

# UNDERGRADUATE GUIDEBOOK

ACADEMIC SESSION 2017/2018

Marketable • Employable • Sustainable • Entrepreneurial

KEJURUTERAAN KIM

FACULTY OF CHEMICAL & ENERGY ENGINEERING (FCEE) Universiti Teknologi Malaysia 81310 Johor Bahru Johor

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# MESSAGE FROM THE DEAN

In the name of God, the most gracious and most merciful.



I am very pleased to welcome all the new students to the Faculty of Chemical and Energy Engineering (FCEE), Universiti Teknologi Malaysia (UTM).

Congratulations for being among the cream of the candidates to get the opportunity to study in one of the top chemical engineering schools globally. I am pleased to announce that our undergraduate intake Cumulative grade point average (CGPA) this year is among the highest in UTM.

At the heart of the success of FCEE lies its academic and support staff who are relentless and innovative in their efforts to produce the best talents within an exciting, productive, challenging and sustainable learning environment. At FCEE, we are committed in our mission to nurture students into a global citizen by designing competitive 21<sup>st</sup> Century Curriculum in line with the 4<sup>th</sup> Industrial Revolution.

I wish that you will grab every opportunity to learn, explore and experience not only about the discipline and profession of chemical, petroleum, gas, bioprocess and nuclear engineering, but also the life virtues; and to work hard to bring your dreams into reality. Above all, I hope that the experiences will equip you with the right attitude to make a difference to the society and to ultimately contribute for the universal well-being. Do make as many friends as possible, and enjoy your total campus experience in UTM.

The faculty guide book contains information about the faculty, programmes, courses offered as well as the rules and regulations on academic matters for undergraduate students. Please go through the contents and plan your academic journey wisely.

It is our aspiration to nurture future talents and produce high quality graduates who are *Marketable, Employable, Sustainable and Entrepreneurial*.

I wish you all the best in your studies and future undertakings.

Thank you and best regards,

**Prof. Dr. Mohd Ghazali Mohd Nawawi** Dean, Faculty of Chemical and Energy Engineering Universiti Teknologi Malaysia

# **1.0 INTRODUCTION TO FACULTY**

### **1.1 FACULTY OF CHEMICAL AND ENERGY ENGINEEERING**

Faculty of Chemical and Energy Engineering (FCEE) was established on the 1st October 2015 with the merging of Faculty of Chemical Engineering and Faculty of Petroleum and Renewable Energy Engineering. The faculty is led by a Dean and assisted by two Deputy Deans, Deputy Dean (Academic and Student Development) and Deputy Dean (Research, Innovation, Commercialization and Network), Head of Departments, Postgraduate Academic Manager, External Programme Academic Manager, IT Manager, Deputy Registrar and Assistant Registrar. FCEE consists of four (4) departments, Department of Chemical Engineering, Department of Bioprocess and Polymer Engineering, Department of Petroleum Engineering and Department of Energy Engineering. FCEE offers five (5) undergraduate programmes,

- Bachelor of Engineering (Chemical)
- Bachelor of Engineering (Chemical-Bioprocess)
- Bachelor of Engineering (Chemical-Gas)
- Bachelor of Engineering (Petroleum)
- Bachelor of Engineering (Nuclear)

FCEE also offers niche programmes at graduate level (Master and Doctor of Philosophy) since 1988.

### 1.2 VISION

To be a referred global centre of academic and technological excellence in Chemical and Energy Engineering.

### 1.3 MISSION

Nurturing holistic entrepreneurial human capitals in the field of Chemical and Energy Engineering for the universal prosperity and well-being

### **1.4 OBJECTIVES**

- To produce professional, ethical, competent, and resilient graduates in Chemical and Energy Engineering
- To be a reference centre of research and technology development based on Chemical and Energy Engineering
- To contribute in human capital development and universal peace and prosperity through product commercialization and technology

The faculty can be reached via website http://fcee.utm.my/

# 2.0 FACULTY ADMINISTRATORS



DEAN Prof. Dr Mohd Ghazali Mohd Nawawi



DEPUTY DEAN Academic and Student Development Assoc. Prof. Dr. Aznizam Abu Bakar



ACADEMIC MANAGER Postgraduates Studies Assoc. Prof. Dr. Muhammad A. Manan



DEPUTY DEAN Research, Innovation, Commercialization and Network Prof. Dr. Mat Uzir Wahit



RESEARCH MANAGER Assoc. Prof. Dr. Zainul Akmar Zakaria



DEPUTY REGISTRAR Student Affairs Mr. Mohd Fauzi Abd Rahman



FACILITY MANAGER Ir. Dr. Zaki Yamani Zakaria



ACADEMIC MANAGER External Program Dr. Hajar Alias



HEAD OF DEPARTMENT Chemical Engineering Assoc. Prof. Dr. Mohd Azizi Che Yunus



HEAD OF DEPARTMENT Bioprocess and Polymer Engineering Assoc. Prof. Dr. Roshanida A. Rahman



HEAD OF DEPARTMENT Energy Engineering Dr. Hasrinah Hasbullah



HEAD OF DEPARTMENT Petroleum Engineering Dr. Wan Rosli Wan Sulaiman



HEAD OF PROGRAM Nuclear Engineering Dr. Khaidzir Hamzah



SENIOR ASSISTANT REGISTRAR Human Resource Mrs. Nurazlyna Mohamad Marjid

# **3.0 ACADEMIC CALENDER**

# UNDERGRADUATE DEGREE PROGRAM JOHOR BAHRU CAMPUS

4 Sept 2017	Registration of New Students (UG)
5 – 8 Sept 2017	Student Orientation Week (1 Week)
6 Sept 2017	*Senate Meeting
6 & 7 Sept 2017 (UG)	Course Registration (Undergraduate) for Semester I, 2017/2018 Academic Session (2 Day)

SEMESTER I 10 Sept 2017 - 8 Feb 2018 (22 weeks)								
10 Sept - 12 Oct 2017	Lectures Semester I (First Half) (5 weeks)							
4 Oct 2017	*Senate Meeting							
15-19 Oct 2017	Mid-Semester Break for Semester I (1 week)							
22 Oct - 21 Dec 2017	Lectures Semester I (Second Half) (9 Week)							
28 Oct - 31 Oct. 2017	*UTM 59 <sup>th</sup> Convocation Ceremony							
1 Nov 2017	*Senate Meeting							
10-21 Dec 2017	Courses Pre- Registration (UG) for Semester II, 2017/2018							
6 Dec 2017	*Senate Meeting							
24 - 28 Dec 2017	Revision Period Semester 1 (1 week)							
2 – 18 Jan 2018	Final Examination for Semester I (3 weeks)							
3 Jan 2018	*Senate Meeting							
21 Jan – 8 Feb 2018	Final Break for Semester I (3 weeks)							
7 Feb 2018	*Senate Meeting							
19 Feb – 1 Mac 2018	Special Examinations for Semester I, 2017/2018							
7 Feb - 8 Feb 2018	Course Registration of New Students for Semester II, 2017/2018 Postgraduate/UG International (2 Days)							
8 & 9 Feb 2018 (UG)	Course Registration Semester II, 2017/2018 Academic Session (UG) (2 Days)							

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SEMESTER II 11 Feb 2018 – 30 August 2018 (29 weeks)								
11 Feb – 29 Mar 2018	Lectures Semesters II (First Half) (7 weeks)							
7Mar 2018	*Senate Meeting							
1 - 5 Apr 2018	Mid-Semester Break for Semester II (1 week)							
4 Apr 2018	*Senate Meeting							
28 – 29 Apr 2018	*UTM 60 <sup>th</sup> Convocation Ceremony							
8 Apr – 24 May 2018	Lectures Semester II (Second Half) (7 weeks)							
9 May 2018	*Senate Meeting							
13 - 24 May 2018	Course Pre- Registration for Semester I, 2018/2019 Academic Session (UG)							
25- 29 May 2018	Revision Period for Semester II (1 Week)							
30 May - 14 June 2018	Final Examination for Semester II (3 weeks)							
6 June 2018	*Senate Meeting							
17 June – 30 Aug 2018	Final Semester Long Vocation (11 weeks)							
4 July 2018	*Senate Meeting							
15- 26 July 2018	Special Examination for Semester II, 2017/2018							
8 Aug 2018	*Senate Meeting							
29 & 30 Aug 2018 (UG)	Course Registration Semester I, 2018/2019 Undergraduate (2 Days)							

SHORT SEMESTER 17 June 2018 – 23 August 2018 (10 weeks)								
17-21 June 2018	Mid Break for Short Semester (1 Week)							
20 & 21 June 2018	Course Registration Short Semester 2018/2019							
24 June - 16 Aug 2018	Lectures Short Semester (8 weeks)							
16 - 23 Aug 2018	Final Break for Short Semester (1 Week)							

# 4.0 PROGRAMME EDUCATIONAL OBJECTIVE AND PROGRAMME LEARNING OUTCOME

### 4.1 PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO are broad statements that describe what graduates are expected to attain after five years of graduation. PEO of FCEE are as follows:

- PEO 1 : Graduates perform competently in chemical/ petroleum/ bioprocess/ gas/ nuclear Industries and become important contributors to national development.
- PEO 2 : Graduates become creative, innovative and adaptable engineers as leaders or team members in their organizations and society.
- PEO 3 : Graduates contribute professionally towards the environmental well-being and sustainable development.

# 4.2 PROGRAMME LEARNING OUTCOMES (PLO)

PLO are statements that describe what students will achieve and be able to do when they graduate from a programme. PLO of FCEE are as follows:

Ability to apply knowledge of mathematics, natural science, engineering fundamentals, chemical/petroleum/bioprocess/gas/nuclear engineering principles to the solution of complex engineering problems.
Ability to identify, formulate, conduct research literature, and analyze complex engineering problems using first principles of mathematics and engineering sciences.
Ability to design solution for complex engineering problems and design system or process to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
Ability to conduct investigation of complex engineering problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
Ability to inculcate modern computational techniques and tools which include prediction and modelling to solve complex engineering problem with an understanding of the limitations.
Ability to responsibly act as well as respond to the societal health, safety, environment, legal and cultural issues that are relevant to the professional engineering practice.
Ability to explain and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.
Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice
Ability to communicate effectively through written and oral modes to all levels of society
Ability to work independently, and as a member or a leader in a team to manage project in multi-disciplinary environment.
Ability to acquire knowledge and engage in independent and life-long learning.
Ability demonstrate knowledge of engineering management principles and entrepreneurial mindset to manage projects in multi-disciplinary environments.

Note: KW = Engineering Knowledge; TS-PA = Thinking Skills-Problem Analysis; DD = Thinking Sills Design/Development of Solution; TS-IV =Thinking Skills-Investigation; MT= Scholarship Modern Tool Usage; GC = Global Citizen Adaptability; AD = Global Citizen Sustainability; ES = Global Citizen Ethics; CS = Communicating Skills; LTW = Leadership and Team Working; SC = Life Long Learning; BU = Enterprising Skills.

# **5.0 ACADEMIC PROGRAMME**

### 5.1 BACHELOR OF ENGINEERING (CHEMICAL)

Chemical Engineering is a field that is expanding widely throughout the world. The demand of chemical engineers has widen and currently covers many aspects of engineering such as systems design and processing of agricultural products, petroleum and petrochemicals, polymers, pharmaceuticals, biofuel, biochemical and many more. In the current state of the world, where resources are limited and sustainable development is a major challenge, the requirement for expertise in chemical engineering is even more crucial.

In addition to fundamental fields such as science and mathematics, humanities and social sciences and basic engineering, there are four major areas in the Bachelor of Chemical Engineering course. These are separation technology, reaction engineering, environmental engineering and process systems engineering.

In separation technology, students are exposed to processes and unit operation equipment in chemical engineering. To understand separation processes, a strong grasp on transport phenomena, which include momentum transfer, mass and heat transfer, is necessary. Mass and heat transfer theories are essential in designing or choosing a suitable heat exchanger to be utilized in a chemical plant. Meanwhile, the unit operation subject covers theories and design of major equipment in the separation of liquid-liquid, gas-liquid, solid-liquid and solid-gas systems. Knowledge in separation theory and unit operations is necessary in designing an optimum and safe plant.

Chemical engineering also focuses on the thermodynamics and chemical reaction aspects apart from

designing a reaction system. Amongst the topics discussed are reaction kinetics in a reactor, types of reactor and reactor design. The students will learn chemical engineering thermodynamics aspects, which elucidate the characteristics of pure fluid, fluid thermodynamics characteristics, homogeneous thermodynamics characteristics, and equilibrium. The knowledge will consequently be used in learning chemical reaction of processes. Another important aspect in chemical engineering is environmental safety. Environmental engineering courses cover types of air and water pollution, and also analytical method for pollution measurement,



waste treatment and waste management. Occupational safety and health aspects will also be introduced.

In process systems engineering, mass and energy balances is the fundamental subject. In this subject, the



students will be introduced to the processes in chemical engineering as well as the calculation method for mass and energy balances for different processes. This includes the processes that have chemical reactions and also processes with physical transformations only. The crux of the chemical engineering course is plant design and synthesis, which includes the selection of process, constructing flow sheets, mass and energy balance, detailed design, selection of equipment and raw materials, process control, operational instruction, cost and economics

and also environmental and safety aspects in a plant. Students are also required to complete a processing plant design project in groups. Here, all the techniques learnt in the previous years will be integrated in proposing a design for an assigned plant.

Apart from chemical engineering theories, students are also exposed to practical aspects of the field. Every area mentioned before has its own practical or laboratory sessions. The students are also required to prepare a project report to train them to integrate technical knowledge with communication and management in carrying out a task. In addition, students will also carry out a bachelor's level research project, in which they will individually work under the supervision of a lecturer. At the end of the design and research work, the students are required to prepare a thesis and give an oral presentation which will be assessed by panel of examiners.

The UTM curriculum requires students to undergo industrial training for 12 weeks during the semester break after the third year of education. A written report about the work done and experiences during the training must be presented at the end of the training period.

# 5.1.1 PROGRAMME SPECIFICATION FOR BACHELOR OF ENGINEERING (CHEMICAL)

1. Programme Name		Bachelor of Engineerin	g (Chemical)				
2. Final Award		Bachelor of Engineerin					
4. Teaching Institution	Universiti Teknologi Malaysia Universiti Teknologi Malaysia						
5. Programme Code	TK03	naysia					
6. Professional or Statutory Body of Accredit	Board of Engineers Ma	lavsia (BEM)					
7. Language(s) of Instruction	auon	English and Bahasa M					
8. Mode of Study (conventional, distance le	earning,	Conventional	elayu				
etc) 9. Mode of Operation (Franchise, self-govern	n, etc)	Self-govern					
10. Study Scheme (Full time / Part time)		Full-time					
11. Study Duration		Minimum: 4 years Maximum: 6 years					
Type of Semester		No. of semesters	No. of weeks per semester				
Normal		8	14				
Short		4	8				
12. Entry Requirement 13. Programme Educational Objectives (PEOs	•)	<ul> <li>Matriculation or STPM with minimum of B- in Mathematics/ Additional Mathematics/ Further Additional Mathematics, Chemistry/ Engineering Chemistry and Physics/ Engineering Physics/ Biology with CPA 3.00 and not physically handicapped which makes him/her unable to conduct experimental/ practical work.</li> <li>Possesses an Engineering Diploma from UTM/equivalent with minimum CGPA of 2.70 or an Engineering Diploma from UTM/equivalent with minimum CGPA of 2.50 and additional 2 years of experience in related field.</li> </ul>					
PE01Graduates perform competentl to national developmentPE02Graduates become creative, position as leaders or team me Graduates contribute professi developmentPE03Graduates contribute professi development14. Programme Learning Outcomes (PLOs)	innovative embers in th	and adaptable enginee eir organizations and so	rs regardless of their ciety				
Intended Learning Outcomes	Teaching a	and Learning Methods	Assessment				
<b>PLO 1</b> Ability to apply knowledge of mathematics, natural science, engineering fundamentals, chemical engineering principles to the solution of complex engineering problems.	Lectures laborat reading, s comput undergra projec learnin	, tutorials, seminars, ory works, directed simulation exercises, er-based exercises, duate project, design st, problem-based g, cooperative and porative learning.	Examinations, reports, problem-based exercises, group projects, and independent projects.				
<b>PLO2</b> Ability to identify, formulate, conduct research literature, and analyze complex engineering problems using first principles of mathematics and engineering sciences	Lectures, works, simulation based exe	Lectures, seminars, laboratory works, directed reading, simulation exercises, computer- based exercises, undergraduate project, design project,Problem-based lea reports, laborator reports, presentat individual resear project, thesis					

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	problem-based learning,	
	cooperative and collaborative	
	learning.	
<b>PLO3</b> Ability to design solution for complex engineering problems and design system or process to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and	Lectures, tutorials, seminars, laboratory works, directed reading, simulation exercises, computer-based exercises, undergraduate project, design	Examinations, problem- based learning reports, laboratory reports, presentations, design project, individual
environmental considerations. <b>PLO4</b> Ability to conduct investigation of	project, problem-based learning, group projects. Lectures, seminars, laboratory	research project and thesis. Problem-based learning
complex engineering problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions,	works, directed reading, simulation exercises, computer- based exercises, undergraduate project, design project, problem-based learning project.	reports, laboratory reports, presentations, thesis.
PLO5 Ability to inculcate modern	Lectures, tutorials, seminars,	Examinations,
computational techniques and tools which include prediction and modelling to solve complex engineering problem with an understanding of the limitations.	laboratory works, simulation exercises, design project, group projects. computer-based exercises, problem-based	presentations, design project, individual research project, computer project and
	learning, undergraduate project.	assignment.
<b>PLO6</b> Ability to responsibly act as well as respond to the societal health, safety, environment, legal and cultural issues that are relevant to the professional engineering practice.	Seminars, group projects, group discussion, problem-based learning, cooperative and collaborative learning, tutorials, undergraduate project, and design project	Written assignments, laboratory reports, essays, thesis, forum and oral presentations.
<b>PL07</b> Ability to explain and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.	Lectures, seminar, industrial training, undergraduate project, design project.	Written reports and presentations, learning logs/journal, peer and lecturer evaluations.
<b>PLO8</b> Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice	Lectures, seminar, industrial training, undergraduate project, design project, problem-based learning project.	Technical reports and presentations, learning logs/journal, peer assessment and lecturer evaluations.
<b>PLO9</b> Ability to communicate effectively through written and oral modes to all levels of society.	Group projects, group discussion, problem-based learning, laboratory work, undergraduate project, and design project.	Written assignments, laboratory reports, essays, thesis, forum and oral presentations.
<b>PL010</b> Ability to work independently, and as a member or a leader in a team to manage project in multi-disciplinary environment.	Undergraduate project, Industrial training, design project, co-operative learning, and problem-based learning.	Group reports and presentations, learning logs/journal, peer assessment and lecturer evaluations.
PLO11 Ability to acquire knowledge and engage in independent and life-long learning.	Industrial training, industrial visit, undergraduate project, design project, and problem- based learning.	E-portfolio, Industrial training report, self- directed learning, report, reflection journal, and project report and presentation.
<b>PL012</b> Ability to demonstrate knowledge of engineering management principles and entrepreneurial mindset to manage projects in multi-disciplinary environments.	Lectures, class projects, industrial training, undergraduate project, and design project.	Forum, presentations, assessment by industrial supervisor, and examinations.

15. Cla	assification of courses		
No.	Classification	Credit Hours	Percentage
i.	University Course		
	a. Social Science/Humanities	12	8.7
	b. Language	8	5.8
	c. Co-Curriculum	2	1.5
ii.	Mathematics, Science and Technology	20	14.5
iii.	Programme Core	87	63.0
iv.	Programme Elective	9	6.5
	Total	138	100
	Classification based on field (refer t	to the Statutory Body guid	delines)
No	Classification	Credit Hours	Percentage
	Engineering Courses		
	a. Lectures	75	
	b. Laboratory/Workshop	6	
A	c. Industrial Training	5	69.6
	d. Undergraduate Project	6	00.0
	e. Integrated Design Project/Capstone	4	
	Total credit hours for Part A	96	
	Related Courses		
	a. Applied Science/Math/Computer	20	
В	b. Management/Law/Humanities/Ethics	20	30.4
	c. Co-Curriculum	2	
	d. Others	-	
	Total credit hours for Part B	42	
	Total credit hours for Part A and B	138	100
16. Tot	al credit hours to graduate	138 cm	edit hours
17. Pro	gramme structures and features, curriculum ar	nd award requirements	

This programme is offered on full-time mode and is based on a 2-Semester Academic Session with several courses being delivered and assessed in each semester. Assessment is based on coursework, final examination, lab reports, presentations, industrial training, final year project, and design project.

