazard identification, risk management and mitigation, toxicology and industrial hygiene, hazard analysis, clean technology and biosafety and process equipment in bioprocess industry. The course also emphasizes on legal and ethical issues concerning biosafety.

Course Outcomes

At the end of the course students are able to:

- Identify the physical, chemical and biological hazards in chemical and bioprocess plants
- Examine hazard and risk for chemical and bioprocess industries
- Assess case studies on accidents and hazards in chemical and bioprocess industries.

CBE 654 **BIOREACTOR ENGINEERING**

Course Description

This course imparts in-depth knowledge of design and scale-up of bioreactors along with transport phenomena in bioreactors. It also imparts the knowledge of sterilization of bioreactor systems and alternate bioreactor configurations for microbial, plant and animal cells. After successfully completing this course, students will be able to choose, design, scale-up and analyze bioreactors for various applications. They will also be able to design sterilization systems for air and media sterilization.

Course Outcomes

At the end of the course students are able to:

- Ability to describe the different configuration of bioreactors
- Ability to solve engineering problems in designing bioreactor with free and immobilized cells.
- Ability to evaluate the transport processes in stirred tank bioreactors and immobilized system for the design of operational performance

CBE661 **BIOPROCESS ENGINEERING LAB**

Course Description

This course provides students with the background to understand the basic principles of culture preparation, fermentation of the product using shake flask and bioreactor, growth kinetics study, production of enzyme and enzyme kinetics, immobilized enzyme, freeze and spray drying and cross flow filtration.

Course Outcomes

At the end of the course, students should be able to:

- Describe the experiments for various bioprocess and biochemical engineering fundamentals and the biochemical product purification processes.
- Perform experiments for various bioprocess and biochemical engineering fundamentals.
- Evaluate the results from the experiments for various bioprocess and biochemical engineering fundamentals.

CBE655 BIOPROCESS SIMULATION LAB

Course Description

This course exposes the students to bioprocess simulations by using SuperPro Designer software. The simulations involved equipment such as fermenters, extraxtors, crystallisers, filters, dryers and centrifuge and chromatographic separator.

Course Outcomes

At the end of the course, students should be able to:

- Recognise suitable unit operation and equipment for a particular bioprocess operation
- Analyze simulated result by comparing it with manual calculation/ theoretical solution.
- Perform simulation of industrial scale specific bio-product production using SPD software

CHE690 INDUSTRIAL TRAINING

Please refer to Programme Core Courses, Bachelor of Engineering (Hons)
Chemical (EH 220) Semester 6.

SEMESTER 7

CBE685 DESIGN PROJECT I

Course Description

The Design Project course is the pinnacle of the Chemical Engineering program. The course is spread out into two semesters, named Design Project I and Design Project II. Students are required to carry out a project on related topic to chemical and bioprocess engineering. Although this course is designed as a team work, much emphasis is given to the individual effort in carrying out of the task. Design Project I focuses on the literature study of the project including process background, market analysis, site selection, environmental & safety consideration, detailed mass & energy balances and process simulation.

Course Outcomes

At the end of the course, students should be able to:

- Demonstrate and analyze the knowledge in designing the designated equipment and process control technologies by using appropriate methods.
- Perform material and energy balance on the overall system using manual calculation and simulate the selected process using SuperPro Designer.
- Apply process for economic evaluation and adapt the aspects on safety, environment and waste treatment in compliance with local legislation.

CBE645 BIOPROCESS CONTROL AND INSTRUMENTATION

Course Description

This course imparts fundamental knowledge needed for bioprocess engineering in terms of the instrumentation and control system applicable to process industry (generally) and bioprocess industry (specifically). Topics covered include introduction to the terms used in measurement and instrumentation, the various instruments used to measure (and hence control) pressure, temperature, flow, level, density, rheological properties, pH and dissolved oxygen and carbon dioxide. The conventional control system and specific applications to bioprocess industry is also introduced and emphasized.

Course Outcomes

At the end of the course, students should be able to:

- Ability to describe and grasp the principle of various instruments used in the chemical and bioprocess industry
- Ability to select the appropriate control system for a given process
- Ability to propose the control system design with different mode of feeding the bioreactor

CHE675 **ENVIRONMENTAL ENGINEERING**

Please refer to Programme Core Courses, Bachelor of Engineering (Hons)
Chemical (EH 220) Semester 7

CBE684 **RESEARCH PROJECT I (SPECIALIZED AREA)**

Course Description

In this course each student will be required to prepare and deliver an oral and written report. A series of lectures on research methodology literature review search strategy, experimental design, and thesis writing will be given as guidance for the students. The sequence of the report is based on a systematic development of the thesis. The subjects of these reports are:

1. An introduction to the general topic
2. A literature review of the specific topic of the project or thesis
3. A thesis proposal that should include the detailed scope and plan of the research.

Each of these reports should contain primary material that will be included in the final thesis report, which will be delivered at the conclusion of the research. Plagiarism detector software, Turnitin, will be used primarily by lecturers as a way to gauge the integrity of students' writing before submitting final drafts. The analysis report of plagiarism must be enclosed together with report. The percentage of plagiarism accepted is below 30%.

Course Outcomes

At the end of the course, students should be able to:

- Design the research methodology in terms of experimental set up and the procedures in order to achieve the objectives of the research
- Carry out the research works according to the outlined procedures and obtain data
- Analyze and interpret data and drawing conclusion based on the findings

SEMESTER 8

CBE695 **DESIGN PROJECT II**

Course Description

Design Project II is a group project which evaluates the ability of the students to apply and integrate fundamental principles of Chemical and Bioprocess Engineering in designing a bio-chemical process plant. An important ability of the Design Project II is to assess the students in the planning and execution of a project. In general, the Design Project II is mainly focusing on the individual work in carrying out the prescribed task including equipment design (mechanical and chemical design), process control and instrumentation, process economic analysis, plant safety, process integration and environment & waste treatment.

Course Outcomes

At the end of the course, students should be able to:

- Utilize the chemical and bioprocess engineering knowledge and principles in designing a bio-chemical plant, emphasize on equipment design comparable to industry.
- Apply the hands-on integration of the process plant, process control and instrumentation, process safety and process economic analysis.
- Design the integrated waste treatment plant in compliance with local legislation.

CBE694	**RESEARCH PROJECT II (SPECIALIZED AREA)**
Course Description	Research Project II provides the continuation to Research Project I. It provides students with the experience in planning a project, literature searching, methodology development, oral presentation and report writing. An important aim of Research Project II is to assess the students in the planning and execution of a task. The Research Project II task will be carried out individually. In this course each student will be briefed on aspects of chemical and bioprocess engineering research. They are subsequently required to spend at least 2 hours per week on carrying out their research experimentally based on their research proposal from Research Project I under the supervision of their supervisor. At the end of the course, the students are required to analyze and interpret the findings prior to presentation of the research outcomes. This will be followed with a submission of a complete report of the research project. A series of lectures on academic writing will be given as guidance for the students. The sequence of the report is based on a systematic development of the thesis. The subjects of these reports are: 1. An introduction and background on the study or research; 2. A literature review of the specific topic of the project; 3. A methodology approach and detailed description of the data collection and analysis techniques; 4. The main results and discussion and significance of findings; 5. The conclusion and recommendation for future work. Each of these reports should contain primary material that will be included in the final report, which will be delivered at the conclusion of the research.
Course Outcomes	The primary objective of this course is to provide training in technical presentation techniques - both written and oral. The results of this course should be a complete research project report based on scope definition, time schedule for implementation, literature review, methodology approach, experiments, analysis and interpretation of data. In addition, this course prepares the student for their final project defense.