# Award requirements:

To graduate, students must:

- achieve a total of 138 credit hours with minimum CPA of 2.00
- pass Industrial Training
- complete all Professional Skill Courses
- sit for Test of English Communication Skills for Graduating Students (*TECS*)

### Core Courses for Minor in Chemical Engineering

For students from different approved programmes who wish to have a Minor in the Chemical Engineering Programme, they must complete 15 credit hours of selected courses.

	Courses											
No	Code	Name of Courses	Credit	Pre-requisite								
1.	SKTK 1123	Mass Balance	3									
2.	SKTK 2133	Energy Balance	3	SKTK 1123								
3.	SKTK 3323	Separation Processes	3	SKTK 2133								
4.	SKTK 3263	Chemical Reaction Engineering	3	SKTK 2133								
5.	SKTK 4573	Process Safety & Operability	3									
	•	15										

### 18. Our Uniqueness

- The faculty has produced the most chemical engineering graduates in Malaysia since the establishment of Chemical Engineering Department in 1983; therefore it has the largest Chemical Engineering alumni in Malaysia.
- The curriculum is unique where "Streaming Courses' are introduced. These courses will give value added for student in terms of specialization. Thus students are more marketable, employable, sustainable and entrepreneurial.
- The Chemical Engineering Student Society (ChESS) is also a Student Chapter of The American Institute of Chemical Engineers (AIChE)
- The faculty also possessed well-equipped laboratory facilities and experience academic staff.

### 19. Career Prospects and Career Paths

Chemical engineers are universal engineers, who are versatile and capable of performing many types of tasks. They can be assigned in various sectors of industries including banking, insurance, administration and business. However, many are working in the industry as production and process engineers, maintenance engineers and project engineer. With their ability spanning these three important aspects, many chemical engineers have been promoted to the position of plant manager, which manages the whole processing plant. The industrial sectors that need many chemical engineers are petroleum and petrochemicals, palm oil and oleo chemicals, rubber and plastics, pharmaceuticals and medicine, food and electronics.

With rapid development in the process industry, the need for chemical engineers in sectors supporting the industry is also becoming more important. For example, the demand for chemical engineers in banking and insurance industry is increasing. A chemical engineer is needed in the management and marketing of raw materials, products and main equipment and instrumentation, which are related to the processing industry. Many engineering consulting companies are also opened and this gives more career opportunities for the newly graduating chemical engineers.

Chemical engineers are needed in semi-government sectors such as in MIDA and the Department of Environment. They are also desired in research institutions such as in MPOB, MARDI and RRI. In institutions of higher learning, chemical engineers with PhDs are highly in demand.

### 20. UTM Professional Skills Certificate and TECS

All undergraduates undergoing bachelor degree programmes are required to enrol for and follow four short courses and one test during their studies in UTM to obtain the *UTM Professional Skills Certificate* as part of the requirements for graduation. Those are:-

- i. How to Get Yourself Employed (HTGYE)
- ii. ISO 9001:2008 Quality Management System Requirement (ISO)
- iii. Occupational Safety and Health Awareness (OSHA)
- iv. How to Manage Your Personal Finance (HTMYPF)
- v. Test of English Communication Skills for Graduating Students (TECS)
  - a. Paper I Oral Interaction
  - b. Paper II Writing

### 21. Assessment Tools

Measurement Tools						Lea	rning	Outco	omes						
	PL01	PL02	PL03	PL04	PLO5	PL06	PL07	PL08	6014	PL010	PL011	PL012	Duration	Action by	
	Exam, quizzes, peer teaching	~	~	~	~	~		~	~			~	~	Continuous	Lecturer, student
	Peer Assessment										~				Student
	e- Portfolio	✓										~		Continuous	Student

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Course Exit Survey	~	~	~	~	~	~	~	~	~	~	~	~	End of sem	Lecturer
Course Assessment Report	~	~	~	~	~	~	~	~	~	~	~	~	End of sem	Lecturer
Research Project Survey	~	~	~	~	~	~	~	~	~		~	~	End of sem	Faculty
Programmme Exit Survey	~	~	~	~	~	~	~	~	~	~	~	~	4th year	Faculty
Industrial Training Survey	~	~	~	~	~	~	~	~	~		~	~	End of session	Faculty
Alumni Survey	~				~		~	~	~		~	~	Once/3 years	Faculty
Employer Survey	~	~	~	~	~	~	~	~	~	~	~	~	Once/3 years	Head of Dept

# 5.1.2 CURRICULUM FOR BACHELOR OF ENGINEERING (CHEMICAL)

	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		
	SKTK 1511	Industrial Seminar & Profession	1	
	SKTK 1523	Introduction to Engineering	3	
	SKTK 1213	Statics <sup>®</sup>	3	
Y	SKTK 1533	Introduction to Computer Programming	3	
	SKTK 1111	Engineering Drawings	1	
E	SSCE 1693	Engineering Mathematics I <sup>®</sup>	3	
	ULAB 1122	Academic English Skills	2	
Α		Sub total	16	
		SEMESTER 2		
R	SKTK 1123	Mass Balance*®	3	
	SKTK 1223	Thermodynamics <sup>@</sup>	3	
1	SSCE 1993	Engineering Mathematics II <sup>®</sup>	3	
	SSCK 1623	Organic Chemistry for Engineering	3	
	SSCK 1831	Organic Chemistry Practical	1	
	UICI 1012	Islam & Asian Civilization	2	
	UHAK 1012	Graduate Success Attributes	2	
		Sub total	17	
	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		
	SSCE 1793	Differential Equations	3	
	SKTK 2133	Energy Balance*®	3	SKTK 1123#
	SKTK 2233	Fluid Mechanics	3	
	SKTK 2243	Materials Engineering	3	
	01/71/ 0744			
	SKTK 2711	Thermodynamics and Material Eng. Laboratory	1	
Y	ULAB 2122	Advanced Academic English Skills	1 2	
		Advanced Academic English Skills Introduction to Entrepreneurship	1 2 2	
Y E	ULAB 2122	Advanced Academic English Skills Introduction to Entrepreneurship Sub total	1 2	
Е	ULAB 2122 UHAK 1032	Advanced Academic English Skills Introduction to Entrepreneurship Sub total SEMESTER 2	1 2 2 <b>17</b>	
	ULAB 2122 UHAK 1032 SSCK 1203	Advanced Academic English Skills Introduction to Entrepreneurship Sub total SEMESTER 2 Analytical Chemistry for Engineering	1 2 2 17 3	
E A	ULAB 2122 UHAK 1032 SSCK 1203 SSCK 1891	Advanced Academic English Skills Introduction to Entrepreneurship Sub total SEMESTER 2 Analytical Chemistry for Engineering Analytical Chemistry Practical	1 2 17 3 1	
Е	ULAB 2122 UHAK 1032 SSCK 1203 SSCK 1891 SKTK 2253	Advanced Academic English Skills Introduction to Entrepreneurship Sub total SEMESTER 2 Analytical Chemistry for Engineering Analytical Chemistry Practical Chemical Engineering Thermodynamics	1 2 17 3 1 3	SKTK 1223
E A R	ULAB 2122 UHAK 1032 SSCK 1203 SSCK 1891 SKTK 2253 SKTK 2313	Advanced Academic English Skills Introduction to Entrepreneurship Sub total SEMESTER 2 Analytical Chemistry for Engineering Analytical Chemistry Practical Chemical Engineering Thermodynamics Transport Processes*	1 2 2 17 3 1 3 3 3	SKTK 1223 SKTK 2133#
E A	ULAB 2122 UHAK 1032 SSCK 1203 SSCK 1891 SKTK 2253 SKTK 2313 SKTK 2721	Advanced Academic English Skills Introduction to Entrepreneurship Sub total SEMESTER 2 Analytical Chemistry for Engineering Analytical Chemistry Practical Chemical Engineering Thermodynamics Transport Processes* Fluid Mechanics Laboratory	1 2 2 17 3 1 3 3 1 3 1	SKTK 2133#
E A R	ULAB 2122 UHAK 1032 SSCK 1203 SSCK 1891 SKTK 2253 SKTK 2313 SKTK 2721 SKTK 2543	Advanced Academic English Skills Introduction to Entrepreneurship Sub total SEMESTER 2 Analytical Chemistry for Engineering Analytical Chemistry Practical Chemical Engineering Thermodynamics Transport Processes* Fluid Mechanics Laboratory Numerical Method & Optimization®	1 2 2 17 3 1 3 3 1 3 3 1 3	
E A R	ULAB 2122 UHAK 1032 SSCK 1203 SSCK 1891 SKTK 2253 SKTK 2313 SKTK 2721 SKTK 2543 UHAS1172	Advanced Academic English Skills Introduction to Entrepreneurship Sub total SEMESTER 2 Analytical Chemistry for Engineering Analytical Chemistry Practical Chemical Engineering Thermodynamics Transport Processes* Fluid Mechanics Laboratory Numerical Method & Optimization® Dinamika Malaysia(local) / Malaysia Studies 3	1 2 2 17 3 1 3 3 1 3 1	SKTK 2133#
E A R	ULAB 2122 UHAK 1032 SSCK 1203 SSCK 1891 SKTK 2253 SKTK 2313 SKTK 2721 SKTK 2543 UHAS1172 /UHAK 1022	Advanced Academic English Skills Introduction to Entrepreneurship Sub total SEMESTER 2 Analytical Chemistry for Engineering Analytical Chemistry Practical Chemical Engineering Thermodynamics Transport Processes* Fluid Mechanics Laboratory Numerical Method & Optimization® Dinamika Malaysia(local) / Malaysia Studies 3 (International Student)	1 2 17 3 1 3 3 1 3 2	SKTK 2133#
E A R	ULAB 2122 UHAK 1032 SSCK 1203 SSCK 1891 SKTK 2253 SKTK 2313 SKTK 2721 SKTK 2543 UHAS1172	Advanced Academic English Skills Introduction to Entrepreneurship Sub total SEMESTER 2 Analytical Chemistry for Engineering Analytical Chemistry Practical Chemical Engineering Thermodynamics Transport Processes* Fluid Mechanics Laboratory Numerical Method & Optimization® Dinamika Malaysia(local) / Malaysia Studies 3	1 2 2 17 3 1 3 3 1 3 3 1 3	SKTK 2133#

	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		
	SKTK 3263	Chemical Reaction Engineering	3	
	SKTK 3323	Separation Processes*	3	SKTK 2313#
	SKTK 3413	Pollution Control Engineering	3	
	SKTK 3731	Pollution Control and Reaction Laboratory	1	
	SKTK 4**3	Elective 1	3	
	SKTK 3552	Occupational Safety and Health in Industry	2	
Y	SKEU 2003	Electrical Technology	3	
Y		Sub total	18	
Е		SEMESTER 2		
<b>-</b>	SKTK 3564	Process Control & Instrumentation*	4	SSCE 1793#, SKTK
А				3323, SKTK 3263
~	SKTK 3334	Unit Operation & Industrial Processes	4	SKTK 2313#
R	SKTK 3741	Separation Processes Laboratory I	1	SKTK 3323
R	SKTK 3812	Undergraduate Project I**	2	
3	SKTK 3343	Engineering Economics and Project	3	
3		Management		
	ULAB 3162	English for Professional Purposes	2	
	UL** 1**2	Foreign Language	2	
		Sub total	18	
		SEMESTER 3		
	SKTK 3915	Industrial Training	5	
		Sub total	5	
	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		
	SKTK 4143	Chemical Product Design	3	
	SKTK 4751	Process Control Laboratory	1	SKTK 3564
	UICL 2302	The Thought of Science and Technology	2	
Y	SKTK 4761	Separation Processes Laboratory II	1	SKTK 3323
	SKTK 4153	Plant Design*	3	SKTK 3564
E	SKTK 4824	Undergraduate Project II**	4	SKTK 3812#
	U*** ***2	General Elective	2	
Α		Sub total	16	
		SEMESTER 2		
R	SKTK 4573	Process Safety & Operability	3	
	SKTK 4834	Plant Design Project**	4	SKTK 4153
4	SKTK 4**3	Elective 2	3	
	SKTK 4**3	Elective 3	3	
		Sub total	13	
		Total credit	138	
			100	

Note: \* - cornerstone course; \*\* - capstone course; @ - with tutorial # - must pass (at least with grade D+) for prerequisite course

### 5.1.3 ELECTIVE COURSES - STREAMING (CHOOSE one STREAM only)

Apart from the core courses, student must also take 9 credits of elective courses. Students are advised to choose one stream and take 3 courses from the same stream. The elective courses are shown in Table below.

1. Energy Management	2. Advanced Materials
<ul> <li>SKTK 4113 Sustainable Energy Management</li> <li>SKTK 4123 Thermal Energy Management</li> <li>SKTK 4133 Energy Planning for Sustainable Development</li> </ul>	<ul> <li>SKTK 4213 Polymer Composites</li> <li>SKTK 4223 Smart Materials</li> <li>SKTK 4233 Biomaterials</li> </ul>
3. Oil and Gas	4. Environment
<ul> <li>SKTK 4313 Introduction to Oil &amp; Gas Industry</li> <li>SKTK 4323 Refinery &amp; Petrochemical Technology</li> <li>SKTK 4333 Gas Transportation and Storage</li> </ul>	<ul> <li>SKTK 4413 Waste Management</li> <li>SKTK 4423 Environmental Management</li> <li>SKTK 4433 Environmental Sustainability</li> </ul>
5. Occupational Salety and Realth	6. Polymer Science and Technology
<ul> <li>5. Occupational Safety and Health</li> <li>SKTK 4513 OSH Legislations and Management</li> <li>SKTK 4523 Industrial Hygiene</li> <li>SKTK 4533 Human Factors in Process Industry</li> </ul>	<ul> <li>6. Polymer Science and Technology</li> <li>SKTK 4613 Fundamentals of Polymer</li> <li>SKTK 4623 Polymer Physics and Properties</li> <li>SKTK 4633 Polymer Rheology and Processing</li> </ul>
<ul> <li>SKTK 4513 OSH Legislations and Management</li> <li>SKTK 4523 Industrial Hygiene</li> <li>SKTK 4533 Human Factors in Process</li> </ul>	<ul> <li>SKTK 4613 Fundamentals of Polymer</li> <li>SKTK 4623 Polymer Physics and Properties</li> <li>SKTK 4633 Polymer Rheology and</li> </ul>

• SKTK 4663 Food Process Engineering

5.1.4 PREREQUISITE

**BACHELOR OF ENGINEERING (CHEMICAL)** 

SEMESTER 8	SKTK 4834
SEMESTER 7	SKTK 4153 SKTK 4751 SKTK 4761 SKTK 4824
SEMESTER 6	<pre>&gt; SKTK 3741 &gt; SKTK 3564 &gt; SKTK 3334* &gt; SKTK 3334* SKTK 3812*</pre>
SEMESTER 5	SKTK 3323
SEMESTER 4	<ul> <li>SKTK 2543</li> <li>SKTK 2313*</li> <li>SKTK 2253</li> </ul>
SEMESTER 3	SKTK 2133*
SEMESTER 2	SKTK 1123*
SEMESTER 1	SKTK 1533

# 5.1.5 MAPPING OF COURSES TO PROGRAMME LEARNING OUTCOMES (PLO)

				PI	ROGR/	AMME	LEARN	ING OU	тсом	es (Pi	_0)		
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	nvestigation	Modern Tool Usage	The Engineer and Society	Environment & Sustainability	Ethics	Communication Skills	-eadership and Team Work	Life Long Learning	Project Management and Finance
CODE	COURSE	PL01	PL02	PLO3	PL04	PLO5	PLO6	PL07	PLO8	PL09	PL010	PL011	PL012
UNIVERSITY G	ENERAL COURSE												
ULAB 1122	Academic English Skills									✓			
ULAB 2122	Advanced Academic English Skills									✓			
ULAB 3162	English for Professional Purposes									✓			
UL** 1**2	Foreign Language									✓			
UHAS 1172/ UHAK 1022	Dinamika Malaysia (local)/Malaysia Studies 3 (International Student)												
UHAK 1012	Graduate Success Attributes												
UHAK1032	Introduction to Entrepreneurship												✓
UICI 1012	Islamic and Asian Civilizations												
UICL 2302	The Thought of Science and Technology												
U*** ***2	Soft Skill Elective												
UKQ ***2	Co-Curriculum and Service Learning											✓	
MATH/SCIEN	CE/TECHNOLOGY			•	•	•			•				
SSCE 1693	Engineering Mathematics I		✓										
SSCE 1893	Engineering Mathematics II		~										
SSCE 1793	Differential Equations		~										
SSCK 1623	Organic Chemistry for Engineering												
SSCK 1831	Organic Chemistry Practical												
SSCK 1203	Analytical Chemistry for Engineering												
SSCK 1891	Analytical Chemistry Practical												
SKEU 2003	Electrical Technology												
PROGRAM CC	ORE COURSES	·		•	•	•			•				
SKTK 1111	Engineering Drawing					~			~			~	
SKTK 1213	Statics	~	~				~				~		
SKTK 1511	Industrial Seminar & Profession	✓				✓	~					~	

### UNDERGRADUATE GUIDE BOOK 2017/2018

				PF	Rogr/	MME	LEARN	ING OU	тсом	ES (PI	_0)		
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment & Sustainability	Ethics	Communication Skills	Leadership and Team Work	Life Long Learning	Project Management and Finance
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	PLO6	PL07	PL08	PL09	PL010	PL011	PL012
SKTK 1523	Introduction to Engineering	~			~					~		~	
SKTK 1533	Introduction to Computer Programming	~				~					~	~	
SKTK 1123	Mass Balance	~	~	~								~	
SKTK 1223	Thermodynamics	~	~						~		~		
SKTK 2133	Energy Balance	~	~									~	
SKTK 2233	Fluid Mechanics	~	~					~			~		
SKTK 2243	Material Engineering	~	~				~				~		
SKTK 2711	Thermodynamics and Material Eng. Laboratory		~		~					~	~		
SKTK 2253	Chemical Engineering Thermodynamics	~	~							~	~		
SKTK 2313	Transport Processes	~		~				~				~	
SKTK 2721	Fluid Mechanics Laboratory		~		~					~	~		
SKTK 2543	Numerical Method & Optimization	~	~			~			~			~	
SKTK 3263	Chemical Reaction Engineering	~	~	~		~		~					
SKTK 3323	Separation Processes I	~		~			~					~	
SKTK 3413	Pollution Control Engineering	~		~			~	~	~				
SKTK 3731	Pollution Control and Reaction Laboratory		~		~					~	~		
SKTK 3552	Occupational Safety and Health in Industry	~					~	~	~				
SKTK 3334	Unit Operation & Industrial Processes	✓	~							~	~		
SKTK 3343	Engineering Economics and Project Management	~							~	~			~
SKTK 3564	Process Control & Instrumentation	~		~		~				~	~		
SKTK 3741	Separation Process Laboratory I		~		~					~	~		
SKTK 3812	Undergraduate Project I	~	~	~			~	✓	~	~		~	~
SKTK 3915	Industrial Training	✓	~				✓		~	~			
SKTK 4143	Chemical Product Design	~				~		~					✓
SKTK 4153	Plant Design	~		~		~		~		~			~
SKTK 4751	Process Control Laboratory		~		~	~				~	~		

### UNDERGRADUATE GUIDE BOOK 2017/2018

				PF	Rogra	MME	LEARN	ING OU	тсом	es (Pi	_0)		
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment & Sustainability	Ethics	Communication Skills	Leadership and Team Work	Life Long Learning	Project Management and Finance
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	PLOG	PL07	PL08	PL09	PL010	PL011	PL012
SKTK 4761	Separation Processes Laboratory II		~		~					~	~		
SKTK 4824	Undergraduate Project II	~	✓	~	~		~	~	✓	~		✓	~
SKTK 4573	Process Safety & Operability	~	✓	~						~	~		
SKTK 4834	Plant Design Project	~	✓	~		~	~	~	~	~	~	~	✓
PROGRAMME	ELECTIVE COURSES	1		1	1	1			1		1		
SKTK 4113	Sustainable Energy Management	✓								✓		✓	
SKTK 4123	Thermal Energy Management	~		~						~		~	
SKTK 4133	Energy Planning for Sustainable Development	~				~				✓		✓	
SKTK 4213	Polymer Composites	~								~		~	
SKTK 4223	Smart Materials	~								~		~	
SKTK 4233	Biomaterials	~								~		~	
SKTK 4313	Introduction to oil & gas industry	~								~		~	
SKTK 4323	Refinery & Petrochemical Technology	~		~						~	~	~	
SKTK 4333	Gas transportation and Storage	~								~		~	
SKTK 4413	Waste Management	~		~						~		~	
SKTK 4423	Environmental Management	~								~		~	
SKTK 4433	Environmental Sustainability	~								~		~	
SKTK 4513	OSH Legislations and Management	~								~		~	
SKTK 4523	Industrial Hygiene	~								~		~	
SKTK 4533	Human Factors in Process Industry	~								~		~	
SKTK 4613	Fundamentals of Polymer	~								~		~	
SKTK 4623	Polymer Physics and Properties	~								~		~	
SKTK 4633	Polymer Rheology and Processing	~								~		~	
SKTK 4643	Downstream Bioprocessing	~								~		~	
SKTK 4653	Pharma and Nutraceutical Engineering	~								~		~	
SKTK 4663	Food Process Engineering	~								~		~	

### 5.1.6 SYNOPSIS OF CHEMICAL ENGINEERING COURSES

### SKTK 1111 Engineering Drawing

This course introduces students to Computer Aided Drawing tools. The topics include Computer Aided Drawing, Computer Aided Command, Geometry, Geometry, Orthographic Drawing, Isometric Drawing, Sectional Drawing and Flowchart Drawing.

### SKTK 1213 Statics

This course introduces students to the basic principles and concepts in mechanics. It will deal with the resultant and resolution of force(s) acting on a particle, the equilibrium of a particle, the effect of force(s) on a rigid body, how to replace a force system with equivalent system and the equilibrium of rigid body. This course also includes the determination of centroid, analysis of structure and friction. At the end of the course, students should be able to demonstrate and apply the knowledge for solving various engineering problems.

### SKTK 1511 Industrial Seminar and Profession

This course introduces students to the basic chemical engineering knowledge and working environment through workshops and seminars by respective personnel (experts, engineers, lectures, alumni, senior students etc.) and also industrial visit to various chemical plants in Malaysia. Students need to prepare learning portfolios which contain summaries and reflections of all the seminars, workshops and industrial visit that they have attended.

### SKTK 1523 Introduction to Engineering

The objective of this course is to introduce engineering and prepare students for learning engineering to become an engineer of the future. This course serves to bridge pre-university education to university life and provide support for adjusting to learning and expectations in tertiary education. This introduction is made through a mix of lectures, student-centred activities and presentations. This course employs Cooperative Problem-based Learning (CPBL). Through CPBL, students are not only exposed to frontier chemical engineering related issues, but are also equipped with other important professional skills such as communication, critical thinking, problem solving and life-long learning. CPBL is utilized to inculcate SD among the first year engineering students in order to foster environmentally responsible behaviours and provide strong foundation for more sustainable societies.

### SKTK 1533 Introduction to Computer Programming

The main objective of this course is to provide the students the foundation of programming skills as a tool for solving problems in chemical engineering. It helps students to feel justifiably confident of their ability to write small programs that allow them to accomplish useful goals. This course includes the coverage of basics and application of MATLAB software for solving simple arithmetic operations with arrays, two-dimensional plotting and programming using flow control commands with conditional statements and loops. With this foundation of basic programming skills, the course provides opportunities to explore advanced topics for solving complex chemical engineering problems.

### SKTK 1123 Mass Balance

This course introduces students to the chemical engineering and chemical processes, process and the fundamental operations of chemical process equipment. It also provides students with the basic principles of chemical engineering material balances as well as calculation techniques to solve material balance problems for chemical process systems and equipment.

### SKTK 1223 Thermodynamics

Thermodynamics is an important basic engineering subject where concepts such as systems, boundaries, mass, heat, work and energy are introduced. These concepts are then related using the 1st and 2nd Law of Thermodynamics. In this subject properties of common substances such as water, air and general working fluids are introduced using property tables and basic state equations. These concepts are applied in many engineering equipment, basic refrigeration and power cycles. Such basic concepts are vital because they form the fundamentals for future chemical engineering subjects.

### SKTK 2133 Energy Balance

### Pre Requisite: SKTK 1123 Mass Balance (pass with at least D+)

This course introduces students to the chemical engineering profession and the fundamental operations of chemical process equipment. It also provides students with the basic principles of chemical engineering

energy balances as well as calculation techniques to solve the material and energy balance problems for chemical process systems and equipment.

### SKTK 2233 Fluid Mechanics

The course introduces the fundamental principles underlying fluid behaviour, hydraulics, hydrodynamics, internal and external flows and its analysis of engineering applications for the design of simple hydraulic components such as pump and turbine. The course covers the physics of fluid, classification of flow, fluid statics, fluid dynamics, the application of Bernoulli, continuity, and momentum equations, friction flow in pipes includes the use of Moody chart, flow metering, pump, dimensional analysis and similarity.

### SKTK 2243 Material Engineering

The first part of this course is the introductory Materials Engineering. Topics covered include classification of materials (metals, ceramics, polymers, composites, semiconductors, smart materials, nanomaterials, and biomaterials); atomic bonds; crystal structure; crystalline defects and solid solutions; and phase diagrams. Main emphasis is on metals because metals are structurally the simplest to characterise and a sound knowledge of structure-property relation of metals can be extended to the study of ceramics and polymers. The second part of the course deals with mechanics of materials. Topics covered include stress and deformation of members under axial loading and torsion in circular shafts.

### SKTK 2711 Thermodynamics and Material Engineering Laboratory

This laboratory course contains 6 experiments that covered basic concepts in Thermodynamics and Strength of Materials. Laboratory experiments are designed for hand-on experiences to understand the engineering principles. The experiments application includes First and Second Law of Thermodynamics, Properties of Pure Substances and Properties & Strength of Materials. This course also emphasizes the technical writing aspect where all students' observation and arguments of each experiment must be reported in proper format.

### SKTK 2253 Chemical Engineering Thermodynamics

Pre Requisite: SKTK 1223 Thermodynamics (taken)

This course introduces students to the chemical engineering thermodynamics theory and applications in the areas of volumetric properties of fluids, heat effects, thermodynamics properties of fluids, thermodynamics of solutions, and physical and chemical equilibria.

### SKTK 2313 Transport Processes

### Pre Requisite: SKTK 2133 Energy Balance (pass with at least D+)

This course introduces students to the basic principles and application of heat and mass transfer engineering. The understanding from this courses will be useful for the better understanding in distillation, absorption, liquid-liquid extraction, membrane separation, leaching, evaporation and others chemical processes.

### SKTK 2543 Numerical Method & Optimization

Pre Requisite: SKTK 1533 Introduction to Computer Programming (taken)

This course introduces students to some numerical techniques in solving problems that could not be solved analytically. Students will be exposed to the numerical solution for root of equation, system of linear algebraic equations, curve fitting, ordinary differential equations, differentiation and integration problem. MATLAB programming language will be implemented with the intention of illustrating the nuances of the methods, and showing more realistically how the methods are applied for problem solving.

### SKTK 2721 Fluid Mechanics Laboratory

The aim of this laboratory course is for students to conduct experiment in conjunction with the theory course SKTK 2233 (Fluid Mechanics). There are a total 9 experiments for this course where two of them (Bourdoun Tube pressure gauge and Toricelli's Law), students needs to construct and setup by their own based on the fundamental knowledge and literature finding. Other experiments include the operation of flow measurement equipment (Venturi nozzle, pitot tube, orifice and nozzle), flow through a piping system to determine major and minor loses. The lab runs closely with the lectures' observation in such a way that experiments support the text covered in the class room.

### SKTK 3263 Chemical Reaction Engineering

This course introduces students to chemical reactor design and theories in the area of chemical reaction engineering with emphasis on homogeneous and heterogeneous reactions. It will examine some problems related to isothermal reaction, data analysis, multiple reactions and non-isothermal operations. Students will also work cooperatively on a computer assignment to expose them to solving problems using software packages such as PolyMath.

### SKTK 3323 Separation Processes

Pre Requisite: SKTK 2313 Transport Processes (pass with at least D+)

This course introduces different types of unit operations involved in the chemical and other physical processing industries such as humidification, absorption, distillation, liquid-liquid extraction and solid-liquid extraction (leaching). It also deals with design of separation operations using mass transfer principles.

### SKTK 3413 Pollution Control Engineering

This course introduces the cause, effect and method to control pollution from industries. The course covers the three major categories of industrial pollution: water pollution, air pollution and industrial waste management. In the first part, the course includes the source and types of water pollutants, environmental regulations pertaining to waste water discharge, and techniques to treat waste water before discharging to the environment. The second part of the course covers the source and effect of air pollution, regulations requirement for air pollution control, technology to control air pollution emissions from industries. The third part covers the management of industrial waste that includes definition of scheduled waste, scheduled waste regulations, and technique to manage the waste.

### SKTK 3552 Occupational Safety and Health in Industry

This course presents a basic knowledge of occupational safety and health (OSH) at work. In particular, it emphasises on current issues and best practices in OSH in Malaysia and the world, OSH legislations, methods of hazard identification, accident prevention concept and its implementation at workplace. At the end of this course, it is expected that the students will be able to appreciate the legal requirements, theoretical and practical aspect of OSH in industry and its impact to surrounding public community.

### SKTK 3731 Pollution Control and Reaction Laboratory

This laboratory course contains experiments that are covered basis concept in chemical reaction engineering and pollution control such as kinetic analysis of reaction, ambient air and water quality analysis. All experiments require students to apply fundamental laboratory techniques and skills as well as communication skill. Students, in group will demonstrate a mastery of laboratory techniques and clearly describe the qualitative and quantitative aspects of the experiments performed.

### SKTK 3334 Unit Operation and Industrial Processes

Pre Requisite: SKTK 2313 Transport Processes (pass with at least D+)

This subject introduces different types of unit operations and separation processes involved in the chemical industries such as particle technology, crystallization, solid-liquid separation, drying and evaporation. All of the topic is illustrated by detail examples and is accompanied by homework exercises.

### SKTK 3343 Engineering Economics and Project Management

This is a two-in-one course covering both Engineering Economy and Project Management topics. Engineering economy is the application of economic factors and criteria to evaluate alternatives, considering the time value of money in order to make an economic decision. The engineering economy study involves computing a specific economic measure of worth for estimated cash flows over a specific period of time. Project Management is the art of planning, scheduling, and controlling of project activities to achieve performance, cost, and time objectives, for a given scope of works, while using resources efficiently and effectively.

### SKTK 3564 Process Control & Instrumentation

Pre Requisite: SSCE 1793 (pass with at least D+), SKTK 3323 Separation Processes & SKTK 3263 (taken) This course covers the fundamentals of dynamic process modelling, dynamic process behaviours and process control. Although more concentration is given to lumped parameter systems modelling, distributed parameter systems is introduced. Feedback control system design, analysis and tuning are dealt with in detail. Also included are model estimation techniques for first order plus dead time (FOPDT) systems. Other commonly found control structures, such as feedforward, ratio, split-range and cascade control, and plantwide control systems design are taught qualitatively. This course employs Active Learning (AL).

### SKTK 3741 Separation Processes Laboratory I

Pre Requisite: SKTK 3323 Separation Processes (taken)

This subject introduces students to the equipment in the separation processes discussed in Separation Processes course. This will give a 'hands on' experience to the students on how to handle the unit operations and to interpret the data taken from the experiments. There are also various types of packing and plate in the column (absorption and distillation) that are being used in the laboratory. Comparison can be made on the efficiency of each packing/plate after all the packing/plate types have been used. This subject also demonstrates the basic principles of different types of unit operations involved in the chemical industries such as liquid-liquid extraction and heat exchanger. Students will be assessed through instructor's observation, peer evaluation and technical report submitted.

### SKTK 3812 Undergraduate Project I

This course is a first stage of the Undergraduate Project which involve in preliminary studies and planning on how to carry out the study that given to the students. It is designed to expose the students in writing a research proposal. It will emphasize on the research philosophy and research methodology. The works include literature review, writing a problem statement, scope identification, objectives and method determination. At the end of the course, students should be able to write a research proposal in a professional practice. The students should also be able to manage and plan their research according the time given.

### SKTK 3915 Industrial Training

This course is a core course which will assign students to industries, governments or semi-governments agencies and organizations for a period of 12 weeks. The training aims to expose students to real chemical engineering practices while enhancing their knowledge and working experiences as well as improving their interpersonal skills. The students also have the opportunities to apply learned theories into real chemical engineering practices. Students are supervised by the faculty and industrial supervisors.

### SKTK 4143 Chemical Product Design

This course offers a background understanding to design a chemical product using a computer-aided approach. This course introduce step by step in designing chemical products from market survey, problem formulation, establish product needs, generate ideas to produce the targeted product, select among ideas and manufacture of product. The lecture will apply the step by step of the product design using applicable case studies for design of a product as well as enhance the understanding of design process among students. The product is design to meet the product specifications, environmental issues and also taking into consideration of sustainable issues.

### SKTK 4153 Plant Design

### Pre Requisite: SKTK 3564 Process Control & Instrumentation (taken)

This course presents the principles and methodology for product and process design. In particular, it emphasises on the key elements of process design which include process synthesis, heat integration, equipment sizing and cost estimation and process optimisation in generating inherently safe, economic and environmentally friendly processes. The course features the use of process simulation tools.

### SKTK 4751 Process Control Laboratory

### Pre Requisite: SKTK 3564 Process Control & Instrumentation (taken)

This lab course exposes students to areas of process control systems in the chemical industry. It also teaches the students how to control the specific control variables through the use of simple PID control. Students will experience how to perform open loop and closed loop tuning method for specific processes. Also included is the application of PLC program to plan and control a simple process. Students will gain hands-on experience in process control through experiments that employ pilot-scale chemical processes.

### SKTK 4761 Separation Processes Laboratory II

### Pre Requisite: SKTK 3323 Separation Processes (taken)

This course introduces students to the equipment in the separation processes discussed in Separation Processes and Unit Operations and Industrial Processes courses. This will give a 'hands on' experience to the students how to handle the unit operations and to interpret the data taken from the experiments. This laboratory covers particulate solid separation process, filtration, fluidised bed, spray drying, tray drying and evaporation experiments which will expose the students to the variety of the equipment that can be used in the chemical process industries. Students will be assessed through instructor's observation, peer evaluation and technical report submitted.

### SKTK 4824 Undergraduate Project II

### Pre Requisite: SKTK 3812 Undergraduate Project I (pass with at least D+)

This course is a second stage of the Undergraduate Project which involve in doing experimental works / studies and discussing the results of the project. It is designed to expose the students in writing a research report. It will emphasize on the research philosophy and research methodology. The works include literature review, writing a problem statement, scope identification, objective, experimental work and discussing the results. At the end of the course, students should be able to write a thesis/ research report in a professional practice. The students should also be able to manage and plan their research according the time given.

### SKTK 4573 Process Safety & Operability

This course is intended to impart important insights on safety and operability of chemical plant operations. It reveals the current state of the art technology adopted by the process industries to deal with everincreasing demand to make the plant safer, environmentally benign and profitable. Techniques to evaluate the adequateness of the layer of protection adopted by the process plant shall be mastered. The course also offers systematic method for troubleshooting plausible root causes of operational problems and deciding appropriate corrective actions. It also features extensive use of project-based learning, discussions and oral presentations and written reports.

### SKTK 4834 Plant Design Project

### Pre Requisite: SKTK 4513 Plant Design (taken)

This project is aimed at equipping the students with the skills and creativity in designing a process plant in the absence of complete data. In particular, it emphasizes on the key elements of process design which include process creation/synthesis, process analysis, process evaluation and process optimization in generating inherently safe, economic and environmentally friendly processes. Students will acquire the skill for hands on application and integration of the principles of chemical engineering required to design a process plant. Students will also learn the technique of writing a comprehensive technical plant design report.

### ELECTIVE COURSES (STREAMING)

### 1. Energy Management

### SKTK 4113 Sustainable Energy Management

This course presents the principles for a holistic approach for energy management in an company setting. It provides strategies and methodologies for setting up a sustainable energy management system in a company and for implementing state-of-the-art energy conservation measures using various analysis tools, involving various processes equipment for thermal energy as well as electrical energy systems.

### SKTK 4123 Thermal Energy Management

This course presents the principles and a system approach methodology to analyse thermal energy system in the industries. The course will cover the fundamentals of typical industrial steam system, including steam generation, steam distribution, steam end-uses, condensate recovery and cogeneration system. This course also presents the key parameters and measurements, that are required to conduct the steam system evaluation. This course also introduces process integration to improve the energy efficiency of a thermal energy system.

### SKTK 4133 Energy Planning for Sustainable Development

This course provides students with the ability to use EXCEL spreadsheet and Generalized Algebraic Modeling System (GAMS) as a tool for solving realistic energy issues. Students are expected to use basic and advanced features of Excel spreadsheet such as regression analysis, optimization calculations, matrix operations and more in depth functions and techniques such as VBA (Visual Basic for Applications) and macro programming as well as Excel's statistical functions as well as GAMS. Emphasis will be placed on the formulation of mathematical models, solve and interpret meaningful problems in engineering, science and business.

### 2. Advanced Materials

### SKTK 4213 Polymer Composites

This course introduces students to composite materials in general and emphasizes on fibre reinforced polymer composite. The types of reinforcement, the types of matrices as well as other constituents are discussed in detail. It will also cover the manufacturing techniques of composite fabrication and identifying products that can be made from different techniques. The course will further explain the factors affecting the strength of polymer composite. Students should be able to apply the knowledge and the fundamental concepts on how to design successful polymer composite based products. At the end of the course students will gain some knowledge of the main types of nanocomposite materials and their specific physical and chemical properties required in applications.

### SKTK 4223 Smart Materials

This course will provide deeper understanding of smart materials and smart microstructures, as well as of the increased functionality of both inorganic and organic materials. This course also covers on the material synthesis as well as microstructure and properties relationships.

### SKTK 4233 Biomaterials

This course introduces students to the field of biomaterials used in the design of medical devices, and to augment or replace soft and hard tissues. Students will learn about the bulk properties, applications, and in vivo behavior of different classes of natural and synthetic biomaterials. Students will have to the analysis of biological response and biocompatibility, degradation and failure processes of implantable biomaterials/devices. The course will also discuss the regulatory compliance and performance requirements for commercialization of biomaterials and medical devices.

### 3. Oil and Gas

### SKTK 4313 Introduction to Oil & Gas Industry

This course is intended to expose students to the major stages in the oil and gas field; from exploration, production, and finally to processing and demonstrate the link between the many disciplines involved. The contents of the course cover comprehensive introduction to the upstream and downstream that include basic methods, concepts and current and emerging technologies used and as well as issues related to operations, safety and environment.

### SKTK 4323 Refinery & Petrochemical Technology

This course presents the principles for chemical and physical processing in the Petrochemical and Refinery technologies. In particular, it emphasizes on the purpose of the process, understanding reaction chemistry, and their application. The course features extensive reading exercises as well as individual/group project and assignments.

### SKTK 4333 Gas Transportation and Storage

This course enables students to develop an advanced knowledge in gas transportation and storage facilities. The course module covers a wide range of scope which includes the flow principles, operation and construction and maintenance. Sustainability of supply and storage system is well reviewed to incorporate state-of-the-art technology. The module also integrates the standards design of transportation system and relevant code of practices. Malaysian standard requirements also are highlighted thoroughly.

### 4. Environment

### SKTK 4413 Waste Management

The course aims to analyse the component of solid and hazardous waste management. Upon completion of the course, student should be able to apply the concept of solid and hazardous waste management and identify the issue in waste management. The course covers the analysis of sources, generation and characteristics of industrial and municipal wastes, selection and evaluation of collection systems, handling and disposal practices of municipal wastes, management of scheduled wastes, the design of waste treatment system and the pollution prevention and techniques.

### SKTK 4423 Environmental Management

The course aims to provide knowledge and understanding on environmental management in Malaysia as well as to develop intellectual skills in environmental planning. In order to achieve this, the course is basically

divided into two components which are the overview of environmental management in Malaysia and the sequence of environmental planning. Students will be taught on the methodology to carry out environmental impact assessment (EIA). Term projects for students to experience the stages involved in environmental planning

### SKTK 4433 Environmental Sustainability

This course introduces students to issues of environmental sustainability. The course includes discussion on the fundamental of environmental cycle, concept of sustainability, environmental consequences of coastal and inland developments. At the end of the course, students should be able to apply the knowledge by associating environmental problems that arise with poor management of environmental sensitive area. The students should be able to work in a team to demonstrate the project development practices related to the environmental enhancement.

### 5. Occupational Safety and Health

### SKTK 4513 OSH Legislations and Management

This course presents the principles of OSH Legislations and Management. The course features extensive use of case studies from industry through group as well as individual project work.