SPECIALIZATION COURSE I SEMESTER 6

ELECTIVE I FOOD TECHNOLOGY STREAM

CBE678	**INTRODUCTION TO FOOD SCIENCE & TECHNOLOGY (BL)**
Course Description	This is an introductory course in food science and technology. It covers an introduction to the food processing industry, food constituents, composition and processing of different food commodities, sensory and nutritional aspects, food safety and legislation, packaging of food product and product development in food industries.
Course Outcomes	At the end of the course, students should be able to: • Ability to explain various aspects of food science and technology including nutrition, product performance, safety, packaging and product development. • Ability to distinguish the processing method of various food commodities. • Ability to evaluate bioprocess engineering application in food industry.

ELECTIVE II PHARMACEUTICAL TECHNOLOGY STREAM

CBE640	**INTRODUCTION TO INDUSTRIAL PHARMACY (BL)**
Course Description	This course introduces the students to the pharmaceutical industry. The topics cover general information about pharmaceutical industry such as the introduction to drug formulation, development, manufacturing process and R&D. In addition, the fundamental principles and special requirements of manufacturing processes of pharmaceutical products are addressed too.
Course Outcomes	At the end of the course, students should be able to: • Ability to describe general facts about pharmaceutical products, drug's administration and manufacturing processes in pharmaceutical industry • Ability to distinguish various stages of manufacturing processes of pharmaceutical products • Ability to propose suitable drug's characterization methods, administration methods and processes of specific drug's type and application

ELECTIVE III INDUSTRIAL BIOTECHNOLOGY STREAM

CBE641	**INDUSTRIAL BIOPROCESS TECHNOLOGY (BL)**
Course Description	In this course, most of the important products of primary microbial and secondary metabolism, their large-scale production and use as raw materials for industrial application are covered. Bio-manufacturing validation and quality control in industrial will also be highlighted. The regulations in bioprocess technology industry also are covered in this course.
Course Outcomes	At the end of the course, students should be able to: • Ability to describe the scope involved in industrial bioprocess for primary and secondary metabolite products. • Ability to examine the different processes involved in industrial bioprocess for primary and secondary metabolite products. • Ability to evaluate the scope involved in industrial bioprocess for primary and secondary metabolite products.

SPECIALIZATION COURSE II SEMESTER 7

ELECTIVE I FOOD TECHNOLOGY STREAM

CBE658	**FOOD PRESERVATION TECHNOLOGY**
Course Description	The syllabus of this course introduces the factors that can cause food spoilage and the different techniques of food preservation which are commonly applied in the food industry, ranging from conventional to the most current technologies. The course also covers the principles, the description of the processes and equipment involved for these different techniques.
Course Outcomes	At the end of the course, students should be able to: • Ability to define food preservation and factors of food spoilage. • Ability to distinguish the different principles and mechanisms of various food preservation techniques. • Ability to recommend and justify appropriate equipment to solve industrial problem in food processing.

ELECTIVE II PHARMACEUTICAL TECHNOLOGY STREAM

CBE609	**PARTICLE PROCESSING FOR PHARMACEUTICAL APPLICATION**
Course Description	This module covers the design and manufacture of liquid and semi-solid dosage forms. The aim is to impart a detailed knowledge of the design, processing and manufacture of liquid and semi-solid pharmaceutical dosage forms and the associated technology.

ELECTIVE III INDUSTRIAL BIOTECHNOLOGY STREAM

CBE647 BIOINFORMATICS

Course Description

The course is designed to introduce the most important and basic concepts, methods, and tools used in Bioinformatics. Topics include (but not limited to) bioinformatics databases, sequence and structure alignment, protein structure prediction, protein folding, protein-protein interaction, Monte Carlo simulation and molecular dynamics. Emphasis will be put on the understanding and utilization of these concepts and algorithms.

Course Outcomes

At the end of the course, students should be able to:

- Ability to understand basic concepts and computational techniques in biomolecular simulations
- Ability to perform data mining and analyse results from biological databases including structure databases of nucleic acids and proteins
- Ability to visualize and predict protein structure by threading approaches, homology based methods and visualization tools

SPECIALIZATION COURSE III & IV SEMESTER 8

ELECTIVE I FOOD TECHNOLOGY STREAM

CBE690 QUALITY MANAGEMENT IN FOOD INDUSTRY

Course Description

This course covers the principles and approaches that can be implemented in food industry to meet the quality standards. This includes food safety, the related regulations and guidelines. Related issues in food industry such as halal and genetically modified food also being discussed.

Course Outcomes

At the end of the course, students should be able to:

- Ability to identify and explain the principles of quality control in food industries
- Ability to compare and describe food safety procedures and approaches in food processing
- Ability to appraise the food laws and guidelines in food processing which includes halal and genetically modified foods related issues

CBE698 FOOD PROCESS ENGINEERING

Course Description

This course introduces students to the processes and unit operations in the food processing industries. The topics which have been selected will provide coverage on broad areas of processes and unit operations within food processing industries, including: Fish, Meat & Poultry, Dairy Products, Fruits & Vegetables, Beverages, and Cereals & Flour.

Course Outcomes

At the end of the course, students should be able to:

- Ability to describe the details of processes and unit operations involved in the food processing industries
- Ability to apply engineering calculations involving mass and heat transfer in various unit operations related to food processing industries
- Ability to evaluate suitable unit operations based on the application, advantages and limitations in the food processing industries

ELECTIVE II PHARMACEUTICAL TECHNOLOGY STREAM

CBE689 PHARMACEUTICAL MATERIAL PROCESSING

Course Description

This course introduces steps in a chain of events leading to the development and production of new drugs. In this module, the identification, characterisation and selection of the chemical and physical nature of drug compounds intended for delivery in the solid form will be discussed. Throughout this course, three characteristics of drugs compounds will emerge as being the fundamental importance: aqueous solubility, partition coefficient and stability (both chemical and physical).

Much of the science and engineering within this module is concerned with understanding, controlling and tailoring these properties.

Course Outcomes

At the end of the course, students should be able to:

- Ability to explain the importance of formulation in solid state form
- Ability to analyze the vital characteristics of solid state form and the processes in the formulation of new drugs.
- Ability to interpret the design of solid state form according to the fundamental knowledge in drug production, process and equipments.

CBE699 BIOPHARMACEUTICAL TECHNOLOGY

Course Description

The course discusses manufacturing of biotherapeutic agents via the application of various biotechnology knowledge and tools. Principles underlying the discovery, development and application of drugs of the future considering ethical issues and safety procedures are also discussed. This course also introduces the basic concepts of immunity, the human defense mechanisms including molecules, cells and tissues of the immune system that provide protection against wide variety of pathogens. The treatment of certain diseases based on knowledge of biotechnology including the development and production of vaccines and immunological diagnostic tests are discussed.

Course Outcomes

At the end of the course, students should be able to:

- Ability to explain the principles of underlining modern biotechnology i.e. recombinant DNA technology and protein science genetic engineering and drugs development
- Ability to analyze the product category in the pharmaceutical, medical and therapeutic properties of numerous biopharmaceutical products
- Ability to interpret the drug identification and development process based on specific product category, focusing on the pharmaceutical, medical and therapeutic properties.

ELECTIVE III INDUSTRIAL BIOTECHNOLOGY STREAM

CBE687 BIOCATALYSTS

Course Description

This course imparts wide knowledge related to biocatalysts i.e. the characteristics of biocatalysts, applications and design of reactors. It also covers the biocatalysts in chemical processes, and a comparison of biological and chemical catalysts for novel processes.

Course Outcomes

At the end of the course, students should be able to:

- Ability to describe the characteristics, reactions, and applications of biocatalysts in various industries
- Ability to outline the process, reactions and kinetics involved in biocatalytic process in various applications
- Ability to propose the most suitable design of biocatalyst processes and applications

CBE697 BIOREFINERIES

Course Description

This course focuses on the technological principles, as well as the economic aspects, green processes, plants, concepts, current and forthcoming biobased product lines. It starts with the description of various types of raw materials and their processing for the biorefineries and continues with the technologies in obtaining product such as microalgal system, biochemical process, thermochemical process and also integrated biorefinery process. Students will also be exposed to the related policies and considerations regarding to biorefinery.

Course Outcomes

At the end of the course, students should be able to:

- Ability to describe biorefinery concepts.
- Ability to distinguish the process involved in biorefinery.
- Ability to select the suitable processes in biorefinery.

8.0 BACHELOR OF ENGINEERING (HONS) OIL AND GAS (EH243)

8.1 Bachelor of Engineering (Hons) Oil and Gas: Academic Staff

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*** On Study Leave**

8.2 Programme Structure: Bachelor of Engineering (Hons) Oil and Gas (EH243)

Study Plan EH243 pakej 3 (ID 5549)

This study plan is used by Semester 1 and Semester 3 students (from Diploma EH110) started from Semester 1 2013/2014 Session. The following are the details on the courses offered:

Number of Faculty courses: 36
Number of Faculty courses with final examination: 26
Number of Faculty courses with continuous assessment: 10

YEAR	SEMESTER	KOD	NAMA KURSUS	KREDIT
	1	CTU551	Tamadun Islam dan Asia	2
		KKR 1	Co curriculum I	1
		ELC400	Preparatory College English	2
		MAT435	Calculus For Engineers	3
		CGE416	Introduction to Petroleum Technology (BL)	3
		CHE495	Hydrocarbon Chemistry	3
		CGE535	Electrical and Instrumentation Technology (BL)	3
	2	CTU553	Ethnic Relationship	2
		KKR2	Co-Curriculum II	1
		MAT455	Further Calculus for Engineers	3
		CPE414	Engineering Drawing	1
		CHE493	Fluid Mechanics	3
		CGE410	Statics and Dynamics	3
		CGE526	Petroleum Geology (BL)	3
		CGE478	Basic Petroleum Engineering Laboratory	1
	3	ELC501	English for Critical Academic Reading	2
		KKR3	Co-Curriculum III	1
		MAT565	Advanced Differential Equations	3
		CHE433	Thermodynamics	3
		CGE577	Drilling Engineering I	3
		CGE674	Formation Evaluation	3
		CGE536	Thermofluids Laboratory	1
		CGE558	Geology and Drilling Laboratory	1
	4	BKE1	Bahasa Ketiga I	2
		CHE515	Instrumental Chemistry For Engineers	3
		CGE653	Health, Safety and Environment (HSE) (BL)	3
		CGE652	Heat & Mass Transfer in Oil and Gas Unit Operations	3
		CGE578	Drilling Engineering II	3
		CGE567	Reservoir Engineering I	3
		CGE617	Reservoir and Gas Laboratory	1
	5	BKE2	Bahasa Ketiga II	2
		CPE680	Leadership And Professional Ethics For Engineers	3
		CGE443	Computer Applications in Oil and Gas	3
		CGE588	Reservoir Engineering II	3
		CGE656	Oil and Gas Simulation Laboratory	1
		CGE659	Petroleum Production Engineering (BL)	3
			Specialization Course I (BL)	3
	6	BKE3	Bahasa Ketiga III	2
		CGE665	Facilities Engineering (BL)	3
		CGE666	Process Design (BL)	3
		CGE660	Engineering Economics of Oil and Gas Operations (BL)	3
		CGE686	Pollution Control and Waste Management (BL)	3

			Specialization Course II (BL)	3
	7	CGE681	Final Year Project I	2
		CGE688	Industrial Training	10
	8	CGE691	Final Year Project II	4
		CGE671	Petroleum Project Management (BL)	3
		CGE601	Field Development Project	4
		ENT600	Technopreneurship	3
			Specialization Course III (BL)	3

SPECIALIZATION COURSES							
SEM	CODE	COURSE	PRA-SYARAT	JAM KT	Jam Temu K	T	M
PETROLEUM ENGINEERING							
5	CGE616	Enhanced Oil Recovery	CGE567	3	3	1	-
6	CGE618	Advanced Production Engineering	CGE659	3	3	1	-
8	CGE696	Well Testing	CGE588	3	3	1	-
GAS ENGINEERING							
5	CGE667	Gas Process Engineering		3	3	1	-
6	CGE677	Gas Utilization		3	3	1	-
8	CGE687	Gas Transmission and Distribution		3	3	1	-
FACILITIES ENGINEERING							
5	CGE676	Maintenance and Reliability Engineering		3	3	1	-
6	CGE658	Platform Architecture		3	3	1	-
8	CGE668	Materials, Codes and Standards		3	3	1	-
OIL & GAS PROCESS							
5	CGE667	Gas Process Engineering		3	3	1	-
6	CPE656	Petroleum Refining Engineering		3	3	1	-
8	CGE697	Process Optimization		3	3	1	

Study Plan EH243 Pakej 2 (ID 4075)

This study plan is used by Semester 1 and Semester 3 students (from Diploma EH110) started from Semester 1 2009/2010 Session. The following are the details on the courses offered:

Number of Faculty courses: 38
Number of Faculty courses with final examination: 25
Number of Faculty courses with continuous assessment: 13

YEAR	SEMESTER	CODE	COURSE	CREDIT
1	1	CTU551	Tamadun Islam dan Asia	2
		KKR 1	Co curriculum I	1
		MAT435	Calculus For Engineers	3
		CHE414	Engineering Drawing	2
		CHE433	Thermodynamics	3

		CGE535	Electrical and Instrumentation Technology	3
		CHE495	Hydrocarbon Chemistry	3
	2	KKR2	Co-Curriculum II	1
		CGE416	Introduction to Petroleum Technology	3
		CHE493	Fluid Mechanics	3
		CGE410	Statics and Dynamics	3
		CGE426	Fundamentals of Geoscience	3
		CGE478	Basic Petroleum Engineering Laboratory	1
		MAT455	Further Calculus for Engineers	3
2	**3**	KKR 3	Co-Curriculum III	1
		BKE1	Bahasa Ketiga I	2
		BEL422	Report Writing	2
		CGE576	Drilling Engineering	3
		CGE567	Reservoir Engineering I	3
		CGE526	Petroleum Geology	3
		CGE558	Geology and Drilling Laboratory	1
		MAT565	Advanced Differential Equations	3
	4	BKE2	Bahasa Ketiga II	2
		BEL499	Communication and Interpersonal Skills	2
		CTU553	Ethnic Relationship	2
		CGE443	Programming and Computer Applications	3
		CGE654	Well Completion	3
		CGE674	Formation Evaluation	3
		CGE586	Reservoir Engineering II	2
		CGE617	Reservoir and Gas Laboratory	1
3	**5**	CHE680	Leadership And Professional Ethics For Engineers	3
		CGE651	Process Unit Operations	2
		CGE653	Health, Safety and Environment (HSE)	3
		CGE656	Oil and Gas Simulation Laboratory	1
		CGE659	Petroleum Production Engineering	3
		BKE3	Bahasa Ketiga III	2
			Specialization Course I	3
	6	CGE662	Materials and Applications	3
		CGE665	Facilities Engineering	3
		CGE666	Pipeline & Subsea Engineering	3
		CGE660	Engineering Economics of Oil and Gas	2
			Specialization Course II	3
		ENT600	Technopreneurship	3
4	**7**	CHE690	Industrial Training	5
		CGE680	Final Year Project I	3
		CGE600	Field Development Plan	3
		CGE670	Petroleum Project and Operations Management	3
			Specialization Course III	3
	8	CGE690	Final Year Project II	3
		CGE610	Economics and Geopolitics of Oil and Gas	3
			Specialization Course IV	3
		CGE655	Field Review and Rejuvenation	3