### SKTK 4523 Industrial Hygiene

This course covers the fundamentals of industrial hygiene, which in most countries including the UK, Commonwealth countries and the Europe, is termed as occupational hygiene. Industrial hygiene is generally defined as the art and science dedicated to the anticipation, recognition, evaluation, communication and control of environmental stressors in, or arising from, the workplace that may result in injury, illness, impairment, or affect the well-being of workers and members of the community. The concept stems out from construction, mining and manufacturing industries, and is particularly familiar among process industries. The course is started by introducing the students to industrial hygiene field of area. Then different categories of hazards are covered so that students may understand the source of problems/hazards. Fugitive emission, which is the main source of background exposure to workers in process industries, is introduced to the students. Finally the assessment and control measure of the hazards are also presented.

### SKTK 4533 Human Factors in Process Industry

This course introduces a basic knowledge of human factors principles and the nature of human interaction with their physical work environment. The content of this course includes behaviours, cognitive, socio-technical systems, and the nature of human performance in the process industry.

### 6. Polymer Science and Technology

### SKTK 4613 Fundamentals of Polymer

Basic terminologies, principles on polymers and structural relationship towards polymer classification are discussed. An overview on the polymer industry is elaborated together with its impact on human life. Molecular weight relationships toward polymer properties and its implication are briefly presented. This course emphasises specifically on the advanced of polymer synthesis including step-growth, chain-growth and co-ordination polymerizations. Kinetic for the polymerization mechanism is described and its relationship to molecular weight is explained in details. The limitations and application for each polymerization mechanism are discussed. The polymerization systems used for the polymerization process are discussed together with their advantages and the disadvantages. Finally, this course also exposed students to the pilot scale set-up of the polymerization systems.

### SKTK 4623 Polymer Physics and Properties

This course is designed to expose students to the properties of polymer which have great importance. It will emphasize on the mechanical properties, electrical properties, chemical resistance, degradation effects and flammability properties, A strong emphasis will be given on the mechanical properties which include viscoelastic behavior, tensile, flexural and impact properties. Long term test using creep deformation is also included. 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.

### SKTK 4633 Polymer Rheology and Processing

This course will discuss about Newtonian and non-Newtonian flow, pseudoplastic, Bingham, dilatant and thixotropic behavior, origin of non-Newtonian flow. Students will be able to do Modelling of polymer melt flow-isothermal flow of Newtonian and power law fluids (drag and pressure flow) through different channels of uniform cross-section. This course will also covers topic such as measurement of flow properties, melt flow indexer, capillary viscometers, and cone and plate viscometer, characteristics and Rabinowitch correction. Students should be able to explain the application of rheological studies in polymer processing-extruder screw and die, analysis of pressure, drag and leakage flow, characterization and interaction of screw and die, balanced runner molding.

### 7. Bioprocess Engineering

### SKTK 4643 Downstream Bioprocessing

The aim of the course is to provide an overview of the various downstream processes involved in the production of bio-products such as food, beverages, antibiotics, antiferons, vitamins, insulins, citric acid and others. The unique natures of biomolecules make their separation processes different from conventional chemical processes. In addition, the application of mass transfer, mass balances, and thermodynamics principles are combined with life sciences so as to develop, impart and vary the biotechnology purification techniques. The various bioseparation techniques include centrifugation, microfiltration, ultrafiltration, adsorption, chromatography, electrophoresis, and many more. Students will be tested in their ability on understanding on the subject based on the ability to answer test, quizzes, tutorials, assignments and final examination. In additional class presentation based on the project also will be carried out during end of semester.

### SKTK 4653 Pharma and Nutraceutical Engineering

This course introduces students to some aspects of pharmaceutical and nutraceutical engineering. Students will be exposed to the fundamental elements, including physicochemical and biopharmaceutical of drugs formulation, drug delivery system, pharmaceutical microbiology and nutraceutical considerations. In the end of lectures, students will be able to understand the theory aspects and some applications in pharmaceutical and nutraceutical engineering. Students will be tested in their ability to answers during lecture class, tests, tutorials, assignments and final examination.

### SKTK 4663 Food Process Engineering

This course introduces students to some major principles, concepts and applications in handling, processing and packaging of foods including the design of process equipment. The course will also provide practice in case studies, carrying out an industrial visit project to observe the application of knowledge in food industries and setting informative research on the business planning of selective food processing operations.

### 5.2 BACHELOR OF ENGINEERING (CHEMICAL-BIOPROCESS)

Bioprocess Engineering is an engineering discipline where biotechnology and natural based products research are being transformed to industrial setting to fuel the current and future world economic

powerhouses. In this program, various engineering principles especially chemical and bioprocess are applied to design, develop and evaluate processes that utilize biological based materials (e.g. animals, plants, microorganisms) to produce products. Throughout our four years of intensive training and industrial exposure. experience state-of-the-art students will technologies that will pave the way for professional bioprocess engineering qualifications. The graduates will be well versed in mathematical-based engineering analysis that will enable them to explain the physical, biological and chemical processes of complex



biological systems and design processes that will yield products which could create wealth, promote health and promote sustainability. The sectors served by bioprocess engineers are in the area of medical, food, environment, agriculture and many more.

The demand for Bioprocess Engineers in Malaysia is enormous. To realize Vision 2020 and beyond, the



s enormous. To realize Vision 2020 and beyond, the government is actively pursuing the establishment of biotechnological-based industries in Malaysia through various Economic Corridors such as Iskandar Malaysia in Johor. The government of Malaysia's commitment in promoting biotechnology industries is reflected in the fund allocated in the ninth Malaysian Plan and further enhanced in the tenth Malaysian Plan. The establishment of Malaysia Biotechnology Corporation and others will nourish the expansion of existing industries while encouraging more relevant industries to participate in the new economic endeavours. Our

bioprocess engineers are designed to lead biotechnology related industries and are equipped with versatile and balanced capability to accommodate other industries such as chemical, petroleum, polymers, oil and gas.

In addition to the knowledge imparted in classrooms, students will also be exposed to the practical aspects of the discipline through laboratory experiments. The Department of Bioprocess Engineering has well developed laboratories with the state-of-the-art equipment for teaching and research. Prospective students can expect to receive hands-on training in these laboratories through laboratory courses and Bachelor Degree Final Year Research Project. Furthermore, students will also experience real-life problem solving and practice what they have learned in class through a 12-week industrial training. In Plant Design Project, students



will have the opportunity to design their own chemical/bioprocess plant and apply their technical knowledge and skills, along with communication, managerial and team-working skills.

# 5.2.1 PROGRAMME SPECIFICATION FOR BACHELOR OF ENGINEERING (CHEMICAL-BIOPROCESS)

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Universiti Teknologi TK29 Board of Engineers I English and Bahasa c.) Conventional Self-govern Full Time Minimum : 4 yrs Maximum : 6 yrs No. of Semester 8 4 atriculation or STPM w athematics/ Additional dditional Mathematics, nemistry and Physics/ Eng	Malaysia Malaysia Melayu ers ers	(BEM) No. of weeks 14 8 imum of B- in natics/ Further
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Self-govern         Full Time         Minimum : 4 yrs         Maximum : 6 yrs         No. of Semester         8         4         atriculation or STPM wathematics/ Additional         dditional         Mathematics, nemistry and Physics/ English	vith mini Mathem	14 8 mum of B- in natics/ Further
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PLO3 Ability to design solution for	Lectures, tutorials, seminars,	Examinations, problem-
complex engineering problems and	laboratory works, directed	based learning reports,
design system or process to meet	reading, simulation exercises,	laboratory reports,
specified needs with appropriate	computer-based exercises,	presentations, design
consideration for public health and safety,	undergraduate project, design	project, individual
cultural, societal, and environmental	project, problem-based learning,	research project and
considerations.	cooperative and collaborative	exercises.
	learning.	
<b>PLO4</b> Ability to conduct investigation of	Lectures, tutorials, seminars,	Examinations,
complex engineering problems using	laboratory works, directed	presentations, design
research-based knowledge and research	reading, simulation exercises,	project, individual
methods including design of	computer-based exercises,	research project,
experiments, analysis and interpretation	undergraduate project, design	computer project and
of data, and synthesis of information to	project, problem-based learning,	assignment
provide valid conclusions.	cooperative and collaborative	
	learning.	
PL05 Ability to inculcate modern	Group projects, group discussion,	Written assignments,
computational techniques and tools	problem-based learning,	laboratory reports,
which include prediction and modelling to	cooperative and collaborative	essays, thesis, forum and
solve complex engineering problem with	learning, tutorials, undergraduate	oral presentations.
an understanding of the limitations.	project, and design project.	
PLO6 Ability to responsibly act as well	Lectures, industrial training,	Group reports and
as respond to the societal health, safety,	undergraduate project, field	presentations, learning
environment, legal and cultural issues	development project, cooperative	logs/journal, peer and
that are relevant to the professional	learning, and problem-based	lecturer evaluations.
engineering practice.	learning.	
<b>PL07</b> Ability to explain and evaluate the	Lectures, tutorials, seminars,	Examinations, problem-
sustainability and impact of professional	laboratory works, computer-	based learning reports,
engineering work in the solution of	based exercises, undergraduate	laboratory skill reports,
complex engineering problems in	project, design project, problem-	presentations, design
societal and environmental contexts.	based learning, cooperative and	project, individual
	collaborative learning.	research project and peer
		assessment.
PLO8 Abilty to apply ethical principles	Group projects, group discussion,	Written assignments,
and commit to professional ethics and	problem-based learning,	laboratory reports,
responsibilities and norms of	cooperative and collaborative	essays, thesis, forum and
engineering practice	learning, tutorials, undergraduate	oral presentations.
	project, and design project.	
<b>PLO9</b> Ability to communicate effectively	Industrial training, undergraduate	Group reports and
through written and oral modes to all	project, design project, co-	presentations, learning
levels of society.	operative learning, and problem-	logs/journal, peer and
	based learning.	lecturer evaluations.
PL010 Ability to work independently,	Lectures, industrial training,	Group reports and
and as a member or a leader in a team	undergraduate project, field	presentations, learning
to manage project in multi-disciplinary	development project, cooperative	logs/journal, peer and
to manage project in multi-disciplinary environment.	development project, cooperative learning, and problem-based	logs/journal, peer and lecturer evaluations.
	learning, and problem-based	
environment.	learning, and problem-based learning.	lecturer evaluations.
environment. PL011 Ability to acquire knowledge and	learning, and problem-based learning. Industrial training, industrial visit,	lecturer evaluations.
environment. <b>PLO11</b> Ability to acquire knowledge and engage in independent and life-long	learning, and problem-based learning. Industrial training, industrial visit, undergraduate project, design	lecturer evaluations. Industrial training report, self-directed learning
environment. <b>PLO11</b> Ability to acquire knowledge and engage in independent and life-long	learning, and problem-based learning. Industrial training, industrial visit, undergraduate project, design project, and problem-based	lecturer evaluations. Industrial training report, self-directed learning report, learning
environment. <b>PLO11</b> Ability to acquire knowledge and engage in independent and life-long	learning, and problem-based learning. Industrial training, industrial visit, undergraduate project, design project, and problem-based	Iecturer evaluations. Industrial training report, self-directed learning report, learning portfolios/ journal, and
environment. <b>PLO11</b> Ability to acquire knowledge and engage in independent and life-long	learning, and problem-based learning. Industrial training, industrial visit, undergraduate project, design project, and problem-based	Iecturer evaluations. Industrial training report, self-directed learning report, learning portfolios/ journal, and project report and
environment. <b>PLO11</b> Ability to acquire knowledge and engage in independent and life-long learning.	learning, and problem-based learning. Industrial training, industrial visit, undergraduate project, design project, and problem-based learning.	lecturer evaluations. Industrial training report, self-directed learning report, learning portfolios/ journal, and project report and presentation.
environment. <b>PLO11</b> Ability to acquire knowledge and engage in independent and life-long learning. <b>PLO12</b> Ability demonstrate knowledge	learning, and problem-based learning. Industrial training, industrial visit, undergraduate project, design project, and problem-based learning. Lectures, class projects,	Iecturer evaluations. Industrial training report, self-directed learning report, learning portfolios/ journal, and project report and presentation. Forum, presentations,
environment. PLO11 Ability to acquire knowledge and engage in independent and life-long learning. PLO12 Ability demonstrate knowledge of engineering management principles	learning, and problem-based learning. Industrial training, industrial visit, undergraduate project, design project, and problem-based learning. Lectures, class projects, industrial training, undergraduate	lecturer evaluations. Industrial training report, self-directed learning report, learning portfolios/ journal, and project report and presentation. Forum, presentations, assessment by industrial
environment. PLO11 Ability to acquire knowledge and engage in independent and life-long learning. PLO12 Ability demonstrate knowledge of engineering management principles and entrepreneurial mindset to manage	learning, and problem-based learning. Industrial training, industrial visit, undergraduate project, design project, and problem-based learning. Lectures, class projects, industrial training, undergraduate	lecturer evaluations. Industrial training report, self-directed learning report, learning portfolios/ journal, and project report and presentation. Forum, presentations, assessment by industrial supervisor, test and

	Classification	Credit	Percentage
		Hours	U
i.	University		
	a. General	12	
	b. Language	8	16
	c. Co-curriculum	2	4 -
ii.	Faculty Core	65	45
	Programme Core	48	34
iv.	Programme Electives	6	5
	Total	141	100
	Classification based on field (refer to the Statutory Body	guidelines)	
А	Engineering Courses		
	(a) Lecture	70	
	(b) Laboratory/Workshop	9	70
	(c) Industrial Training	5	10
	(d) Final Year Project	10	
	Total credit hours for Part A	94	
В	Related Courses	05	
	(a) Applied Science/Maths/Computer	25	
	(b) Management/Law/Humanities/Ethics (c) Co-Curriculum	12 2	30
	(c) Co-Curriculum (d) Others	8	
	Total credit hours for Part B	47	
	Total Credit Hours for Part A and B	141	100
C Total aradit	hours to graduate		credit hours
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courses bei examination Award reque Students m • ach • pas • com • sit f 8. Our unique • Our core engineer knowled	ing delivered and assessed in each Semester. Assessment in and 50% coursework (subject to courses). irements: ieve a total of 141 credit hours with minimum CPA of 2.00 is industrial training inplete UTM Professional Skills courses or Test of Engish Communication Skills for Graduating Stude eness engineering courses are composed of approximately 70% ring, thus students have a strong foundation in chemica ge and skills in biotechnology and other bioprocess-related a process Engineering Student Society (BIOSS) is a highly em	ents (TECS) chemical and al engineering areas.	30% bioproce on top of t
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courses bei examination Award reque Students m • ach • pas • com • sit f 8. Our unique • Our core engineer knowled • The Biop many na	ing delivered and assessed in each Semester. Assessment in and 50% coursework (subject to courses). irements: ieve a total of 141 credit hours with minimum CPA of 2.00 is industrial training inplete UTM Professional Skills courses or Test of Engish Communication Skills for Graduating Stude eness engineering courses are composed of approximately 70% ring, thus students have a strong foundation in chemica ge and skills in biotechnology and other bioprocess-related a process Engineering Student Society (BIOSS) is a highly em	ents (TECS) chemical and al engineering areas. thusiastic stud	through 50% 30% bioproces on top of the tight of the tight society wi
courses bei examination Award reque Students m • ach • pas • com • sit f 8. Our unique • Our core engineer knowled • The Biop many na • The facu	ing delivered and assessed in each Semester. Assessment in and 50% coursework (subject to courses). irements: ieve a total of 141 credit hours with minimum CPA of 2.00 is industrial training inplete UTM Professional Skills courses or Test of Engish Communication Skills for Graduating Stude eness engineering courses are composed of approximately 70% ring, thus students have a strong foundation in chemica ge and skills in biotechnology and other bioprocess-related a process Engineering Student Society (BIOSS) is a highly en- tional- and international level activities.	ents (TECS) chemical and al engineering areas. thusiastic stud	through 50% 30% bioproce on top of the tight of the tight society wi
courses bei examination Award reque Students m • ach • pas • com • sit f 8. Our unique • Our core engineer knowled • The Biop many na • The facu boasts a 9. Career Pro	ing delivered and assessed in each Semester. Assessment in and 50% coursework (subject to courses). irements: ust: ieve a total of 141 credit hours with minimum CPA of 2.00 is industrial training inplete UTM Professional Skills courses or Test of Engish Communication Skills for Graduating Stude eness engineering courses are composed of approximately 70% ring, thus students have a strong foundation in chemica ge and skills in biotechnology and other bioprocess-related a process Engineering Student Society (BIOSS) is a highly en- tional- and international level activities. alty has well-equipped laboratory facilities and experience	ents (TECS) chemical and al engineering areas. thusiastic stud ed academic s on activities.	through 50% 30% bioproce on top of th lent society wi taff. Our facu

### 20. UTM Professional Skills Certificate

All undergraduates undergoing bachelor degree programmes are required to enrol for and follow four short courses and one test during their studies in UTM to obtain the *UTM Professional Skills Certificate* as part of the requirements for graduation. Those are:-

- i. How to Get Yourself Employed (HTGYE)
- ii. ISO 9001:2008 Quality Management System Requirement (ISO)
- iii. Occupational Safety and Health Awareness (OSHA)
- iv. How to Manage Your Personal Finance (HTMYPF)
- v. Test of English Communication Skills for Graduating Students (TECS)
  - a. Paper I Oral Interaction
  - b. Paper II Writing

### 21. Assessment Tools

					Lear	ning	Outco	mes						
Measurement Tools	PL01	PL02	E014	PL04	PLO5	PLOG	PL07	PL08	607d	PL010	PL011	PL012	Duration	Action by
e- Portfolio	~	~	~	~	~	~	~	~	~	~	~	~	Continuous	Student
Course Outcome Survey	~	~	~	~	~	~	~	~	~	~	~	~	End of sem	Lecturer
Course Outcome Report	~	~	~	~	~	~	~	~	~	~	~	~	End of sem	Lecturer
Research Project Survey	~	~		~	~	~		~	~			~	End of sem	Faculty
PO Survey	~	~	~	~	~	~	~	~	~	~	~	~	End of sem	Faculty
Industry Attachment Survey	~	~	~	~	~	~	~	~	~		~	~	End of session	Faculty
Alumni Survey	~	~	~	~	~	~	~	~	~	~	~	~	Once/3 years	Head of Dept
Employer Survey	~	~	~	~	~	~	~	~	~	~	~	~	Once/3 years	Head of Dept