8.3 Learning Outcome and Soft Skill (LO-KI) Matrix For Programme EH 243 Courses

Course Code	Course	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9
University Courses										
CTU551	Tamadun Islam dan Tamadun Asia I				√	√	√	√		√
KKR1	Co curriculum I				√	√		√		√
ELC400	Preparatory College English	√	√	√				√		
MAT435	Calculus For Engineers				√	√	√	√		√
KKR2	Co-Curriculum II	√	√	√				√		
CTU553	Ethnic Relationships	√	√	√				√		
MAT455	Further Calculus for Engineers				√	√	√	√		√
ELC501	Critical Academic Reading				√			√		
KKR3	Co-Curriculum III				√	√		√		√
MAT565	Advance Differential Equations				√	√		√		√
BKE1	Bahasa Ketiga I	√		√	√	√		√		√
BKE2	Bahasa Ketiga II	√		√	√	√		√		√
Total	**Number of courses**	5	3	5	9	8	3	12	0	8
Core Courses										
CGE416	Introduction to Petroleum Engineering	√		√	√					
CGE535	Electrical and Intrumentation Technology	√		√						
CHE495	Hydrocarbon Chemistry	√		√						
CGE410	Statics and Dynamics	√		√						
CGE526	Petroleum Geology	√		√						
CPE414	Engineering Drawing	√	√	√				√		
CHE493	Fluid Mechanics	√		√						
CHE434	Process	√		√						

	Chemistry									
CGE478	Basic Petroleum Engineering Laboratory	√	√	√	√	√				√
CGE577	Drilling Engineering 1	√		√						
CHE433	Thermodynamics	√		√						
CGE536	Thermofluids Laboratory		√	√	√	√				√
CGE674	Formation Evaluation	√		√						
CGE558	Geology and Drilling Laboratory		√	√	√	√				√
CGE443	Computer Applications in Oil & Gas	√	√	√	√	√		√		√
CGE578	Drilling Engineering II	√		√						
CGE567	Reservoir Engineering I	√		√						
CHE515	Intrumental Chemistry for Engineers	√	√	√	√					
CGE655	Operations	√		√						
CGE617	Reservoir and Gas Laboratory		√	√	√	√				√
CHE680	Leadership and Professional Ethics For Engineers				√	√	√	√		√
CGE588	Reservoir Engineering II	√		√						
CGE653	HSE	√		√			√			
CGE656	Oil and Gas Simulation Laboratory		√	√	√	√		√		√
CGE659	Petroleum Production Engineering	√	√	√				√		
CGE666	Process Design	√	√	√				√		
CGE686	Pollution Control and Waste Management	√					√			
CGE665	Facilities Engineering	√		√			√			

CGE660	Engineering Economics od Oil and Gas	√			√	√	√	√		√
CGE681	Final Year Project I	√		√	√	√		√		√
CGE688	Industrial Training	√			√		√	√	√	
CGE691	Final Year Project II	√	√	√	√	√	√	√	√	√
CGE671	Petroleum Project and Operations Management	√			√	√	√	√		√
CGE600	FDP	√	√	√	√	√	√	√	√	√
Total	**Number of courses**	29	12	29	16	13	10	3	4	13
Specialization Courses										
CGE616	Enhanced Oil Recovery	√		√						
CGE618	Advance Production Engineering	√	√					√		
CGE676	Well Testing	√	√					√		
CGE667	Gas Processing Engineering	√		√						
CGE677	Gas Utilization	√		√			√			
CGE687	Gas Tranmission and Distribution	√		√			√			
CGE676	Maintenance and Reliability Engineering	√		√			√			
CGE658	Platform Architecture	√		√						
CGE668	Material Codes and Standards	√					√	√		
CGE667	Gas Process Engineering	√		√						
CPE656	Petroleum Refining Engineering	√		√	√		√			
CGE697	Process Optimization	√		√			√			
Total	**Number of courses**	12	2	9	1	0	6	3	0	0
Total		46	17	43	26	21	19	28	4	21

8.4 Programme Core Courses: Bachelor of Engineering (Hons) Oil and Gas (EH243)

SEMESTER 1	
CGE416	**INTRODUCTION TO PETROLEUM TECHNOLOGY**
Course Description	This course introduces an overview of the main disciplines and fundamental concepts of upstream petroleum industry. The course comprises of several main topics which include petroleum geology, overview of petroleum play and petroleum exploration, reservoir engineering concepts, drilling and completion concepts development, production and petroleum economic. The importance of petroleum industry in aspect of economic and technology advancement is also included in this course.
Course Outcomes	At the end of the course students are able to: • Describe the chronology of events and overall disciplines of oil and gas industry and development • Analyze the basic calculations in oil and gas measurement units, conversion factors and dimensions as the fundamentals of engineering and its applications • Evaluate the sequence of activities in oil and gas industry and its importance towards economic, development and technology advancement
CGE535	**ELECTRICAL & INSTRUMENTATION TECHNOLOGY**
Course Description	Electrical and instrumentation technology is a course that studies the basic knowledge of electrical engineering in the context of applications in introduction to the basic concepts of electricity which leads to DC circuits and analysis. Also taught in this course are semiconductor electronic devices, simple AC circuit, transformers, electrical motors and instrumentation, safety and electrical power transmission and distribution.
Course Outcomes	At the end of the course students are able to: • Explain the processes in electricity transmission and distribution, safety and the regulations. • Analyze and describe the operation of transformers, motors and electrical measuring instruments in different types of applications. • Analyze simple electric circuit and propose electrical and electronic components in different type of circuits.
SEMESTER 2	
CHE434	**STATICS AND DYNAMICS** This course has been designed to introduce students to the basic principles and concepts in static and dynamics. The course is divided into two parts. The first part deals with the analysis of particle and rigid body in static. It covers the resultant and resolution of forces acting on a particle and rigid body, the equilibrium of a particle and rigid body, how to replace a force system with an equivalent system, analysis of structure, forces in beams, analysis of friction and moments of inertia. The second part deals analysis of particles in motion. It includes the kinematic and kinetic of rigid bodies. It will cover the rectilinear and curvilinear motion of particles, Newton's Second Law of particles, work and energy for particles.

Course Outcomes

At the end of the course students are able to:

- Explain basic knowledge of statics and dynamics
- Analyze the mechanic principle of the kinematics and kinetic of rigid bodies, analysis of truss, beams and law of friction
- Assess the mechanic principle on the kinematics and kinetic of rigid bodies, the principle of work, energy and conversation of energy

CGE526 **PETROLEUM GEOLOGY**

Course Description

This subject is covered the geological foundations of petroleum formation and exploration is essential to any career in the hydrocarbon industry. It also provides a basic introduction to geology and develops the knowledge and skills necessary for understanding petroleum formation, migration and accumulation, and methods of detecting, measuring and developing petroleum reserves.

Course Outcomes

At the end of the course students are able to:

- Describe the structures, tectonic, traps and lithology and identify geological factors that lead to accumulation of oil and gas
- Analyze properties of petroleum formation
- Evaluate geological and geophysical data to perform volumetric calculations, identify risk and uncertainties

CGE478 **RESERVOIR FLUID AND ROCK PROPERTIES LAB**

Course Description

This course involves series of experiments that deals with the principles of properties measurement of certain liquids and gases and fluid mechanics unit.

SEMESTER 3

CGE577 **DRILLING ENGINEERING I**

Course Description

This course provides a basic knowledge on the mechanical components of oil and gas drilling rig to familiarize student with the drilling equipments and processes. It is also designed to facilitate an understanding of drilling techniques and problems employed in general drilling operation.

Course Outcomes

At the end of the course students are able to:

- Explain the functions and principles of drilling system and operational procedures.
- Differentiate various types of drilling components, systems and processes used in drilling operation.
- Develop well plan for a successful drilling operation.

CGE674 **FORMATION EVALUATION**

Course Description

This course deals with principles and techniques in reservoir rock evaluation, which can be applied to assess for the potential reservoirs. Students will be exposed to the various type of logging tools and the log interpretation techniques used to evaluate the important petrophysical parameters of the reservoirs. The course begins with the introduction to conventional open hole logging tools and the log interpretation techniques calibrated with core analysis to evaluate petrophysical parameters in detailing reservoir description. Students will also be introduced to cased hole and advanced logging tools which are unique and fundamentally different from conventional logging tools.

Course Outcomes

At the end of the course students are able to:

- Describe the basic principles of formation evaluation and various openhole logging tools to evaluate reservoir rock and fluid properties.
- Evaluate the potential reservoirs through log interpretation techniques integrated with core analysis in detailing reservoir description and diagnose the production performance problem.

- Analyze non-conventional cased hole and advanced logging tools for reservoir saturation monitoring and evaluating more complex rock and fluid properties.

CGE536 **THERMOFLUIDS LAB**

Course Description This course involves series of experiments that deals with the principles of thermodynamic units, as well as fluid flow concept

CGE558 **GEOLOGY AND DRILLING LABORATORY**

Course Description This module is designed with series of laboratory exercises that will supplement to lectures and offer practical experience to equip the students with a basic understanding of the concepts and method in drilling and geology.

SEMESTER 4

CGE655 **MASS AND HEAT TRANSFERS IN OIL AND GAS UNIT OPERATION**

Course Description This course introduces the students the fundamental knowledge of mass transfer and heat transfer operations. The topics covered include the concept of mass transfer and equipment design for distillation and absorption, the concept of heat transfer and exposure to heat exchanger design. Students are also exposed to several types and designs of equipment employing the principle which are important to oil and gas industries.

Course Outcomes At the end of the course students are able to:

- Describe the concept of mass transfer and heat transfer in oil and gas unit operations.
- Analyze engineering calculations involving mass and heat transfer principles in oil and gas unit operations.
- Justify the design of thermal recovery technique, handling systems, separation systems, heat exchangers and facilities in oil and gas operations.

CGE578 **DRILLING ENGINEERING II**

Course Description Drilling Engineering II is an advanced course from Drilling Engineering I. This course is designed to introduce and comprehend the students to the more advance concept and technique in well planning and drilling operations. Topics covered include directional drilling, directional surveying, hole problems, hydraulic and wellbore integrity, special operation, drilling program and special topics, which introduces new and advanced technologies in drilling.

Course Outcomes At the end of the course students are able to:

- Explain the process, procedures and equipments as part of the planning in advanced well drilling operation.
- Analyze the problems related to drilling operation and suggest the suitable preventive and corrective methods.
- Propose and construct a program for a well drilling operation.

CGE567 **RESERVOIR ENGINEERING I**

Course Description The course begins with overview of reservoir rock and fluid properties before focusing in details on concepts of fluid flow through porous media. The course also include study of rock-fluid interactions, hydrocarbon phase behaviour and PVT analysis. Finally, the course discusses on reservoir fluid identification with analysis of dry gas behaviour and black oil properties.

Course Outcomes	At the end of the course students are able to: • Describe and relate the fundamental of reservoir rock and fluid properties in term of their interaction, fluid flow, and accumulation in porous media. • Apply and analyze the fundamental of reservoir rock and fluid properties in term of their interaction, fluid flow, and accumulation in porous media. • Evaluate and interpret the reservoir fluid properties through applications of charts, correlations and oil field standards.
CGE617	**RESERVOIR AND GAS LABORATORY**
Course Description	This course involves series of experiments that deals with the principles application of gas engineering and reservoir engineering

SEMESTER 5

CGE443	**COMPUTER APPLICATION IN OIL AND GAS**
Course Description	This is a fundamental computing course focusing on computational mathematics for the use in oil and gas engineering applications. This course also aims to introduce the fundamentals of reservoir simulation to solve real reservoir engineering problems.
Course Outcomes	At the end of the course students are able to: • Identify MATLAB and C++ for engineering problem solutions" • Analyze numerical solution in oil and gas engineering • Interpret reservoir simulation results and estimate well performance
CGE588	**RESERVOIR ENGINEERING II**
Course Description	This course covers concepts of reservoir engineering, flow through porous media, reserve estimation, drive mechanism, material balance equations, water influx and immiscible displacement.
Course Outcomes	At the end of the course students are able to: • Describe the concepts of fluid flow in porous media to appraise reservoir flow behavior. • Analyze oil and gas material balance concepts for reserve and recovery factor estimation. • Interpret the fundamentals of reservoir engineering for prudent development of oil and gas fields.
CGE656	**OIL AND GAS SIMULATION LABORATORY**
Course Description	This course deals with the application of oil and gas simulation tools to solve different engineering problems. Tempest/Eclipse, Prosper/WellFlo and ICON softwares are used in this laboratory course. Students are preliminarily introduced to the fundamental of reservoir simulation such as the mathematical derivation of material balance equation as well as application of Darcy's equation to solve basic reservoir engineering associated with fluid flow for different conditions. Then, they are introduced to Tempest/Eclipse software from the basic knowledge to the analysis of each input data file to run simulation of various cases in reservoir engineering problems. This includes simulating the static and dynamic models, as well as performing sensitivity analysis for optimum field development strategies. After that, Prosper/WellFlo software is introduced in order to solve production problems, performing sensitivity analysis on the selection of optimum tubing size, as well as simulating different production enhancement methods for optimum production strategies. Last but not least, the introduction to the ICON software and its application. Students are given several individual and group assignments including mini projects for assessment.

CGE659	**PETROLEUM PRODUCTION ENGINEERING**
Course Description	This course introduces the petroleum production systems including reservoir's inflow performance and well's outflow performance concepts, formation damage mechanisms; surface production facilities and operation; tubing performance analysis, design and selection; basic well completion design concepts and familiarization of downhole completion equipment; overview of artificial lift systems including technologies, equipment and fundamental mechanisms of each system, selection criteria, design and analysis of artificial lift systems including gas lift, and pump lift; Analysis and optimization of total petroleum production systems using conventional and nodal analysis. The connecting theme of the topics is to follow flow of fluids from the reservoir/well interface through the well and surface facilities, with emphasis on hardware components, their functions and importance.
Course Outcomes	At the end of the course students are able to: • Describe the principles, components and methods used to complete and produce oil and gas wells, production processes, separation, surface facilities, well stimulation technologies and other advances in oil and gas production processes. • Analyze overall system performance using the appropriate tools and determine appropriate size and materials for components of tubings, flowlines and separation facility equipment. • Evaluate artificial lift based upon well construction, fluid properties and production scenario.