	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		
	SKTB 1011	Industrial Career & Seminar	1	
	SKTB 1021	Engineering Drawing	1	
	SKTB 1023	Introduction to Chemical & Bioprocess	3	
		Engineering		
	SKTB 1123	Statics & Biomaterial®	3	
Y	SKTB 1721	Bioprocess Engineering Laboratory I	1	
_	SKEU 2003	Electrical Technology	3	
E	SSCE 1693	Engineering Mathematics I <sup>®</sup>	3	
	ULAB 1122	Academic English Skills	2	
A		Sub total	17	
R		SEMESTER 2		
ĸ	SKTB 1133	Microbiology	3	
1	SKTB 1113	Mass Balance* <sup>®</sup>	3	
- <b>-</b>	SSCE 1993	Engineering Mathematics II®	3	SSCE 1693
	SSCK 1603	Organic Chemistry: Functional Group	3	
	SSCK 1831	Organic Chemistry Practical	1	
	UICI 1012	Islam & Asian Civilization	2	
	UKQ ***2	Co-curriculum	2	
		Sub total	17	
	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		
	SSCE 1793	SEMESTER 1 Differential Equations	3	Prerequisite SSCE 1693
	SSCE 1793 SKTB 2113	SEMESTER 1 Differential Equations Introduction to Programming	33	SSCE 1693
	SSCE 1793 SKTB 2113 SKTB 2123	SEMESTER 1 Differential Equations Introduction to Programming Energy Balance*®	3 3 3	
	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043	SEMESTER 1 Differential Equations Introduction to Programming Energy Balance*® Fluid Mechanics	3 3 3 3 3	SSCE 1693
Y	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2721	SEMESTER 1 Differential Equations Introduction to Programming Energy Balance*® Fluid Mechanics Fluid Mechanics Laboratory	3 3 3 3 1	SSCE 1693
	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2721 SKTB 2033	SEMESTER 1 Differential Equations Introduction to Programming Energy Balance*® Fluid Mechanics Fluid Mechanics Laboratory Thermodynamics®	3 3 3 3 1 3	SSCE 1693
Y	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2721	SEMESTER 1 Differential Equations Introduction to Programming Energy Balance*® Fluid Mechanics Fluid Mechanics Laboratory Thermodynamics® Advanced Academic English Skills	3 3 3 1 3 2	SSCE 1693
E	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2721 SKTB 2033	SEMESTER 1 Differential Equations Introduction to Programming Energy Balance*® Fluid Mechanics Fluid Mechanics Laboratory Thermodynamics® Advanced Academic English Skills Sub total	3 3 3 3 1 3	SSCE 1693
	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2721 SKTB 2033 ULAB 2122	SEMESTER 1 Differential Equations Introduction to Programming Energy Balance*® Fluid Mechanics Fluid Mechanics Laboratory Thermodynamics® Advanced Academic English Skills Sub total SEMESTER 2	3 3 3 1 3 2 <b>18</b>	SSCE 1693
E A	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2721 SKTB 2033 ULAB 2122 SSCK 1203	SEMESTER 1         Differential Equations         Introduction to Programming         Energy Balance*®         Fluid Mechanics         Fluid Mechanics Laboratory         Thermodynamics®         Advanced Academic English Skills         Sub total         SEMESTER 2         Analytical Chemistry for Engineering	3 3 3 1 3 2 <b>18</b> 3	SSCE 1693
E	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2721 SKTB 2033 ULAB 2122 SSCK 1203 SSCK 1203 SSCK 1891	SEMESTER 1         Differential Equations         Introduction to Programming         Energy Balance*®         Fluid Mechanics         Fluid Mechanics Laboratory         Thermodynamics®         Advanced Academic English Skills         Sub total         SEMESTER 2         Analytical Chemistry for Engineering         Analytical Chemistry Practical	3 3 3 1 3 2 <b>18</b> 3 1	SSCE 1693
E A R	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2043 SKTB 2721 SKTB 2033 ULAB 2122 SSCK 1203 SSCK 1203 SSCK 1891 SKTB 2133	SEMESTER 1         Differential Equations         Introduction to Programming         Energy Balance*®         Fluid Mechanics         Fluid Mechanics Laboratory         Thermodynamics®         Advanced Academic English Skills         Sub total         SEMESTER 2         Analytical Chemistry for Engineering         Analytical Chemistry Practical         Chemical Engineering Computation	3 3 3 1 3 2 <b>18</b> 3 1 3	SSCE 1693 SKTB 1113#
E A	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2721 SKTB 2033 ULAB 2122 SSCK 1203 SSCK 1203 SSCK 1891 SKTB 2133 SKTB 2213	SEMESTER 1         Differential Equations         Introduction to Programming         Energy Balance*®         Fluid Mechanics         Fluid Mechanics Laboratory         Thermodynamics®         Advanced Academic English Skills         Sub total         SEMESTER 2         Analytical Chemistry for Engineering         Analytical Chemistry Practical         Chemical Engineering Computation         Chemical Engineering Thermodynamics	3 3 3 1 3 2 <b>18</b> 3 1 3 3 3	SSCE 1693 SKTB 1113# SKTB 2033
E A R	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2721 SKTB 2033 ULAB 2122 SSCK 1203 SSCK 1891 SKTB 2133 SKTB 2213 SKTB 2313	SEMESTER 1         Differential Equations         Introduction to Programming         Energy Balance*®         Fluid Mechanics         Fluid Mechanics Laboratory         Thermodynamics®         Advanced Academic English Skills         Sub total         SEMESTER 2         Analytical Chemistry for Engineering         Analytical Chemistry Practical         Chemical Engineering Computation         Chemical Engineering Thermodynamics         Transport Processes*	3 3 3 1 3 2 <b>18</b> 3 1 3 3 3 3 3	SSCE 1693 SKTB 1113# SKTB 2033 SKTB 2123#
E A R	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2721 SKTB 2033 ULAB 2122 SSCK 1203 SSCK 1203 SSCK 1891 SKTB 2133 SKTB 2213	SEMESTER 1         Differential Equations         Introduction to Programming         Energy Balance*®         Fluid Mechanics         Fluid Mechanics Laboratory         Thermodynamics®         Advanced Academic English Skills         Sub total         SEMESTER 2         Analytical Chemistry for Engineering         Analytical Chemistry Practical         Chemical Engineering Thermodynamics         Transport Processes*         Thermodynamics and Material Eng.	3 3 3 1 3 2 <b>18</b> 3 1 3 3 1 3 3 1	SSCE 1693 SKTB 1113# SKTB 2033
E A R	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2721 SKTB 2033 ULAB 2122 SSCK 1203 SSCK 1891 SKTB 2133 SKTB 2133 SKTB 2313 SKTB 2711	SEMESTER 1         Differential Equations         Introduction to Programming         Energy Balance*®         Fluid Mechanics         Fluid Mechanics Laboratory         Thermodynamics®         Advanced Academic English Skills         Sub total         SEMESTER 2         Analytical Chemistry for Engineering         Analytical Chemistry Practical         Chemical Engineering Computation         Chemical Engineering Thermodynamics         Transport Processes*         Thermodynamics and Material Eng.         Laboratory	3 3 3 1 3 2 <b>18</b> 3 1 3 3 3 3 3	SSCE 1693 SKTB 1113# SKTB 2033 SKTB 2123#
E A R	SSCE 1793 SKTB 2113 SKTB 2123 SKTB 2043 SKTB 2721 SKTB 2033 ULAB 2122 SSCK 1203 SSCK 1891 SKTB 2133 SKTB 2213 SKTB 2313	SEMESTER 1         Differential Equations         Introduction to Programming         Energy Balance*®         Fluid Mechanics         Fluid Mechanics Laboratory         Thermodynamics®         Advanced Academic English Skills         Sub total         SEMESTER 2         Analytical Chemistry for Engineering         Analytical Chemistry Practical         Chemical Engineering Thermodynamics         Transport Processes*         Thermodynamics and Material Eng.	3 3 3 1 3 2 <b>18</b> 3 1 3 3 1 3 3 1	SSCE 1693 SKTB 1113# SKTB 2033 SKTB 2123#

### 5.2.2 CURICULLUM FOR BACHELOR OF ENGINEERING (CHEMICAL - BIOPROCESS)

Note: \* - cornerstone course; \*\* - capstone course; @ - with tutorial # - must pass (at least with grade D+) for prerequisite course

	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		
	SKTB 3213 SKTB 3123 SKTB 3223 SKTB 3323 SKTB 3413 SKTB 3721 U*** ***2	Biochemistry Molecular Biology & Genetic Engineering Chemical Reaction Engineering Separation Processes* Environmental Eng. and Sustainability Pollution Control and Reaction Laboratory General Elective	3 3 3 3 3 1 2	SKTB 2313#
Y	-	Sub total	18	
Е	SKTB 3113	SEMESTER 2 Bioseparation Technology	3	
A R	SKTB 3133 SKTB 3812 SKTB 3721 SKTB 3143	Bioreactor Design & Analysis Undergraduate Project I** Bioprocess Engineering Laboratory II Process Control*	3 2 1 3	SSCE 1793#, SKTB 3323
3	SKTB 3731 SKTB 3173 UL** ***2	Separation Processes Laboratory I Engineering Economics and Project Management Foreign Language	1 3 2	SKTB 3323
		Sub total	18	
		SEMESTER 3		
	SKTB 3915	Industrial Training	5	
		Sub total	5	
	CODE	COURSES	CREDIT	Prerequisite
Y	SKTB 4**3 SKTB 4741 SKTB 4814 SKTB 4153 SKTB 4163 UICL 2302	SEMESTER 1 Bioprocess Courses Elective 1 Process Control Laboratory Undergraduate Project II** Plant Design* Safety and Health in Chemical & BioIndustry The Thought of Science & Technnology	3 1 4 3 2	SKTB 3212# SKTB 3143
E		Sub total	16	
A R 4	SKTB 4824 SKTB 4133 SKTB 4**3 UHAK 1032 UHAS 1172 /UHAK 1022 UHAK 1012	SEMESTER 2 Plant Design Project** Quality Management in BioManufacturing Bioprocess Courses Elective 2 Introduction to Entrepreneurship Dinamika Malaysia(local) / Malaysia Studies 3 (International Student) Graduate Success Attributes Sub total	4 3 2 2 2 2 16	SKTB 4153, SKTB 4163
		Total credit	141	
		Total ofcult		

Note: \* - cornerstone course; \*\* - capstone course; @ - with tutorial # - must pass (at least with grade D+) for prerequisite course

### 5.2.3 ELECTIVE COURSES (choose two courses only)

No.	Code	Courses
1.	SKTB 4213	Food Process Engineering
2.	SKTB 4223	Environmental Biotechnology
3.	SKTB 4233	Bioproduct Development and Validation
4.	SKTB 4243	Biopharmaceutical Manufacturing
5.	SKTB 4253	Biomass Energy
6.	SKTB 4263	Tissue Culture and Cell Engineering

SEMESTER 8	SKTB 4824
SEMESTER 7	<ul> <li>&gt; SKTB 4153</li> <li>&gt; SKTB 4163</li> <li>&gt; SKTB 4814</li> </ul>
SEMESTER 6	SKTB 3143 - SKTB 3731 - SKTB 3731 - SKTB 3812*
SEMESTER 5	SKTB 3323
SEMESTER 4	<ul> <li>SKTB 2313*</li> <li>SKTB 2711</li> <li>SKTK 2213</li> </ul>
SEMESTER 3	<ul> <li>SSCE 1793*</li> <li>SKTB 2123*</li> <li>SKTB 2033</li> </ul>
SEMESTER 2	SSCE 1993
SEMESTER 1	SSCE 1673

5.2.4 PREREQUISITE BACHELOR OF ENGINEERING (CHEMICAL-BIOPROCESS) Note: \* must pass the prerequisite course

1
# 5.2.5 MAPPING OF COURSES TO PROGRAMME LEARNING OUTCOMES (PLO)

				PRO	GRAN	IME L	EARN	NG O	UTCO	MES (	PLO)		
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment & Sustainability	Ethics	Communication Skills	Leadership and Team Work	Life Long Learning	Project Management and Finance
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	PLO6	PL07	PL08	PL09	PL010	PL011	PL012
UNIVERSITY G	ENERAL COURSE												
ULAB 1122	Academic English Skills									$\checkmark$			
ULAB 2122	Advanced Academic English Skills									✓			
ULAB 3162	English for Professional Purposes									✓			
UL** 1**2	Foreign Language									✓			
UHAS 1172/ UHAK 1022	Dinamika Malaysia (local)/Malaysia Studies 3 (International Student)												
UHAK 1012	Graduate Success Attributes												
UHAK1032	Introduction to Entrepreneurship												✓
UICI 1012	Islamic and Asian Civilizations												
UICL 2302	The Thought of Science and Technology												
U*** ***2	General Elective												
UKQ ***2	Co-Curriculum and Service Learning											~	
MATH/SCIENC	E/TECHNOLOGY	•		•	•	•							
SSCE 1693	Engineering Mathematics I		$\checkmark$										
SSCE 1893	Engineering Mathematics II		~										
SSCE 1793	Differential Equations		~										
SSCK 1603	Organic Chemistry – Functional Group												
SSCK 1831	Organic Chemistry Practical												
SSCK 1203	Analytical Chemistry for Engineering												
SSCK 1891	Analytical Chemistry Practical												
SKEU 2003	Electrical Technology												
PROGRAM CO	RE COURSES												
SKTB 1011	Industrial Career & Seminar	~				~				~		~	
SKTB 1021	Engineering Drawing	~				~				~			
SKTB 1023	Introduction to Chemical & Bioprocess Engineering	~	~					~		✓	✓		

				PRO	GRAN	IME L	EARN	ING O	UTCO	MES (	PLO)		
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment & Sustainability	Ethics	Communication Skills	Leadership and Team Work	Life Long Learning	Project Management and Finance
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	9014	PL07	PL08	PL09	PL010	PL011	PL012
SKTB 1123	Statics & Biomaterial	~								~		✓	
SKTB 1721	Bioprocess Engineering Laboratory	~	~						~	~			
SKTB 1133	Microbiology	✓										✓	
SKTB 1113	Mass Balance	✓	✓									✓	
SKTB 2113	Introduction to Programming	✓				✓						✓	
SKTB 2123	Energy Balance	✓						~				✓	
SKTB 2043	Fluid Mechanics	✓	✓					~			✓		
SKTB 2721	Fluid Mechanics Laboratory		~		✓						~	✓	
SKTB 2033	Thermodynamics	✓	~								~		
SKTB 2133	Chemical Engineering Computation	~	~		~							~	
SKTB 2213	Chemical Engineering Thermodynamics	~										~	
SKTB 2313	Transport Processes	✓										✓	
SKTB 2711	Thermodynamics and Material Eng. Laboratory	~	~				~	~	~		~		
SKTB 3213	Biochemistry	~										~	
SKTB 3123	Molecular Biology & Genetic Engineering	~										~	
SKTB 3223	Chemical Reaction Engineering	~		✓	✓	~		~					
SKTB 3323	Separation Processes	~		~								✓	
SKTB 3413	Environmental Eng. and Sustainability	~		~			~					~	
SKTB 3721	Pollution Control and Reaction Laboratory	~			~					~		~	
SKTB 3113	Bioseparation Technology	~					~	~				~	
SKTB 3133	Bioreactor Design & Analysis	~		~	✓							✓	
SKTB 3212	Undergraduate Project I	~	~	~	~				~	~	~	~	
SKTB 3721	Bioprocess Engineering Laboratory	~	✓						✓	~			
SKTB 3143	Process Control	~	~								~		
SKTB 3731	Separation Processes Laboratory I	~	~		✓					~	~		
SKTB 3173	Engineering Economics and Project Management	~								~			~

				PRO	GRAM	IME L	EARN	NG O	UTCO	MES (	PLO)		
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment & Sustainability	Ethics	Communication Skills	Leadership and Team Work	Life Long Learning	Project Management and Finance
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	PL06	PL07	PL08	PL09	PL010	PL011	PL012
SKTB 4741	Process Control Laboratory	~	~	~							✓	~	
SKTB 4814	Undergraduate Project II	~	~	~	~	~	~		~	~	$\checkmark$	~	✓
SKTB 4153	Plant Design	✓		~	✓		~		~				✓
SKTB 4163	Safety and Health in Chemical & Biolndustry	~			~				✓		~		
SKTB 4824	Plant Design Project	~		~	~	~	~	~	~	~	~	~	✓
SKTB 4133	Quality Management in BioManufacturing	~				~	~	~	~				
PROGRAMME	ELECTIVE COURSES												
SKTB 4213	Food Process Engineering	~					~					~	
SKTB 4223	Environmental Biotechnology	✓					✓					✓	
SKTB 4233	Bioproduct Development and Validation	~					~					~	
SKTB 4243	Biopharmaceutical Manufacturing	~					~					~	
SKTB 4253	Biomass Energy	✓					✓					✓	
SKTB 4263	Tissue Culture and Cell Engineering	~					~					~	

# 5.2.6 SYNOPSIS OF BIOPROCESS ENGINEERING COURSES

# SKTB 1011 Industrial Career & Seminar

This course introduces students to the chemical/bioprocess engineering working environment through seminars from respective personnel and industrial visit to various chemical plants in Malaysia. Assignments and group-based project will be given.

#### SKTB 1021 Engineering Drawing

Computer Aided Drawing Computer Aided Command, , Geometry, Orthographic Drawing, Isometric Drawing, Sectional Drawing, Flowchart Drawing.

# SKTB 1023 Introduction to Chemical & Bioprocess Engineering

Overview of engineering, the profession and its requirements in the Malaysian scenario. Communication (oral and written) and teamwork skills. Mind mapping, learning styles and time management. Basic calculations and unit conversions. Create an engineering graph and solving iterative problems using computer. Ethics. Seminar. Plant visits. This course employs Cooperative Learning and grooms students with skills for Problem-based Learning.

## SKTB 1123 Statics & Biomaterial

This course is designed to introduce students to the basic principles and concepts in mechanics. The content will be divided to two parts which are i) statics and ii) strength of material/biomaterial. The first part will deal with the resultant and resolution of force(s) acting on a particle, the equilibrium of a particle, the effect of force(s) on a rigid bodies, how to replace a force system with equivalent system and the equilibrium of rigid bodies. At the end of the course, students should be able to demonstrate and apply the knowledge by solving various problems in Statics. The second part will focus on the types of material/biomaterial (introduction, overview) and will follow with few elements that are important in understanding the material/biomaterial (atomic bonding, structures, strength analysis etc.). At the end of this part, should be able to relate material/biomaterial and its characteristics in order to choose the right material for different application especially in medical devices etc.

### SKTB 1721 Bioprocess Engineering Laboratory I

This laboratory course is designed to expose students to basics microbiology, biochemistry and genetic engineering techniques. The experiment will expose students to handling bacterial culture, analysis of biomolecule such as enzyme and carbohydrate.

#### SKTB 1133 Microbiology

The course aims to provide a strong background of various types of microorganisms to the engineering students. Topics include microbe diversity; metabolism type-based classification; factors that determine the growth and their control techniques; microbial ecology, fundamental of immunology; and biotechnological aspects of microbe.

#### SKTB 1113 Mass Balance

Introduction to chemical engineering and chemical processes, process and process variables, material balance strategy, degree of freedom analysis, material balance with reactions, material balance with recycle, single-phase and multiphase systems. Introduction to energy balance.

# SKTB 2113 Introduction to Programming

This course primarily aimed at the beginner who as no or little experience of using compiled languages. It is an introductory course to two different types of programming languages. First, is the C programming language and secondly, is the Matlab programming language. The course will cover various stages of programme development for both types of programming language. One who completed the course will have the ability to write a simple program using both C programming language and Matlab programming language.

#### SKTB 2123 Energy Balance

### Pre Requisite: SKTB 1113 Mass Balance (pass with at least D+)

Energy balance on non-reactive systems, balance on reactive systems, material and energy balances on transient processes, entropy, power and refrigeration cycles.

#### SKTB 2043 Fluid Mechanics

Physics of fluid: what is fluid, some difinitions, surface tension, compressible and incompressible flow, classes of flow, and physical classification. Fluid statics: pressure, differential equations of fluid statics, manometry, fluid force on submerge bodies, buoyancy and stability of floating bodies, and liquid in relative equilibrium. Fluid in motion: continuity equation, energy and mass equilibrium, Euler, Bernoulli and Momentum equations. Friction in fluid flow: velocity profile in pipes, roughness, friction factor, Moody chart. Flow measurement: venturi and pitot tube, orifice, notches and weirs. Pump and pumping: principle, types, selection, and application of pumps. Dimensional analysis, similitude in fluid mechanics, parameters of incompressible and compressible flow.

#### SKTB 2721 Fluid Mechanics Laboratory

The course covers seven fluid mechanics-related experiments which are friction losses in pipe, stability of floating body, jet impact, flow measurement, centifugal pump, forced vortex flow, and calibration of bourdon tube pressure gauge.

#### SKTB 2033 Thermodynamics

Thermodynamics is an important basic engineering subject where concepts such as systems, boundaries, mass, heat, work and energy are introduced. These concepts are then related using the 1st and 2nd Law of Thermodynamics. In this subject properties of common substances such as water, air and general working fluids are introduced using property tables and basic state equations. These concepts are applied in many

engineering equipments, basic refrigeration and power cycles. Such basic concepts are vital because they form the fundamentals for future chemical engineering subjects.

## SKTB 2133 Chemical Engineering Computation

This course introduces students to some numerical techniques in solving chemical engineering problems that could not be solved analytically. Students will be exposed to the numerical solution for root of equation, simultaneous algebraic equation, curve fitting, ordinary differential equations, numerical differentiation and integration problems. MATLAB programming language will be implemented with the intention of illustrating the nuance of the methods, and showing more realistically how the methods are applied for problem solving.

#### SKTB 2213 Chemical Engineering Thermodynamics

#### Pre Requisite: SKTB 2033 Thermodynamics (taken)

Volumetric properties of pure liquid, heat effects, thermodynamics properties of fluids, properties relationship for homogeneous mixture, phase equilibrium and chemical reaction equilibrium.

#### SKTB 2313 Transport Processes

## Pre Requisite: SKTB 2123 Energy Balance (pass with at least D+)

Fundamentals of mass transfer, rate equation for molecular diffusion, mass transfer at boundary layer, mass transfer between phases, mass transfer rate at simple surface geometry, simultaneous mass transfer and chemical reaction. Also included is heat transfer theory, conduction, steady state conduction in two dimensions, steady state conduction with convection to environment, unsteady-state conduction, convection, radiation heat transfer, heat exchanger design.

#### SKTB 2711 Thermodynamics and Materials Engineering Laboratory

#### Pre Requisite: SKTB 2033 Thermodynamics (taken)

Experiments performed in this laboratory include boiler tests, diesel engine performance test, equilibrium test, energy (heat engine), tensile test, metal metalography, determination of Young modulus, air compressor, cooling system, torsion testing, stress and strain analysis.