SEMESTER 6

CGE665	**FACILITIES ENGINEERING**
Course Description	This course deals with the ability of students to apply fundamental science and engineering knowledge to solve knowledge in the area of offshore engineering and further their understanding of the multidisciplinary nature of offshore oil and gas engineering. This course provides study on surface equipment related to Exploration and Production (E&P) processes and introduce the conception of the overall facilities setup as well as designing of some of the critical equipment. As part of the assignment work, students have the opportunity to work as individuals and as part of a team.
Course Outcomes	At the end of the course students are able to: • Describe and identify suitable equipment and processing techniques for petroleum production and export facilities • Compare and illustrate type of platform and equipment/facilities used in oil & gas production platform • Design pipeline, horizontal and vertical separator (process equipment) based on the interpretation on process requirement.
CGE666	**PROCESS DESIGN**
Course Description	This course covers the concepts of process design, economic decision making, input information, process flow diagram, piping and instrumentation diagram, process simulation, process integration and plant wide control. Besides, students will be exposed to the computational software to guide them in designing and simulating the processes.
Course Outcomes	At the end of the course students are able to: • Describe steps in various process designs. • Analyze the fundamental of process designs for oil and gas applications. • Evaluate process designs for oil and gas applications.

CGE660 **ENGINEERING ECONOMICS OF OIL AND GAS OPERATIONS**

Course Description

This course outlines the fundamentals of general economic principles. It introduces topics related to upstream operation petroleum economics and give an overview to the students on exploration and production (E&P) projects. This course also covers on overview of E&P project economic evaluation, risks & uncertainty and various economic representations.

Course Outcomes

At the end of the course students are able to:

- Describe economic aspects of upstream petroleum project.
- Perform sensitivity and decision analysis.
- Estimate upstream petroleum project's worth by employing profitability measures.

CGE686 **POLLUTION CONTROL AND WASTE MANAGEMENT**

Course Description

This course includes introductory topics on general overview of oil pollution occurrences, oil compositions and properties as well as remote sensing and detection technology used. Oil spill effects on the environment and oil pollution management is discussed in the subsequent topics. Fundamentals of oil spillage are covered in the behavior of oil spilled topic. Natural weathering processes, oil spreading and trajectory models are elaborated. This is followed by topics on oil containment and recovery methods which include physical, chemical and biological approach. At this juncture, students will be introduced to booms, skimmers, chemical dispersant and biodegradation aspects in dealing with oil spillage. Also included is the topic on oil pollution spill response and preparedness. Finally the course discusses the broader aspect of wastes generated from oil and gas industries. This includes treatments and management hierarchy involved in treating these wastes.

Course Outcomes

At the end of the course students are able to:

- Identify the types of oil pollution and the resulting negative impacts on the environment.
- Demonstrate understanding on the fate of the oil spilled in terms of spreading and weathering effects and its relationship with the selection and deployment of oil containment and recovery countermeasures.

  Analyze the waste streams generated in the oil and gas industry and the waste management practiced within the industry.

SEMESTER 7

CGE681 **FINAL YEAR PROJECT I**

Course Description

The Final Year Project I (FYP I) provides an introduction to engineering study by giving students experience in project planning, literature searching, methodology development, oral presentation, report writing and plagiarism checking that is done in the first semester of the fourth year. It is a prerequisite for Final Year Project II course and is conducted concurrently with the industrial training course that runs off-campus. The outcome of this course is a research proposal related to oil and gas area.

CGE688 **INDUSTRIAL TRAINING**

Course Description

Industrial training is an important component in engineering curriculum. Theories learnt in the entire core and non-core courses will have to be applied into the real working environment in engineering industries, specifically to get them involved in chemical or relevant engineering projects. Prior to the actual training in industries, students are required to make job applications before stepping into the real working environment.

SEMESTER 8

CGE690 FINAL YEAR PROJECT II

Course Description

The Final Year Project II provides the continuation to research study by giving students the experience in executing the planned research based project, analyzing and interpreting data, concluding the findings, poster presentation, report and journal writing. The task in Final Year Project II will be carried out individually.

CGE671 PETROLEUM PROJECT MANAGEMENT

Course Description

This course aims at providing student a general exposure to petroleum project and operations management theories and practices.

Course Outcomes

At the end of the course students are able to:

- Describe project management concepts and discuss project planning, procurement, risk assessment and control.
- Demonstrate proficiency in applying network techniques for project management.
- Evaluate various aspects of petroleum project engineering management.

CGE601 FIELD DEVELOPMENT PLAN

Course Description

This is a capstone course which integrates key learning outcomes from previous taught courses. Students work in a team to perform a technical and economic study of a given field by considering latest viable technology, economics, environmental and political conditions. Each team is expected to work collectively with other student groups and/or industry players to ensure that production and development costs are optimized. Finally, students must produce a written report and present their findings to a panel of examiners to convince their case. This course also covers front-end engineering design of new production facilities for a potentially viable oil/gas field. Various oil/gas processing systems are studied, including gas dehydration, condensate handling, acid gas removal, LPG extraction and crude oil stabilization. Design task include process simulation, preparation of process flow diagrams/piping & instrumentation diagrams, HAZOP studies, and project management arrangements. Students to carry out an example facilities scoping study and submit as their final design report.

SPECIALIZATION COURSE SEMESTER 5, 6 & 8

ELECTIVE I PETROLEUM ENGINEERING

CGE616 ENHANCED OIL RECOVERY

Course Description

This course aims to introduce the students the fundamentals knowledge of enhanced oil recovery (EOR) processes used or proposed to be used in the petroleum industry. Basic concepts and theories of enhanced oil recovery, such as water flooding, polymer flooding, surfactant flooding, miscible and immiscible gas flooding and thermal recovery processes and strategies will be taught in this course.

Course Outcomes

At the end of the course, students should be able to:

- Explain the principles of EOR and to describe the miscible and immiscible displacement processes
- Compare different mobility-control processes
- Compare the environmental concerns of different chemical and thermal EOR processes.

CGE616 ADVANCED PRODUCTION ENGINEERING

Course Description

This course provides understanding about common problems and scenarios encountered in oil and gas industry and provides insight about how to deal with them. More Over design of gas lift and sand control process will be discussed in details.

Course Outcomes	At the end of the course, students should be able to: • Comprehend complex problems of production operation • Design basic process of production operation • Deal with flow assurance problems
CGE616	**WELL TESTING**
Course Description	This course provides disscuations on line source solution, an introduction to well test analysis in oil and gas reservoirs. The syllabus covers the general well tests commonoly conducted in the industry. Moreover interpreatation of the tests using various methods and their applications will be covered in this course.
Course Outcomes	At the end of the course, students should be able to: • Comprehend basics of well testing • Interpret various types of well testing in oil wells • Solve problems of gas well testing

ELECTIVE II GAS ENGINEERING

CGE667	**GAS PROCESS ENGINEERING**
Course Description	This course aims to introduce students the scientific fundamentals and engineering practice of natural gas processing. The course starts with a short introduction on natural gas and natural gas industry, including the review on the use of natural gas and its transportation practices. The course will then provide an overview of natural gas processing objectives and activities and introduce the phenomenon of gas hydrate formation as well as hydrate inhibition strategies. Strong emphasis will then be given on the principles governing the techniques and technologies used in processing and liquefying natural gas. Processes to be covered include phase separation, gas compression, gas conditioning, gas dehydration and gas liquefaction.
Course Outcomes	At the end of the course, students should be able to: • Describe knowledge and comprehension of natural gas science, technology and industry and discuss the fundamental of natural gas field processing as well as hydrate formation and inhibition • Apply the fundamental concepts of phase separation, natural gas compression, treating and dehydration. • Appraise the natural gas liquid recovery process, the non-hydrocarbon component recovery/removal processes and the liquefaction of natural gas.
CGE677	**GAS UTILIZATION**
Course Description	This course enables students to understand the basic concepts of gas utilization, combustion of natural gas, flame properties and structure, equipments for gas utilization, design principles and characteristics, power production from gas, waste heat recovery as well as safety in gas utilization facilities.
Course Outcomes	At the end of the course, students should be able to: • Describe the basic concept of gas utilization, combustion of natural gas and flame properties and structures. • Apply the fundamentals equipments for gas utilization, design principle and characteristics as well as power production from gas. • Evaluate the waste heat recovery and safety in gas utilization facilities.

CGE687	**GAS TRANSMISSION AND DISTRIBUTION**
Course Description	This course has been designed to expose students to hydrocarbon gas pipeline system used locally and overseas. The course contents include an introduction to gas industry, types of gas transmission and distribution system, the related gas floe equations, methods used to design gas pipeline system, gas pipeline network analysis and the construction materials and procedures
Course Outcomes	At the end of the course, students should be able to: • Describe gas transmission and distribution system. • Apply general gas flow equation by incorporating low pressure system and high pressure piping system and apply concept of network analysis. • Evaluate various material properties for pipe construction, piping construction and maintenance and justify the gas regulation and measurement.

ELECTIVE III FACILITIES ENGINEERING

CGE676	**MAINTENANCE & RELIABILITY ENGINEERING**
Course Description	In this unit, we will focus on the fundamental reliability terms and concepts, basic mathematics of probability and statistics, reliability analysis as well as tools used for reliability evaluation (FMEA, FMECA, etc) and its applications. This is supplemented by themaintenance strategies which include reliability-centered maintenance (RCM), risk based inspection and total productive maintenance (TPM).
Course Outcomes	At the end of the course, students should be able to: • Describe the terms and concepts of reliability and explain the principles and objectives of reliability engineering. • Analyze the maintenance and relaibility engineering problems and compare the best tools or solutions. • Select the best tools to be used in maintenance and reliability engineering and justify its applications.
CGE658	**PLATFORM ARCHITECTURE**
Course Description	This course has been designed to expose students to hydrocarbon gas pipeline system used locally and overseas. The course contents include an introduction to gas industry, types of gas transmission and distribution system, the related gas floe equations, methods used to design gas pipeline system, gas pipeline network analysis and the construction materials and procedures
Course Outcomes	At the end of the course, students should be able to: • Describe and identify basic principles of platform architechture • Analyze design of platform architechture • Design and compare several types of platform architechture
CGE668	**MATERIAL CODES AND STANDARDS**
Course Description	This course covers principles of materials codes and Standards by American Society of Mechanical Engineers (ASME), American Petroleum Institute (API), National Association of Corrosion Engineers (NACE), Ingress Protection Code (IP), British Standard (BS), National Fire Protection Association (NFPA) and International Conventions for Maritime Safety (SOLAS and MARPOL) for oil and gas facilities engineering.
Course Outcomes	At the end of the course, students should be able to: • Describe and recognize material codes and Standard used for oil and gas facilities engineering. • Apply and differentiate the principles of codes and standards to design engineering facilities. • Evaluate and justify the codes and standards to design engineering facilities.

ELECTIVE IV OIL & GAS PROCESS

CGE697	**PROCESS OPTIMIZATION**
Course Description	This course covers concepts of process optimization that covers the fundamentals of optimization, convexity, constrained and unconstrained problems, linear programming (LP), and mixed integer linear programming (MILP).
Course Outcomes	At the end of the course, students should be able to: • Describe the several types of optimization problems (LP, NLP, MILP, MINLP) • Select various methods to solve optimization problems. • Formulate optimization problems.

9.0 Important Academic Information

9.1 Plagiarism: Statement

Plagiarism is using other people's ideas such as words, opinions, thoughts, products, information and findings/results, (both spoken or written) inclusive of assignments, project papers, thesis/dissertations, research, proposals, tests and examination papers and pass them off as your own without giving credit to them in the form of citation, acknowledgement and referencing.

The penalties for plagiarism include the following:

A fail grade of work
Suspension from academic session
Expulsion from the University
Withdrawal or revocation of Degree

9.2 Requirements of Class Attendance

Students must attend all lectures including other forms of learning activities such as workshops/ tutorials/ laboratory work/ studio work/ fieldwork/ practical work/ practicum/ industrial or clinical training as stipulated in the syllabus. Students with less than 80% attendance from the total contact hours for;

1. courses with final examinations, are not allowed to sit for the final examination of that course.
2. courses with no final examinations, the course work will not be evaluated.

This is true for every course if the written approval for absence is not sought from the Faculty/Branch Campus/Learning Centre.

Students affected will be given a Grade F or fail with a ZZ status and are required to pay a processing fee of RM100.00.

9.3 Award of Degree

A Bachelor's (Honours) Degree will be conferred on a student who fulfills the following requirements:

1. acquired a CGPA of at least 2.00
2. passed all the courses required by the Programme of Study and obtained a Completed status (ANC, TS or TM)
3. fulfilled all conditions and requirements of the University
4. endorsed by the Senate

9.4 Class of Degree

Class	Range of CGPA
First	3.50-4.00
Second (Upper)	3.00-3.49
Second (Lower)	2.20-2.99
Third	2.00-2.19

Students will be given the following status based on their CGPA:

ANC : Completed with Vice Chancellor's Award
TS : Completed with Dean's List Award
TM : Completed
AD : Dean's List Award
LU : Pass
P : Probation (Unsatisfactory)
D : Failed and Terminated

9.5 Vice Chancellor's Award

The Vice Chancellor's Award is a distinction award for students who completed their studies and obtained the Dean's List Award every semester (not including practical training semesters) throughout the duration of their studies at the University.

9.6 Dean's List Award

The Dean's List award is a distinction award for students who obtained a minimum GPA of 3.50 for at least 12 credit units (excluding courses with Pass/Fail status) in a semester.

9.7 Marking Scheme

The official marking scheme of the university and its stipulations are as follows. Students will be given a grade according to this marking scheme.

Grade	Marks	Grade Points	Interpretation
A+	100 - 90	4.00	Excellent
A	89 - 80	4.00	Excellent
A-	79 - 75	3.67	Excellent
B+	74 - 70	3.33	Good
B	69 - 65	3.00	Good
B-	64 -60	2.67	Good
C+	59 - 55	2.33	Pass
C	54 - 50	2.00	Pass
C-	49 - 47	1.67	Fail
D+	46 - 44	1.33	Fail
D	43 - 40	1.00	Fail
E	39 - 30	0.67	Fail
F	29 - 0	0.00	Fail

LU Pass

F1 Fail a course on first (1st) attempt

F2 Fail a course on second (2nd) attempt

F3 Fail a course on third (3rd) attempt

PD Credit Transfer

PC Credit Exemption

TL Incomplete

UD Audit

FD Disciplinary Action

XX Absent from final examination with permission

YY Absent from final examination without permission

ZZ Barred from taking the final examination for courses with final examination; or not given the assessment marks for courses without the final examination

10.0 Student Facilities

10.1 Library

Perpustakaan Tun Abdul Razak

The library was established in 1960 under the Rural and Industrial Development Authority (RIDA) in Petaling Jaya. In 1972, a new main library building was completed in Shah Alam and named Perpustakaan Tun Abdul Razak 1. To date, the library collections have more than 600,500 volumes comprising books, pamphlets, conference papers, bibliographies, calendars and other non-print materials in microform format. The library also holds about 5,000 periodical titles currently subscribed or received through requests/donations. A number of more than 50 online databases are subscribed from various journals. In addition to the main library, there are eight other component libraries namely:

Perpustakaan Tun Abdul Razak 2 (1986)

The library specialises in Business and Law Collections besides providing reading and reference materials for the off campus and distance learning students.

Perpustakaan Tun Abdul Razak 3 (2003)

The library specialises in collections on Chemical Engineering, Mechanical Engineering, Civil Engineering and Electrical Engineering. Materials available in the library cater to subjects offered by these Faculties.