#### SKTB 3213 Biochemistry

This course is designed to give an overall outlook on basic chemistry of major biomolecules and their roles in biological systems. Topics include introducing the structure, properties, and functionalities of major biomolecules such as carbohydrates, proteins, lipids; roles of lipids in membrane; Michaelis-menten enzyme kinetics, major catabolism pathways such as glycolysis, and TCA cycle; electron transport system and oxidative phosphorylation; structure and functions of DNA and RNA.

## SKTB 3123 Molecular Biology & Genetic Engineering

The course introduces to students on fundamental aspects of molecular biology and gene manipulation. Discussion will emphasize on synthesis, organization, replication of DNA and RNA both eukaryote and prokaryote systems; roles of RNA in translation and transcription; regulation in gene transcription; protein synthesis and post-translational modification; recombinant technology (e.g. gene transfer and splicing techniques, genomic library development).

#### SKTB 3223 Chemical Reaction Engineering

Topics in this course are: introduction to homogeneous reaction kinetic, batch reactor data analysis, introduction to reactor design, single reactor design, reactor design for single reaction and multiple reactor, temperature and pressure effect, nonideal flow, introduction to heterogeneous reaction system design, types of reactor test, catalytic reaction.

#### SKTB 3323 Separation Processes

Pre Requisite: SKTB 2313 Transport Processes (pass with at least D+)

Introduction to unit operations in chemical engineering: evaporation, liquid-liquid separation, liquid vapour separation, liquid-liquid extraction and leaching.

#### SKTB 3413 Environmental Eng. and Sustainability

Introduction to pollution control includes: water pollution, air pollution, noise pollution and environmental acts and techniques to reduce pollutants.

#### SKTB 3721 Pollution Control and Reaction Laboratory

Experiments performed in this laboratory are: acidity and alkalinity, biological oxygen demand (BOD), coagulation and flocculation, ambient air quality monitoring, the use of direct spectrophotometer,

conductivity measurement, sludge index, water sampling. To test the saponification reaction, iodine reaction, esterification reaction, continuous stirred tank reactor and biodiesel production

#### SKTB 3113 Bioseparation Technology

The aim of the course is to provide an overview of the various downstream processes involved in the production of bioproducts such as food, beverages, antibiotics, antiferons, vitamins, insulins, citric acid and others. The unique natures of biomolecules make their separation processes different from conventional chemical processes. In addition, the application of mass transfer, mass balances, and thermodynamics principles are combined with life sciences so as to develop, impart and vary the biotechnology purification techniques. The various bioseparation techniques include centrifugation, microfiltration, ultrafiltration, adsorption, chromatography, electrophoresis, and many more.

#### SKTB 3133 Bioreactor Design & Analysis

The aim of the course is to analyze the bioreactor functions so that the intended fermentation performance can be achieved. It will emphasize on mass balances on growth and product formation, kinetics of three main operation modes, oxygen transfer in aerobic cultures, heat sources and their management, power consumption, rheological effect on mixing, scaling up, the architecture and functional parts of bioreactor, and instrumentation and control.

#### SKTB 3812 Undergraduate Project I

A first stage of the Undergraduate Project which involve in preliminary studies and planning on how to carry out the study given to the student. The works include literature review, problem and scope identification, objective and method determination.

#### SKTB 3721 Bioprocess Engineering Laboratory II

In this laboratory, students are given opportunity to gain experience in bioreactor and downstream processes (bioseparation). This laboratory work will assist the students to consolidate their fundamental understanding involved in fermentation and downstream processes of bioproducts. The experiments performed are fermentation in shake flask and 2 L bioreactor, cell immobilization, microfiltration, cell homogenization, protein precipitation and a final project.

#### SKTB 3143 Process Control

Pre Requisite: SSCE 1793 (pass with at least D+), SKTB 3323 Separation Processes (taken)

This subject covers chemical process control, static and dynamic process behaviour, mathematical modelling, analysis of dynamic chemical process behaviour, analysis and design of feedback control systems, analysis and design of complex control systems.

## SKTB 3731 Separation Processes Laboratory I

Pre Requisite: SKTB 3323 Separation Processes (taken)

Evaporation operation, distillation operation, gas-liquid absorption operation, drying operation, liquid physical and chemical properties identification and heat transfer.

#### SKTB 3173 Engineering Economics and Project Management

The engineering economy study involves computing a specific economic measure of worth for estimated cash flows over a specific period of time. Project Management is the art of planning, scheduling, and controlling of project activities to achieve performance, cost, and time objectives, for a given scope of works, while using resources efficiently and effectively.

#### SKTB 3915 Industrial Training

A 12-week training in industry. The main rational of introducing the programme is to provide UTM students with exposure to practical aspects of industry and their work practices. During the programme, the students will have the opportunity to relate their theoretical understanding to the real application in industry and to develop skills in work ethics, management, communication and human relations.

# SKTB 4741 Process Control Laboratory

Experiments performed in this laboratory include: PLC, introduction to transducers and instrumentation, control of a heat exchanger, liquid level control, analysis of dynamic response, and controller tuning.

#### SKTB 4814 Undergraduate Project II

Pre Requisite: SKTB 3212 Undergraduate Project I (pass with at least D+)

Students are required to do research project where they are required to collect data from the apparatus in laboratory and pilot plant under the supervisor of a lecturer. The use of computer is also emphasised. Students are required to submit a report at the seminar at the end of the project.

### SKTB 4153 Plant Design

## Pre Requisite: SKTB 3143 Process Control (taken)

Introduction to process plant synthesis where design of each individual unit operation are combined with the objective of optimising the raw material and energy use for processing, cost factor and economics, environmental and also safety factor. Selection of reactor design, selection of separator design, reaction-separation system synthesis and also heat exchanger network synthesis, process safety, and waste minimisation.

#### SKTB 4163 Safety and Health in Chemical & BioIndustry

Main danger and act, introduction to relief, occupational safety and health, danger identification, risk analysis, accident inspection.

#### SKTB 4824 Plant Design Project

Pre Requisite: SKTB 4153 Plant Design, SKTB 4163 Safety and Health in Chemical & Biolndustry (taken) Students are divided into groups. Each group will be given a design topic and will be under the supervision of a lecturer. The design project involves process selection, building the process flow diagram (PFD), material and energy balances, detailed equipment design, equipment selection and material of construction, equipment control, operational instruction, economics and costing.

#### SKTB 4133 Quality Management in BioManufacturing

This course highlights the importance of a quality management system in bioproduct manufacturing processes/industries to meet customer satisfaction. The quality system will cover both management and technical elements according to the requirements of the International Organization for Standardization (ISO) and other relevant regulations. The management requirements focus on a clear organization structure with well-defined objectives and well-organized documentation, whereas the technical requirements ensure on the competency of staffs and validity of test methods for quality assurance. The techniques and validation procedures will be included for numerous types of bioproducts such as cosmeceuticals, nutraceuticals, functional foods and pharmaceuticals. Up-to-date technologies combined with systematic validation plan will ensure bioproduct quality and its consistency. The introduction of this course will equip students with quality management skill and knowledge to be innovative and creative entrepreneurs, especially in bioproduct manufacturing.

## SKTB 4213 Food Process Engineering

This course introduces students to some major principles, concepts and applications in handling, processing and packaging of foods including the design of process equipment. The course will also provide practice in case studies, carrying out an industrial visit project to observe the application of knowledge in food industries and setting informative research on the business planning of selective food processing operations.

#### SKTB 4223 Environmental Biotechnology

This course describes the diverse problems of the environment and the approaches toward their solution or mitigation in connection to the modern or classical methods of biotechnology. It describes the significance in conservation of environmental resources and biodiversity, provision for alternate sources of energy, biological control of pests and pathogens, purification of environment, mitigation of problems of chemical fertilizers, and most important of all, improvement in the quality of life.

# 5.3 BACHELOR OF ENGINEERING (CHEMICAL-GAS)

With total proven natural gas reserves of up to 75 trillion cubic feet (2007), Malaysia has been placed at the 13<sup>th</sup> spot in the list of countries with the most gas reserves. The abundant amount of gas reserves is estimated to fulfill the country's energy needs for at least 85 years. Based on the report from The Natural Gas Industry Annual Review for 2014, the upstream sector achieved considerable success in new gas discoveries contributing to an increase in the Malaysian gas reserves. In addition, PETRONAS also recorded 100 active Production Sharing Contracts (PSC) in Malaysia. These are significant achievements and underscore the fact that Malaysia's hydrocarbon potential is not yet fully exploited.



It is also testament to the relentless efforts put in by PETRONAS and the upstream partners in pushing technology limits and employing innovative means in maximizing the recovery of our domestic basins.

Thus, Malaysia urgently needs more engineers in the field of chemical and gas engineering in order to meet the increasing manpower allocation to support the numerous chemical and gas related projects especially in the processing and gas delivery to the power plant, industries, commercial, domestics as well as export market.

Gas engineering is the field of study that involves activities like processing, transmission, distribution, and gas utilization, while chemical engineering is the field of study that involves the process of converting



resources into value-added products using the application of basic sciences and engineering principles to the development, design, operation and maintenance of processes. Expertise in process design, operation, project supervising, maintenance, research and management is very important in ensuring the success of these activities. The main task of chemical and gas engineers is to ensure that are downstream activities carried out optimally. economically, safely, and without the effect of pollution on the environments and ecosystem. The combination of Gas and Chemical engineering programs is offered at Universiti Teknologi Malaysia would thus produce graduates with a

broad range of physical and chemical processes which enables them to easily participate in a wide variety of industrial and governmental activities.

# 5.3.1 PROGRAMME SPECIFICATION FOR BACHELOR OF ENGINEERING (CHEMICAL-GAS)

1. P	Programme Name		Bachelor of Engineering	g (Chemical-Gas)					
	inal Award		Bachelor of Engineering						
	warding Institution		Universiti Teknologi Ma						
	eaching Institution		Universiti Teknologi Ma	•					
	Programme Code		TK30	liaysia					
	Professional or Statutory Body of Accreditat	ion	Board of Engineers Malaysia (BEM)						
		.1011							
	anguage(s) of Instruction	raing ata)	English and Bahasa Melayu						
	Adde of Study (conventional, distance lea	<u> </u>	Conventional						
	Adde of Operation (Franchise, self-govern,	etc)	Self-govern						
10. 5	tudy Scheme (Full time / Part time)		Full-time Minimum: 4 years						
11. S <sup>1</sup>	tudy Duration		Maximum: 6 years						
	ype of Semester		No. of semesters	No. of weeks per semester					
	lormal		8	14					
	Short		4	8					
13. Pi	Programme Educational Objectives (PEO) PEO1 Graduates perform competently national development PEO2 Graduates become creative, in members in their organizations a PEO3 Graduates contribute profession development	novative ar and society	Mathematics/ Add Further Additional M Engineering Chen Engineering Physics, and not physicall makes him/her experimental/ pract colour blind). • Possesses an Eng UTM/equivalent with or an Enginee UTM/equivalent with and additional 2 y related field.	ical work (not seriously ineering Diploma from n minimum CGPA of 2.70 ring Diploma from n minimum CGPA of 2.50 years of experience in ortant contributors to as leaders or team					
14. Pi	Programme Learning Outcomes (PLO)	Teeching	and Learning Matheda	Accessed					
funda	ematics, natural science, engineering amentals and gas engineering principles ne solution of complex engineering	Lectures laborat reading, s comput undergra projec learnin	and Learning Methods , tutorials, seminars, ory works, directed simulation exercises, er-based exercises, duate project, design et, problem-based g, cooperative and porative learning.	Assessment Examinations, reports, presentations, discussions, problem- based exercises, group projects and independent projects.					
resear engine	Ability to identify, formulate, conduct irch literature and analyze complex eering problems using first principles of ematics and engineering sciences.	works simulatior based exe design pr learnin	seminars, laboratory , directed reading, n exercises, computer- ercises, final year and roject, problem-based g, cooperative and borative learning.	Examinations, problem- based learning reports, laboratory reports, presentations, design project, individual research project and exercises.					

<b>PLO3</b> Ability to design solution for complex engineering problems and design system or process to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	Lecturers, tutorials, seminars, laboratory works, directed reading, simulation exercises, computer-based exercises, undergraduate project, design project, problem-based learning, cooperative and collaborative learning.	Examinations, problem- based learning reports, laboratory reports, presentations, design project, individual research project and exercises.
<b>PLO4</b> Ability to conduct investigation of complex engineering problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.	Lectures, tutorials, seminars, laboratory works, directed reading, simulation exercises, computer-based exercises, undergraduate project, design project, problem-based learning, cooperative and collaborative learning.	Examinations, problem- based learning reports, laboratory reports, presentations, design project, individual research project and exercises.
<b>PL05</b> Ability to inculcate modern computational techniques and tools which include prediction and modelling to solve complex engineering problem with an understanding of the limitations.	Lectures, tutorials, seminars, laboratory works, directed reading, simulation exercises, computer-based exercises, undergraduate project, design project, problem-based learning, cooperative and collaborative learning.	Examinations, problem- based learning reports, laboratory reports, presentations, design project, individual research project and exercises.
<b>PLO6</b> Ability to responsibly act as well as response to the societal health, safety, environment, legal and cultural issues that are relevant to the professional engineering practice.	Industrial training, undergraduate project, design project, cooperative learning and problem-based learning.	Industrial training assessment by industrial supervisor, peer and lecturer evaluations, seminars and reports.
<b>PLO7</b> Ability to explain and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.	Lectures, industrial training, undergraduate project, field development project, cooperative learning and problem-based learning.	Reports, presentations, peer and lecturer evaluations and industrial training assessment by industrial supervisor.
<b>PLO8</b> Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.	Industrial training, industrial visit, undergraduate project, design project and problem- based learning.	Industrial training report, self-directed learning report, learning portfolios/journal, and project report and presentation.
<b>PLO9</b> Ability to communicate effectively through written and oral modes to all levels of society.	Group projects, group discussion, problem-based learning, cooperative and collaborative learning, tutorials, undergraduate project and design project.	Written assignments, laboratory reports, essays, thesis and oral presentations.
<b>PLO10</b> Ability to work independently, and as a member or a leader in a team to manage project in multi-disciplinary environment.	Design project, tutorials, undergraduate projects, laboratory works, group assignments, problem-based learning and cooperative learning.	Group reports and presentations, learning logs/journal, peer and lecturer evaluations.
<b>PLO11</b> Ability to acquire knowledge and engage in independent and life-long learning.	Lectures, class projects, industrial training, undergraduate project and design project.	Reports, presentations, industrial training assessment by industrial supervisor,

				examinations and assignments.		
enginee entrepre	Ability demonstrate knowledge of ring management principles and eneurial mindset to manage projects disciplinary environments.		tures, class projects, industrial training, ergraduate project and design project.	Reports, presentations, industrial training assessment by industrial supervisor, examinations and assignments.		
15. Cla	ssification of courses					
No.	Classification		Credit Hours	Percentage		
i.	University Course d. General e. Language f. Co-Curriculum		14 6 2	10.2 4.4 1.5		
ii.	Mathematics, Science and Technolog	ν.	18	13.1		
	Faculty Core (Chemical Engineering)	y	_	49.6		
iii.	, , , , , , , , , , , , , , , , , , , ,		68			
iv.	Programme Core (Gas Engineering)		20	14.6		
۷.	Programme Elective		9	6.6		
	Total		137	100		
	Classification based on field	d (refer t	o the Statutory Body gui	delines)		
No.	Classification		Credit Hours	Percentage		
A	Engineering Courses f. Lectures g. Laboratory/Workshop h. Industrial Training i. Undergraduate Project j. Final Year Design Project Total credit hours for Part A		75 7 5 6 4 97	70.8		
В	Related Courses e. Applied Science/Math/Compute f. Management/Law/Humanities/ g. Co-Curriculum h. Others Total credit hours for Part B		18 20 2 - 40	29.2		
	Total credit hours for Part A and B		137	100		
16. Tota	al credit hours to graduate			redit hours		
This seve cour	gramme structures and features, currice programme is offered on full-time mo eral courses being delivered and asse sework and 50% final examination. rd requirements:	de and	is based on a 2-Semes			
• • •	raduate, students must: achieve a total of 137 credit hours with pass Industrial Training complete all Professional Skill Courses sit for Test of English Communication S			ECS)		
18. Our • •	CUniqueness Students who graduate as a chemical- in pure chemical engineering to gas en The faculty has produced the most ch therefore it has the largest Chemical-G The curriculum is unique where "Elect added for students in term of special sustainable and entrepreneurial. The faculty also possessed well-equipp	gineering nemical-g as Engin tive Cour lization.	g background. gas engineering graduat eering alumni in Malays 'ses" are introduced. Th Thus, students are mor	es in Malaysia since 1996; ia. ese courses will give value re marketable, employable,		

# 19. Career Prospects and Career Paths

A gas engineer is primarily concerned with two main activities: (1) the transformation of raw (hydrocarbon and non-hydrocarbon) gases into more usable and marketable products through chemical and physical processes, and (2) storage, transportation, distribution and utilization of processed gases. Among related projects are gas processing, gas transmission and distribution, and gas power plant. A combination of gas and chemical engineering courses makes it a uniquely distinct engineering discipline. Hence, graduates can also be a chemical engineer and easily participate in a wide variety of petrochemical & oleo chemical industries and governmental activities such as Petronas, Shell, Talisman, Murphy Oil, Newfield, Hess, ExxonMobil, Felda, Energy Commission of Malaysia (EC), SIRIM, DOSH, NIOSH and consulting firms. Gaschemical graduates can also involve in the field of academics through teaching and research activities in university.

## 20. UTM Professional Skills Certificate and TECS

All undergraduates undergoing bachelor degree programmes are required to enrol for and follow four short courses and one test during their studies in UTM to obtain the *UTM Professional Skills Certificate* as part of the requirements for graduation. Those are:-

- vi. How to Get Yourself Employed (HTGYE)
- vii. ISO 9001:2008 Quality Management System Requirement (ISO)
- viii. Occupational Safety and Health Awareness (OSHA)
- ix. How to Manage Your Personal Finance (HTMYPF)
- x. Test of English Communication Skills for Graduating Students (TECS)
  - c. Paper I Oral Interaction
  - d. Paper II Writing
- 21. Assessment Tools

					Lear	ning	Outco	omes						
Measurement Tools	PL01	PL02	PL03	PL04	PLO5	PLO6	PL07	PL08	PL09	PL010	PL011	PL012	Duration	Action by
Exams, quizzes, lab reports, design projects, theses	~	~	*	*	~	~	~	~	*		*	~	Continuous	Lecturer, student
Peer Assessment										~			Continuous	Lecturer, student
e- Portfolio	~										~		Continuous	Lecturer, student
Course Exit Survey	~	~	✓	✓	~	~	~	✓	✓	✓	✓	~	End of sem	Lecturer, student
Course Assessment Report	~	~	~	~	~	~	~	~	~	~	~	~	End of sem	Lecturer
Research Project Survey	~	~	~	~	~	~	~	~	~		~	~	End of sem	Faculty
Programmme Exit Survey	~	~	~	~	~	~	~	~	~	~	~	~	4th year	Faculty
Industrial Training Survey	~	~	~	~	~	~	~	~	~		~	~	End of session	Faculty
Employer Survey	~	~	~	~	~	~	~	~	~	~	~	~	Once/3 years	Head of Dept

# 5.3.2 CURICULLUM FOR BACHELOR OF ENGINEERING (CHEMICAL-GAS)

	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		
	SKEU 2003	Electrical Technology	3	
	SKTG 1313	Mechanics of Engineering	3	
	SKTG 1233	Introduction to Chemical and Gas Engineering	3	
Y	SKTG 1323	Engineering Drawing	3	
	SSCE 1693	Engineering Mathematics I®	3	
E	ULAB 1122	Academic English Skills	2	
		Sub total	17	
A		SEMESTER 2		
R	SKTG 1333	Thermodynamics <sup>@</sup>	3	
R	SKTG 1413	Mass Balance <sup>@</sup>	3	
1	SCSJ 1013	Programming Technique I	3	
<b>–</b>	SSCE 1993	Engineering Mathematics II <sup>®</sup>	3	
	UICI 1012	Islamic and Asian Civilization I (TITAS I)	2	
	UHAS 1172	Malaysian Dynamic (local)/		
	/UHAK 1022	Malaysia Studies 3 (International student)	2	
		Sub total	16	
	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		
	SKTG 2343	Fluid Mechanics	3	
	SKTG 2353	Introduction to Organic and Analytical	3	
	SKTG 2353	Introduction to Organic and Analytical Chemistry for Engineers		
Y		- ·		SKTG 1413#
Y	SKTG 2353	Chemistry for Engineers	3 3 3	SKTG 1413#
	SKTG 2353 SKTG 2423	Chemistry for Engineers Energy Balance	3 3	SKTG 1413#
Y E	SKTG 2353 SKTG 2423 SSCE 1793	Chemistry for Engineers Energy Balance Differential Equations	3 3 3	SKTG 1413#
	SKTG 2353 SKTG 2423 SSCE 1793 UHAK 1012	Chemistry for Engineers Energy Balance Differential Equations Graduate Success Attribute Advanced English Academic Skills Sub total	3 3 3 2	SKTG 1413#
E	SKTG 2353 SKTG 2423 SSCE 1793 UHAK 1012 ULAB 2122	Chemistry for Engineers Energy Balance Differential Equations Graduate Success Attribute Advanced English Academic Skills	3 3 2 2	
E	SKTG 2353 SKTG 2423 SSCE 1793 UHAK 1012 ULAB 2122 SKTG 2741	Chemistry for Engineers Energy Balance Differential Equations Graduate Success Attribute Advanced English Academic Skills Sub total	3 3 2 2 <b>16</b> 1	SKTG 1413#
E A	SKTG 2353 SKTG 2423 SSCE 1793 UHAK 1012 ULAB 2122 SKTG 2741 SKTG 2363	Chemistry for Engineers Energy Balance Differential Equations Graduate Success Attribute Advanced English Academic Skills Sub total SEMESTER 2 Fluids Mechanics Laboratory Material Engineering	3 3 2 2 <b>16</b> 1 3	
E A	SKTG 2353 SKTG 2423 SSCE 1793 UHAK 1012 ULAB 2122 SKTG 2741 SKTG 2363 SKTG 2133	Chemistry for Engineers Energy Balance Differential Equations Graduate Success Attribute Advanced English Academic Skills Sub total SEMESTER 2 Fluids Mechanics Laboratory	3 3 2 2 <b>16</b> 1 3 3	SKTG 2343
E A R	SKTG 2353 SKTG 2423 SSCE 1793 UHAK 1012 ULAB 2122 SKTG 2741 SKTG 2363	Chemistry for Engineers Energy Balance Differential Equations Graduate Success Attribute Advanced English Academic Skills Sub total SEMESTER 2 Fluids Mechanics Laboratory Material Engineering	3 3 2 2 <b>16</b> 1 3 3 3 3	SKTG 2343
E A R	SKTG 2353 SKTG 2423 SSCE 1793 UHAK 1012 ULAB 2122 SKTG 2741 SKTG 2363 SKTG 2133	Chemistry for Engineers Energy Balance Differential Equations Graduate Success Attribute Advanced English Academic Skills Sub total SEMESTER 2 Fluids Mechanics Laboratory Material Engineering Combustion Engineering and Gas Utilisation	3 3 2 2 <b>16</b> 3 3 3 3 3	SKTG 2343 SKTG 1313
E A R	SKTG 2353 SKTG 2423 SSCE 1793 UHAK 1012 ULAB 2122 SKTG 2741 SKTG 2363 SKTG 2133 SKTG 2433	Chemistry for Engineers Energy Balance Differential Equations Graduate Success Attribute Advanced English Academic Skills Sub total SEMESTER 2 Fluids Mechanics Laboratory Material Engineering Combustion Engineering and Gas Utilisation Chemical Engineering Thermodynamics Transport Processes	3 3 2 2 <b>16</b> 1 3 3 3 3	SKTG 2343 SKTG 1313 SKTG 1333#, SKTG 2423
E A R	SKTG 2353 SKTG 2423 SSCE 1793 UHAK 1012 ULAB 2122 SKTG 2741 SKTG 2363 SKTG 2133 SKTG 2433 SKTG 2443	Chemistry for Engineers Energy Balance Differential Equations Graduate Success Attribute Advanced English Academic Skills Sub total SEMESTER 2 Fluids Mechanics Laboratory Material Engineering Combustion Engineering and Gas Utilisation Chemical Engineering Thermodynamics	3 3 2 2 <b>16</b> 3 3 3 3 3	SKTG 2343 SKTG 1313 SKTG 1333#, SKTG 2423

Note:

# - must pass the prerequisite course (minimum of grade D+)

	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1	UNLDI	Toroquisito
	SKTG 3751	Thermodynamics and Material Engineering	1	SKTG 2363
		Laboratory	_	SKTG 1333
	SKTG 3453	Chemical Engineering Computation	3	SSCE 1693, SSCE 1993
	SKTG 3123	Gas Processing and Liquefaction	3	SKTG 2423#
	SKTG 3463	Chemical Reaction Engineering	3	SKTG 2443#
	SKTG 3473	Separation Process*	3	
Y	SKTG 3373	Environmental Engineering and Sustainability	3	
		Sub total	16	
Е		SEMESTER 2	10	
-	SKTG 3483	Process Control and Instrumentation*	3	SSCE 1793, SKTG 3473
Α	SKTG 3213	Gas Transmission and Distribution*	5	SKTG 2343
	SKTG 3721	Combustion Engineering and Gas Utilisation	3	SKTG 2133
R	SKIG STZ1	Laboratory	1	5616 2155
	SKTG 3731	Separation Process Laboratory	1	SKTG 3473
3	SKTG 3383		3	3610 3473
3	SKTG 3812	Safety and Health in Petrochemical Industry	2	
	ULAB 3162	Undergraduate Project I	2	
	UL** ***2	English for Professional Purposes	2	
		Foreign Language	17	
		Sub total	17	
		SEMESTER 3		
	SKTG 3915	Industrial Training*	5	
		Sub total	5	
	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		
	SKTG 4761	Pollution Control and Reaction Laboratory	1	SKTG 3463, SKTG 3373
		Process Control Laboratory		CI/TC 2/102
	SKTG 4771		1	SKTG 3483
	SKTG 4493	Plant Design*	3	SKTG 3473
		Plant Design* Engineering Economics and Project		SKTG 3473
Y	SKTG 4493 SKTG 4393	Plant Design* Engineering Economics and Project Management	3	SKTG 3473 SKTG 3213
Y	SKTG 4493 SKTG 4393 SKTG 4223	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System*	3	SKTG 3473 SKTG 3213 SKTG 3213
	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory	3 3	SKTG 3473 SKTG 3213
Y E	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711 SKTG 4824	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory Undergraduate Project II**	3 3 3 1 4	SKTG 3473 SKTG 3213 SKTG 3213
E	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory	3 3 1 4 2	SKTG 3473 SKTG 3213 SKTG 3213
	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711 SKTG 4824	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory Undergraduate Project II**	3 3 3 1 4	SKTG 3473 SKTG 3213 SKTG 3213
E A	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711 SKTG 4824	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory Undergraduate Project II** Energy Security (Elective)	3 3 1 4 2	SKTG 3473 SKTG 3213 SKTG 3213
E	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711 SKTG 4824	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory Undergraduate Project II** Energy Security (Elective) Sub total	3 3 1 4 2 <b>18</b> 3	SKTG 3473 SKTG 3213 SKTG 3213
E A	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711 SKTG 4824 UKPU 2112 SKTG 4**3 SKTG 4**3	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory Undergraduate Project II** Energy Security (Elective) Sub total SEMESTER 2 Gas Engineering Elective I Gas Engineering Elective II	3 3 1 4 2 <b>18</b> 3 3 3	SKTG 3473 SKTG 3213 SKTG 3213
E A R	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711 SKTG 4824 UKPU 2112 SKTG 4**3	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory Undergraduate Project II** Energy Security (Elective) Sub total SEMESTER 2 Gas Engineering Elective I	3 3 1 4 2 <b>18</b> 3	SKTG 3473 SKTG 3213 SKTG 3213
E A R	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711 SKTG 4824 UKPU 2112 SKTG 4**3 SKTG 4**3	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory Undergraduate Project II** Energy Security (Elective) Sub total SEMESTER 2 Gas Engineering Elective I Gas Engineering Elective II	3 3 1 4 2 <b>18</b> 3 3 3	SKTG 3473 SKTG 3213 SKTG 3213
E A R	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711 SKTG 4824 UKPU 2112 SKTG 4**3 SKTG 4**3 SKTG 4**3	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory Undergraduate Project II** Energy Security (Elective) Sub total SEMESTER 2 Gas Engineering Elective I Gas Engineering Elective II Gas Engineering Elective III	3 3 1 4 2 <b>18</b> 3 3 3 3	SKTG 3473 SKTG 3213 SKTG 3213
E A R	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711 SKTG 4824 UKPU 2112 SKTG 4**3 SKTG 4**3 SKTG 4**3 SKTG 4**3	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory Undergraduate Project II** Energy Security (Elective) Sub total SEMESTER 2 Gas Engineering Elective I Gas Engineering Elective II Gas Engineering Elective III Gas Engineering Elective III Gas Engineering Seminar	3 3 1 4 2 <b>18</b> 3 3 3 HW	SKTG 3473 SKTG 3213 SKTG 3213 SKTG 3812#
E A R	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711 SKTG 4824 UKPU 2112 SKTG 4**3 SKTG 4**3 SKTG 4**3 SKTG 4**3 SKTG 4834	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory Undergraduate Project II** Energy Security (Elective) Sub total SEMESTER 2 Gas Engineering Elective I Gas Engineering Elective II Gas Engineering Elective III Gas Engineering Elective III Gas Engineering Seminar Plant Design Project**	3 3 1 4 2 <b>18</b> 3 3 3 HW 4	SKTG 3473 SKTG 3213 SKTG 3213 SKTG 3812#
E A R	SKTG 4493 SKTG 4393 SKTG 4223 SKTG 4711 SKTG 4824 UKPU 2112 SKTG 4**3 SKTG 4**3 SKTG 4**3 SKTG 4**3 SKTG 4834	Plant Design* Engineering Economics and Project Management Gas Storage and Reticulation System* Gas Flow System Laboratory Undergraduate Project II** Energy Security (Elective) <b>Sub total</b> <b>SEMESTER 2</b> Gas Engineering Elective I Gas Engineering Elective II Gas Engineering Elective III Gas Engineering Seminar Plant Design Project** Introduction to Entrepreneurship	3 3 1 4 2 <b>18</b> 3 3 3 HW 4 2	SKTG 3473 SKTG 3213 SKTG 3213 SKTG 3812#

Note: \* - cornerstone course; \*\* - capstone course; @ - with tutorial,

# - must pass (at least with grade D+) for prerequisite course

# 5.3.3 ELECTIVE COURSES (choose 3 courses only)

Student must take 9 credits of elective courses. Students are advised to choose one category and take 3 courses from the same category. The elective courses are shown in Table below.

CATE	GORY
ENERGY	GAS
<ul> <li>SKTG 4243 Non-Conventional Oil and Gas</li> </ul>	SKTG 4173 Membrane Based Gas Separation
Exploitation	Technology
SKTG 4143 Energy Management and Economics	SKTG 4273 Gas Operation and Maintenance
SKTG 4113 Carbon Capture and Sequestration	<ul> <li>SKTG 4263 Fire and Explosion Safety</li> </ul>
<ul> <li>SKTG 4163 Green Energy Technology</li> </ul>	<ul> <li>SKTG 4253 Gas Production Engineering</li> </ul>
<ul> <li>SKTG 4153 Energy Conversion Technology</li> </ul>	<ul> <li>SKTG 4283 Corrosion Engineering</li> </ul>

SEMESTER 8	> SKTG 4834
SEMESTER 7	<ul> <li>SKTG 4223</li> <li>SKTG 4711</li> <li>SKTG 4793</li> <li>SKTG 4761</li> <li>SKTG 4824</li> </ul>
SEMESTER 6	SKTG 3213 SKTG 3721 SKTG 3721 SKTG 3383 SKTG 3483 SKTG 3483 SKTG 3812#
SEMESTER 5	SKTG 3751   SKTG 3473   SKTG 3463   SKTG 3453   SKTG 3453
SEMESTER 4	<ul> <li>SKTG 2741</li> <li>SKTG 2133</li> <li>SKTG 2433</li> <li>SKTG 2433</li> <li>SKTG 2443#</li> </ul>
SEMESTER 3	SKTG 2343
SEMESTER 2	SKTG 1333# SKTG 1413# SSCE 1993
SEMESTER 1	SKTG 1313 SSCE 1693

BACHELOR OF ENGINEERING (CHEMICAL-GAS)

5.3.4 PREREQUISITE

Note: # must pass the prerequisite course (minimum of grade D+

# 5.3.5 MAPPING OF COURSES TO PROGRAMME LEARNING OUTCOMES (PLO)

					PROGI	RAMMI	E LEARN	ING OUT	COME	s (plo	)		
		Knowledge	Problem-solving	Design	Research Skills	Engineering/Computational Skills	Responsibility towards Issues	Sustainable Development	Ethics	Communication	Independent/Teamwork	Life-long Learning	Project Management/Entrepreneurship
CODE	COURSE	PL01	PL02	PLO3	PL04	PLO5	PLO6	PL07	PL08	PL09	PL010	PL011	PL012
UNIVERSITY GE	I NERAL COURSE												
ULAB 1122	Academic English Skills									~			
UICI 1012 UHAS 1172/ UHAK 1022	Islamic and Asian Civilization I (TITAS I) Malaysian Dynamic (local)/Malaysia Studies 3 (International student)												
UHAK 1012	Graduate Success Attribute												
ULAB 2122	Advanced English Academic Skills									~			
UICL 2302	The Thought of Science and Technology												
UKQ* ***2	Co-Curriculum											~	
ULAB 3162	English for Professional Purposes									~			
UL** 1**2	Foreign Language									~			
UKPU 2112	Energy Security (Elective)												
UHAK 1032	Introduction to Entrepreneurship												~
MATH/SCIENCE	E/TECHNOLOGY	-					1	1					1
SKEU 2003	Electrical Technology												
SSCE 1693	Engineering Mathematics I		~										
SCSJ 1013	Programming Technique I												
SSCE 1993	Engineering Mathematics II		~										
SSCE 1793	Differential Equations		~										
SKTG 2353	Introduction to Organic and Analytical Chemistry for Engineers	~	~							~			
PROGRAM COR	E COURSES												
SKTG 1313	Mechanics of Engineering	~									~		
SKTG 1233	Introduction to Chemical and Gas Engineering	~	~							~	~		
SKTG 1323	Engineering Drawing	~				~					~		
SKTG 1333	Thermodynamics	~	~								~		
SKTG 1413	Mass Balance	~	~									~	

					PROG	RAMMI	E LEARN	ING OUT	COME	s (plo	)		
		Knowledge	Problem-solving	Design	Research Skills	Engineering/Computational Skills	Responsibility towards Issues	Sustainable Development	Ethics	Communication	Independent/Teamwork	Life-long Learning	Project Management/Entrepreneurship
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	PLO6	PL07	PL08	6014	PL010	PL011	PL012
SKTG 2343	Fluid Mechanics	~	~								~		
SKTG 2423	Energy Balance	~	~									~	
SKTG 2741	Fluid Mechanics Laboratory		~							~			
SKTG 2363	Material Engineering	~									~		
SKTG 2133	Combustion Engineering and Gas Utilisation	~	~								~		
SKTG 2433	Chemical Engineering Thermodynamics	~	~								~	~	
SKTG 2443	Transport Processes	~	~										
SKTG 3751	Thermodynamics and Material Engineering Laboratory	✓			~						~		
SKTG 3453	Chemical Engineering Computation	~				~							
SKTG 3123	Gas Processing and Liquefaction	~									~		
SKTG 3463	Chemical Reaction Engineering	~				~					~		
SKTG 3473	Separation Process	~										~	
SKTG 3373	Environmental Engineering and Sustainability	~						~					
SKTG 3483	Process Control and Instrumentation	~			~						~		
SKTG 3213	Gas Transmission and Distribution	~	~							~			
SKTG 3721	Combustion Engineering and Gas Utilisation Laboratory		~		~					~			
SKTG 3731	Separation Process Laboratory		~		~					~			
SKTG 3383	Safety and Health in Petrochemical Industry	~					~				~		
SKTG 3812	Undergraduate Project I	~	~	~					~	~		~	~
SKTG 3915	Industrial Training	~	~	~	~	~	~	~	~	~	~	~	~
SKTG 4761	Pollution Control and Reaction Laboratory		~	~	~					~			
SKTG 4771	Process Control Laboratory		~							~	~	~	
SKTG 4493	Plant Design	~	~	~		~			~	~			~
SKTG 4393	Engineering Economics and Project Management	~	~										~
SKTG 4223	Gas Storage and Reticulation System	~	~	~					~	~	~		
SKTG 4711	Gas Flow System Laboratory		~	~	~		~			~	~		
SKTG 4824	Undergraduate Project II	~	~		~	~	~	~	~	~		~	~

					PROG	RAMME	E LEARN	ING OUT	COME	s (plo)	)		
		Knowledge	Problem-solving	Design	Research Skills	Engineering/Computational Skills	Responsibility towards Issues	Sustainable Development	Ethics	Communication	Independent/Teamwork	Life-long Learning	Project Management/Entrepreneurship
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	ЭОТА	PL07	PL08	607d	PL010	PL011	PL012
SKTG 4611	Gas Engineering Seminar						~			~			
SKTG 4834	Plant Design Project	~		~	~					~			~
PROGRAMME E	LECTIVE COURSES												
SKTG 4**3	Gas Engineering Elective I	~	~							~		~	
SKTG 4**3	Gas Engineering Elective II	~	~							~		~	
SKTG 4**3	Gas Engineering Elective III	~	~							~		~	

# 5.3.6 SYNOPSIS OF CHEMICAL-GAS ENGINEERING COURSES

#### SKTG 1233 Introduction to Chemical and Gas Engineering

The objective of this course is to introduce chemical and gas engineering and prepare students for learning engineering to become an engineer of the future. This course serves to bridge pre-university education to university life and provide support for adjusting to learning and expectations in tertiary education. The topics/skills that will be learnt in this course include: overview of engineering & chemical gas engineering, basic principles of gas engineering related processes, uses of Microsoft Excel, basic calculations of common process variables and cooperative Problem-Based Learning (CPBL) case study on sustainable development. One of the important elements of the CPBL case study is Teaching-Research Nexus (TRN) in which students will learn through research even at the undergraduate level.

# SKTG 1313 Mechanics of Engineering

This course is designed to introduce students to the basic principles and concepts in mechanics. It will deals with statics in engineering mechanics that are the resultant and resolution of force(s) acting on a particle, the equilibrium of a particle, the effect of force(s) on a rigid bodies, how to replace a force system with equivalent system, the equilibrium of rigid bodies, determination of centroid as well as analysis of structure and friction. This course also includes the dynamics in engineering mechanics that are determination of rectilinear and curvilinear motions of particle and analysis of principle of work and energy. At the end of the course, students should be able to demonstrate and apply the knowledge by solving various problems in Statics and Dynamics, which forms the basis of further engineering subjects especially Mechanics of Materials and Fluid Mechanics.

#### SKTG 1323 Engineering Drawing

This course provides a fundamental background in engineering drawing to the students, which will enable them to work more effectively in the various fields of engineering. This course aims at developing the skills needed for documenting designs using drawings and for performing graphical analysis of two dimensional and three dimensional problems. The students will be exposed to available CAD for engineering drawing with more emphasis on the utilization of AutoCAD software. This course focuses on the introduction to engineering drawing, fundamentals of engineering drawing, geometry, orthographic and isometric drawing. This course also introduces the sectional drawing and computer aided engineering drawing to the students.

Besides that, this course also provides the basic skills and concept on the technical drawing of the gas engineering related Piping & Instrumentation Diagram (P&ID) that is essential for process industries.

#### SKTG 1333 Thermodynamics

Thermodynamics is an important basic engineering subject where concepts such as systems, boundaries, mass, heat, work and energy are introduced. These concepts are then related using the 1st and 2nd Law of Thermodynamics. In this subject properties of common substances such as water, air and general working fluids are introduced using property tables and basic state equations. These concepts are applied in many engineering equipments, basic refrigeration and power cycles. Such basic concepts are vital because they form the fundamentals for future chemical/gas engineering subjects.

#### SKTG 1413 Mass Balance

This course introduces students to the chemical engineering profession and the fundamental operations of chemical process equipment. It also provides students with the basic principles of chemical engineering material balances as well as calculation techniques to solve material balance problems for chemical process systems and equipment.