Perpustakaan Tun Abdul Razak 4 (2004)

The library specialises in collections on Medicine, Pharmacy, Computer Science, Performing Arts and Sport Science. Materials available in the library cater to subjects offered by the Faculties.

Library Services	
Counter Services PTAR	Counter 1: charging, discharging & renewals. Counter 2: registration, cancellation of membership, overdue payments and enquiries.
Book Reservation	Books that are needed but are on loan can be reserved through Infotrack (ILMU) and also through **PTAR Web** (Online Patron Enquiry).
Inter-Library Loans	Books which are not available in our library may be borrowed from other libraries via Inter-library Loans (ILL).
Past years final papers	Past years question papers, student and staff thesis can be accessed via **digital collections.**
Membership Registration	Registration of members will be done at the counter service or otherwise their details can be uploaded from Pusat Sistem Maklumat Bersepadu (PSMB) in case of full-time students.
Serial Services	Procurement of periodicals in printed - journal, magazine, etc. Procurement of electronic form (Online Database) relating to the curriculum of studies in UiTM. E-journals Journals with impact factor Open access journals Indexing of locally based UiTM publications journal articles UiTM publications Newsletter & Bulletin

Tun Abdul Razak Library (PTAR)

Universiti Teknologi MARA,
40450, Shah Alam Selangor,
MALAYSIA
(603) - 5544 3714 , (603) - 5544 3743 , (603) - 5544 3718 , (603) - 5521 1704
Faxs: (603) 5544 3730

10.2 Class, Meeting Room and Lecture Theatre

The faculty offers a wide choice of facilities to help the students in their learning process. It has well developed laboratories for teaching and research. High technology equipments are available in specialized laboratories with recent facilities for unit operations, chemical reaction, heat transfer, fluid flow, particle technology, industrial process, control and instrumentation. There are four courses that takes care the hands-on practice in the laboratory.

Chemical Engineering Laboratory syllabi are constructed to help the students understand the theory through experiments, which they have learned in their classes through lectures. Apart from these equipments, there are also available equipment used for research activities and consultancy work by our academic staff.

In line with recent development of new technologies, the faculty also provides the Computer Lab to enhance students skill and knowledge towards computer. The Computer Lab is also equipped with the up to date software which can assist the students to develop their knowledge in modelling and simulation as required by the processes in the chemical industries such as HYSIS, AutoCAD, Vantage PID and MATLAB suitable for teaching and research activities. Students also can make use of the computer facilities to prepare their assignments and reports.

10.2.1 Lecture Class

B5-A11-1B (22)	**B5-A11-6A& (20)**	**B5-A12-1A& (27)**
B5-A11-2A (22)	**B5-A11-7A (20)**	**B5-A12-2B (26)**
B5-A11-3A (34)	**B5-A11-8A& (23)**	**B5-A12-4B (33)**
B5-A11-4B (32)	**B5-A11-9B (23)**	**B5-A12-5A (34)**
B5-A11-5A (36)	**B5-A12-3A (36)**	**B5-A12-6B& (21)**
	B5-A12-8B (25)	**B5-A12-7B (21)**

10.2.2 Lecture Theatre

Lecture Theatre H (DKH) (200) **Lecture Theatre G (DKG) (100)**

10.2.3 Meeting Room

Oval Meeting room (Level 10) (30) **Mini Meeting Room (Leval 6) (15)**
B5-A10-10 **B5-A6-18A**

10.2.4 Computer Lab				
Computer Lab	**Location**	**Person Incharge**	**Number of Computer**	**Available Software**
Computer Lab A	B5-A9-15A	**Tengku Nor Fatimah Tengku Kamal Ariffin** Tel: 03 55436485	30	MATLAB & AUTOCAD
Computer Lab B	B5-A9-15B	**Ariff bin Azizan** Tel: 03 55436367	30	MATLAB & AUTOCAD
Computer Lab C	B5-A9-C	**Azril Mohamed Sharuddin** Tel: 03 55436337	30	MATLAB &HYSIS
Computer Lab D	B5-A9-D	**Nur Ermy Nadia Mohd Hussain** Tel: 03 55436544	30	MATLAB & HYSIS
Computer Lab Bioprocess	B5-A5-13A	**Mohd Khairi Yusof** Tel: 03 55436541	20	SUPERPRO

* (Number) : Capacity

Coding System Used

The location of classes and laboratories within the faculty are presscibed by the following coding system:

Example : B5-A11-1A
B5 : Block 5
A11 : Level 11
1A : Room No

10.3. Laboratory safety

All students must read and understand the information in this document with regard to laboratory safety and emergency procedures prior to the first laboratory session. Effort has been made to address situations that may pose a hazard in the lab but the information and instructions provided cannot be considered all-inclusive.

Students must adhere to written and verbal safety instructions throughout the academic term. Since additional instructions may be given at the beginning of laboratory sessions, it is important that all students arrive at each session on time.

Safety training and/or information should be provided by a faculty member, teaching assistant, lab safety contact, or staff member at the beginning of a new assignment or when a new hazard is introduced into the workplace.

10.3.1 Personal and General Laboratory safety Regulations

1. Never eat, drink, or smoke while working in the laboratory.
2. Read labels carefully.
3. Do not use any equipment unless you are trained and approved as a user by your supervisor.
4. Wear safety glasses or face shields when working with hazardous materials and/or equipment.
5. Wear gloves when using any hazardous or toxic agent.
6. Clothing: wear gloves, laboratory coats (white), safety shield or glasses and shoes are required when working in a Lab
7. If you have long hair or loose clothes, make sure it is tied back or confined.
8. Keep the work area clear of all materials except those needed for your work. Hang your coats in the hall or placed them in a locker. Extra books, purses, etc. should be kept away from equipment, that requires air flow or ventilation to prevent overheating.
9. Disposal - Students are responsible for the proper disposal of used material if any in appropriate containers.

10. Equipment Failure - If a piece of equipment fails while being used, report it immediately to your Lab Assistant or Tutor. Never try to fix the problem yourself because you could harm yourself and others.
11. If leaving a lab unattended, turn off all ignition sources and lock the doors.
12. Never pipette anything by mouth.
13. Clean up your work area before leaving.
14. Wash hands before leaving the lab and before eating.
15. Never do unauthorized experiments.
16. Never work alone in laboratory.
17. Keep your lab space clean and organized.
18. Do not leave an on-going experiment unattended.
19. Always inform your instructor if you break a thermometer. Do not clean mercury yourself!!
20. Never taste anything. Never pipette by mouth; use a bulb.
21. Never use open flames in laboratory unless instructed by the Technical Assistant.
22. Check your gla ssware for cracks and chips each time you use it. Cracks could cause the glassware to fail during use and cause serious injury to you or lab mates.
23. Maintain unobstructed access to all exits, fire extinguishers, electrical panels, emergency showers, and eye washes.
24. Do not use corridors for storage or work areas.
25. Do not store heavy items above table height. Any overhead storage of supplies on top of cabinets should be limited to lightweight items only. Also, remember that a 36" diameter area around all fire sprinkler heads must be kept clear at all times.
26. Areas containing lasers, biohazards, radioisotopes, and carcinogens should be posted accordingly. However, do not post areas unnecessarily and be sure that the labels are removed when the hazards are no longer present.
27. Be careful when lifting heavy objects. Only trained staff may operate forklifts or cranes.
28. Clean your lab bench and equipment, and lock the door before you leave the laboratory.
29. Treat every chemical as if it were hazardous.
30. Make sure all chemicals are clearly and currently labeled with the substance name, concentration, date, and name of the individual responsible.