#### SKTG 2343 Fluid Mechanics

Physics of fluid: what is fluid, some definitions, surface tension, compressible and Incompressible flow, classes of flow, and physical classification. Fluid statics: pressure, differential equations of fluid statics, manometry, fluid force on submerge bodies, buoyancy and stability of floating bodies, and liquid in relative equilibrium. Fluid in motion: continuity equation, energy and mass equilibrium, Euler, Bernoulli and Momentum equations. Friction in fluid flow: velocity profile in pipes, roughness, friction factor, Moody chart. Flow measurement: venturi and pitot tube, orifice, notches and weirs. Pump and pumping: principle, types, selection, and application of pumps. Dimensional analysis, similitude in fluid mechanics, parameters of incompressible and compressible flow.

#### SKTG 2423 Energy Balance

#### Pre-requisites: SKTG 1413 (pass with at least D+)

This course introduces students to the chemical engineering profession and the fundamental operations of chemical process equipment. It also provides students with the basic principles of chemical engineering energy balances as well as calculation techniques to solve the material and energy balance problems for chemical process systems and equipment.

#### SKTG 2741 Fluid Mechanics Laboratory

#### Pre-requisites: SKTG 2343 (taken)

This laboratory course contains 7 experiments that cover basic concepts in Fluid Mechanics. Laboratory experiments are designed for hands-on experience to understand the engineering principles. The experiment includes Flow Measurement, Bernoulli's Principles, Stability of Floating Body, Jet Impact, Forced Vortex Flow, Minor and Major Losses in Pipes. This course also emphasizes the technical writing aspect where all students' observation and arguments of each experiment must be reported in proper format.

#### SKTG 2363 Material Engineering

#### Pre-requisites: SKTG 1313 (taken)

The first part of SKTG 2363 is introductory Materials Engineering. Topics include classification of materials (metals, ceramics, polymers, composites and semiconductors); atomic bonds; crystal structure; crystalline defects and solid solutions; and phase diagrams. Main emphasis is on metals because metals are structurally the simplest to characterize and a sound knowledge of structure-property relation of metals can be extended to the study of ceramics and polymers. The second part of the course deals with Mechanics of Materials. Topics cover stress and deformation of members under axial loading, torsion in circular shafts, analysis and design of beams for bending, and stress transformation. Throughout the course, strong emphasis is placed on drawing a free-body diagram, selecting appropriate coordinate system, using the correct sign convention.

#### SKTG 2133 Combustion Engineering and Gas Utilisation

This course enables students to understand the basic concept of combustion and related calculations as well as to expose them to the concept of flame, explosion, and detonation and its related safety aspects. In addition, it permits students to explain the use of gaseous fuels and its related energy generating technologies and equipment. The important concept and methods of fuel inter-changeability will be highlighted. The course also covers some fundamental aspects of gas utilization and equipment for various applications.

## SKTG 2433 Chemical Engineering Thermodynamics

Pre-requisites: SKTG 1333(pass with at least D+), SKTG 2423 (taken)

This course introduces students to the chemical engineering thermodynamic theory and applications in the areas of volumetric properties of fluids, heat effects, thermodynamic properties of fluids, thermodynamics of solutions, and physical and chemical equilibria.

### SKTG 2443 Transport Processes

#### Pre-requisites: SKTG 2423 (taken)

This course introduces principles and applications of unit operation involving separation processes in gasliquid, liquid-liquid and solid-liquid systems. It also deals with design of separation operations using heat and mass transfer principles.

### SKTG 3751 Thermodynamics and Material Engineering Laboratory

Pre-requisites: SKTG 2363, SKTG 2433 (taken)

This laboratory course contains 6 experiments that covered basic concepts in Thermodynamics and Strength of Material. Laboratory experiments are designed for hand-on experience to understand the engineering principles. The experiments application includes First Law of Thermodynamics, Second Law of Thermodynamics, Properties of Pure Substance and Properties & Strength of Materials. This course also emphasizes the technical writing aspect where all students' observation and arguments of each experiment must be reported in proper format.

## SKTG 3453 Chemical Engineering Computation

Pre-requisites: SSCE 1693, SSCE 1993 (taken)

This course introduces students to some numerical techniques in solving problems that could not be solved analytically. Students will be exposed to the numerical solution for root of equation, system of linear algebraic equations, curve fitting, ordinary differential equations, differentiation and integration problem. MATLAB programming language will be implemented with the intention of illustrating the nuance of the methods, and showing more realistically how the methods are applied for problem solving.

## SKTG 3123 Gas Processing and Liquefaction

This course is designed to expose students to techniques and technologies of processing and liquefying hydrocarbon and non-hydrocarbon gases. The course enables students to relate and apply the knowledge of some core chemical engineering courses such as mass and energy balance, separation process in gas production and liquefaction processes. A visit to the related industries which requires students to prepare a brief report will also be arranged for them gain some industrial experience.

#### SKTG 3463 Chemical Reaction Engineering

## Pre-requisites: SKTG 2423 ((pass with at least D+)

This course introduces students to chemical reactor design and theories in the area of chemical reaction engineering with emphasis on homogeneous and heterogeneous reactions. It will examine some problems related to multiple reactions and non-isothermal operations. Students will also work cooperatively on a computer assignment to expose them to solving problems using software packages such as PolyMath.

#### SKTG 3473 Separation Process

## Pre-requisites: SKTG 2443 (pass with at least D+)

This course introduces principles and applications of unit operation involving separation processes in gasliquid, liquid-liquid and solid-liquid systems. It also deals with design of separation operations using heat and mass transfer principles.

#### SKTG 3373 Environmental Engineering and Sustainability

This course introduces the cause, effect and method to control pollution from industries. The course covers the three major categories of industrial pollution; water pollution, air pollution and industrial waste management. In the first part, the course includes the source and types of water pollutants, environmental regulations pertaining to waste water discharge, and techniques to treat waste water before discharging to the environment. The second part of the course covers the source and effect of air pollution, regulations requirement for air pollution control, and technology to control air pollution emissions from industries. The third part covers the management of industrial waste that includes definition of scheduled waste, scheduled waste regulations, and techniques to manage the waste.

## SKTG 3483 Process Control and Instrumentation

Pre-requisites: SSCE 1793, SKTG 3473 (taken)

This course covers the fundamentals of dynamic process modelling, dynamic process behaviours and process control. Although more concentration is given to lumped parameter systems modelling, distributed parameter systems is introduced. Feedback control system design, analysis and tuning are dealt with in detail. Also included are model estimation techniques for first order plus deadtime (FOPDT) systems. Other commonly found control structures, such as feedforward, ratio, split-range and cascade control, and plantwide control systems design are taught qualitatively. This course employs Active Learning (AL).

### SKTG 3213 Gas Transmission and Distribution

#### Pre-requisites: SKTG 2343 (taken)

This course is design to expose student to hydrocarbon gas transmission and distribution system. The course contents include an introduction to gas industry, gas delivery concept, codes and standards in gas pipeline system, gas hydraulics, gas pipeline network analysis, construction, materials and procedures, operation and maintenance and gas regulation and measurements. A visit to the related industries which requires student to prepare a brief report and application of CEASER II software will be arranged for them to gain some industrial experience.

#### SKTG 3721 Combustion Engineering and Gas Utilisation Laboratory

#### Pre-requisites: SKTG 2133 (taken)

The laboratory is the practical introduction to the method of determining fuel characteristics such as specific gravity and calorific value. This course also introduces students to the method of determining flame properties such as flame speed and flame characteristics. It also enables students to obtain understanding of a few phenomenon during combustion with some related factors. Students also are introduced into explosion study. At the end of this course, students will able to describe and explain the process and operation of equipment related to gas combustion engineering such as boiler, gas absorption refrigeration system, and gas turbine system.

#### SKTG 3731 Separation Process Laboratory

#### Pre-requisites: SKTG 3473 (taken)

This subject introduces students to the equipment in the separation processes discussed in Separation I subject. This will give a 'hands on' experience to the students how to handle the equipments and to interpret the data taken from the experiments. There are also various types of packing and plate in the column (absorption and distillation) that are being used in the laboratory. Comparison can be made on the efficiency of each packing/plate after all the packing/plate types have been used.

#### SKTG 3383 Safety and Health in Petrochemical Industry

This course presents fundamental principle of safety and risk assessment in chemical process industry. In particular, it emphasises on safety legislations, inherent safety design concept, and applies various method of process hazard identification on petrochemical process and health risk assessment. At the end of this course, it is expected that the students will be able to appreciate the theoretical and practical aspect of occupational safety, health and environment in petrochemical process industry and also be able to use the techniques of hazard identification and risk assessment in the design and operation of petrochemical plant.

#### SKTG 3812 Undergraduate Project 1

This course is designed to train students on some important aspects of research management. In the first part of the undergraduate research project course, the students are only required to carry out preliminary studies on the assigned chemical and gas engineering related topics but also to do research planning that will be implemented in the following semester. At the end of this course, students should be able to prepare a complete research proposal and subsequently present their proposal. In addition, students will have opportunity to gain important generic skills such as communication, team working, problem-solving and creative and critical thinking.

## SKTG 3915 Industrial Training

Students shall attend industrial training prior to their final year at UTM. Students will undergo a practical training lasting for 12 weeks at an approved private, government or semi-government agency. Placement at the respective agency will be initiated by the applications from the students. Approval of the application is at the discretion of the Faculty after considering the suitability of the company. The industrial training provides an opportunity for students to experience the actual working environment and to be able to put into practice the theories that they learned in class. Undergraduates are expected to acquire hands on experience not only in the engineering aspects of work, but also to other related matters such as

administration, accounting, management, safety, etc. during the industrial training period. Students will be supervised by Faculty's supervisor and Industrial's supervisor.

#### SKTG 4761 Pollution Control and Reaction Laboratory

Pre-requisites: SKTG 3463, SKTG 3373 (taken)

This laboratory course contains experiments that are covered basis concept in chemical reaction engineering and pollution control such as kinetic analysis of reaction, ambient air and water quality analysis. All experiments require students to apply fundamental laboratory techniques and skills as well as communication skill. Students, in group will demonstrate a mastery of laboratory techniques and clearly describe the qualitative and quantitative aspects of the experiments performed.

#### SKTG 4771 Process Control Laboratory

## Pre-requisites: SKTG 3483 (taken)

This lab course exposes students to areas of process control systems in the chemical industry. It also teaches the students how to control the specific control variables through the use of simple PID control. Students will experience how to perform open loop and closed loop tuning method for specific processes. Also included is the application of PLC program to plan and control a simple process. Students will gain hands-on experience in process control through experiments that employ pilot-scale chemical processes.

#### SKTG 4493 Plant Design

### Pre-requisites: SKTG 3473 (taken)

This course presents the principles and methodology for product and process design. In particular, it emphasises on the key elements of process design which include process synthesis, heat integration, equipment sizing and cost estimation and process optimisation in generating inherently safe, economic and environmentally friendly processes. The course features the use of process simulation tools.

#### SKTG 4393 Engineering Economics and Project Management

This is a two-in-one course covering both Engineering Economy and Project Management topics. Engineering economy is the application of economic factors and criteria to evaluate alternatives, considering the time value of money. The engineering economy study involves computing a specific economic measure of worth for estimated cash flows over a specific period of time. Project Management is the art of planning, scheduling, and controlling of project activities to achieve performance, cost, and time objectives, for a given scope of works, while using resources efficiently and effectively.

#### SKTG 4223 Gas Storage and Reticulation System

#### Pre-requisites: SKTG 3213 (taken)

This subject enables students to acquire and practice the fundamental knowledge of liquefied petroleum gases (LPG), natural gases (NG) and liquefied natural gases (LNG) storage. The course also emphasizes on gas reticulation systems which include service pipe sizing, pipe route, pressure testing and corrosion protection systems. The students are also required to prepare a group technical report and present their project at the end of the course. Students also will be exposed to computer software (PV Elite and CEASAR II) to enhance their learning quality. A visit to the related industries will also be arranged for them to gain some industrial experience.

#### SKTG 4711 Gas Flow System Laboratory

#### Pre-requisites: SKTG 3213 (taken)

This course is designed to allow students to undergo some laboratory works related to gas engineering courses (SKPG 3213 & SKPG 4223). At the end of the course, students should be able to practically apply different methods of gas pipeline jointing technique, gas metering calibration, gas pipeline control, metering system and gas reticulation system. The students are required to prepare a group laboratory report. This course also implement Industrial Project-based lab where the students are required to design and assemble a gas reticulation system that represents an actual industrial operation. In addition, students will have opportunity to gain important generic skills such as responsibilities, communication, and team working.

### SKTG 4824 Undergraduate Project II

#### Pre-requisites: SKTG 3812 (pass with at least D+)

This course is continuation of the Undergraduate Research Project I (SKTG 4812). The second part of Undergraduate Research Project requires students to implement the research proposal that has been prepared in the previous semester. This might involve practical activities such as laboratory works, data collection from industry and computer programming / simulation. At the end of the course, students should be able to prepare a full report compiling the first and second part of the Undergraduate Research Project

and subsequently present their research findings. Finally, students must submit a bound thesis according to the UTM thesis-writing format. In addition, students will have opportunity to gain important generic skills such as communication, team working, problem-solving and creative and critical thinking.

### SKTG 4611 Gas Engineering Seminar

This seminar provides the platform for verbal sharing experience and providing forums of discussion amongst industrialists, academicians and final year gas engineering students. It is expected to prepare the students with current development in the related gas industry operation and activities. The actual industrial operation scenario will be addressed by various well-verse industrial personnel and experienced engineers. The dialog and presentation would strengthen students understanding of the current, future and past trend of the gas industry and its relevant applications. It is expected that students would also able to enlighten the correlation of professional ethics in societal and global context by appreciating the values of resources, latest technological development, issues of health and environment, integrated safety, professional practices and personal integrity.

## SKTG 4834 Plant Design Project

## Pre-requisites: SKTG 4493, SKTG 3383 (taken)

This project is aimed at equipping the students with the skills and creativity in designing a process plant in the absence of complete data. In particular, this course emphasizes on the key elements of process design which include process creation/synthesis, process analysis, process evaluation and process optimization in generating inherently safe, economic and environmentally friendly processes. The students will acquire the skill for hands on application and integration of the principles of chemical engineering required to design a process plant. Students will also learn the technique of writing a comprehensive technical plant design report. The students are also required to present their project at the interim level and end of the course. In this course, students also will be exposed to computer software (ASPEN HYSIS and PV Elite) to enhance their learning quality. The students are also required to do an industrial visit to the related industries to gain some industrial experience and submit an industrial visit report discussing on the benefits of the visit.

## **ELECTIVE COURSES**

#### 1. Energy

#### SKTG 4243 Non-Conventional Oil and Gas Exploitation

This course enables students to describe formation of hydrocarbons, determine exploration methods and techniques, describe fundamental of drilling and reservoirs, processing of effluent streams, safety and the environment, hydrodynamic of petroleum exploration, characterize the reserves and describe the principle of petroleum economics.

## SKTG 4143 Energy Management and Economics

This course introduces basic background, terminology, and fundamentals of energy conversion. Discusses current and emerging technologies for production of thermal, mechanical, and electrical energy. Topics include fossil and nuclear fuels, solar energy, wind energy, fuel cells, and energy storage.

#### SKTG 4113 Carbon Capture and Sequestration

This course enables students to examine CO2 separation and capture technologies and also monitoring and verification. It is provide an overview of current technologies and discuss critical technical challenges. Sequestration in geologic formation and sequestration in the oceans using injection methods are clarified. Costs, public acceptance and legal and environmental issues are clarified and factored into the strategy for future energy systems.

## SKTG 4163 Green Energy Technology

The aim of the programme is to prepare students for a professional career in the development of advanced technologies and systems that can satisfy energy demand while striving for environmental, social and economic sustainability. In addition to in-depth knowledge of energy technologies and systems, students will be trained to understand the basic challenges of sustainable development, with a specific focus on the challenges that face the energy system. The course is unique in that it deals with the energy system on all relevant systems levels and that the courses are integrated in such a way that students are trained to approach problem solving in an interdisciplinary way. At the end of the course, students will have acquired a thorough insight into the possibilities and limitations of energy systems, specifically in relation to sustainable development.

## SKTG 4153 Energy Conversion Technology

This course introduces basic background, terminology, and fundamentals of energy conversion. It provides a broad conceptual and analytical understanding of the engineering aspects of energy generation, storage and conversion with an emphasis on sustainable energy use and renewable energy production.

## 2. Gas

### SKTG 4173 Membrane Based Gas Separation Technology

This course introduces students to the fundamentals of gas separation membrane and membrane processes. Students are exposed to membrane materials, morphology, and properties in relation to the gas separation application. In addition, the students will be able to evaluate the productivity and purity of the products under fixed operating conditions from transport equation or supplier information. This subject is also briefly provide the students with the knowledge of potential application of membrane gas separation technology in various industries including petrochemicals, environment and other energy related emerging applications.

## SKTG 4273 Gas Operation and Maintenance

This course is design to expose student to gas supply operation and maintenance. The course contents include a gas supply systems, legislature, maintenance activity, and asset management and control. The course covers for pipeline and storage systems.

## SKTG 4263 Fire and Explosion Safety

This course enables students to understand the basic concept of fire science and combustion and related calculations as well as to expose them to the concept of explosion and detonation. In addition, the principles of fire and explosion protection and mitigation will be discussed within the context of understanding the fire and explosion development mechanism. At the end of the course, students should be able to explain and relate the fundamental knowledge of combustion, flame and explosion and its important safety aspects involving gaseous fuel utilization. Students should able to apply general combustion and engineering principles to fires and explosion and should know the parameters involved on the initiation of both fire and explosion. The students should be also able to use CFD fire modeling (CFast) to analyze the fire development on the case studies given.

#### SKTG 4253 Gas Production Engineering

This course is design to expose student to gas production system. The course contents include a natural gas source, gas well performance, production surface facilities, gas treatment and gas transportation and storage. The course covers the relationship between upstream and downstream activities and the processes involve in the transporting and treating.

#### SKTG 4283 Corrosion Engineering

The aim of this course is to provide basic knowledge of corrosion and corrosion protection of metals and alloys from electrochemistry perspective. This course is specially designed for students who want to have a basic understanding of the corrosion process. Students will be introduced to the underlying science of corrosion engineering principles, corrosion management with particular emphasis on the corrosion design of pipeline corrosion tests will be discussed. This course also covers most traditional and non-traditional tests for corrosion studies, including electrochemical techniques for corrosion, analysis of corrosion phenomenon and corrosion monitoring principles. This course will examine the general mechanisms of corrosion and relate these to specific engineering issues and methods being used to reduce the cost of corrosion. Finally at the end of the course student will be required to do a case study on corrosion problem that shall introduces students on real corrosion problem in industries and group project allow students to become familiar with directing their own investigations of corrosion problem.

# **5.4 BACHELOR OF ENGINEERING (PETROLEUM)**

Petroleum engineering involves a wide range of activities related to field exploration, development, production and abandonment of oil and gas resources. Petroleum engineering Programme covers formation evaluation, reservoir engineering, drilling engineering, well completion, well treatment and diagnosis, and production engineering. Besides that, the Programme requires a good knowledge of other related disciplines, namely geophysics, petroleum geology, petroleum project economics and management, engineering safety, etc.



UTM's undergraduate Petroleum Engineering Programme was the first Petroleum Engineering Programme offered in this country by the Department of Petroleum Engineering, UTM way back in 1975. The goal of the Programme is to provide undergraduate students with a world-class petroleum engineering education that will equip them with the technical and generic skills as required by the global oil and gas industry. Our undergraduate Programme is fully accredited by the Engineering Accreditation Council (EAC) and Washington Accord. In addition, the Programme has also been benchmarked against ABET Programme criteria for petroleum and similarly named engineering Programmes, Society of Petroleum Engineering competency matrix for Petroleum Engineers, and six ABET-accredited institutions of higher learning in the United States of America (USA).

Petroleum engineering graduates are involved in the wide spectrum of the exploration and production

business; from making discoveries and developing reservoirs to optimizing production and making commercial evaluations, determining the drilling methods to be used, and monitoring the drilling and production activities. They also work on designing tools and operational procedures in order to gain efficiency in the recovery of oil and gas. Simulation Programmes are used extensively by petroleum engineers to determine the best possible method of recovery of petroleum from different reservoirs. Models and designs of drilling and other equipment are also simulated on computers. The aim is to maximize hydrocarbon recovery at minimum cost while maintaining a strong emphasis on reducing environmental impact.



Over the years, we have been assisted by experienced advisory panels from oil and gas industry and renowned universities in improving our academic curriculum so that it is of high quality and relevant to the needs of oil and gas industry. Industry practitioners are invited every semester to give professional talks to all petroleum students on latest technology and contemporary oil and gas related issues. There are numerous opportunities for our students to participate in student organizations. The Society of Petroleum Engineers' Student Chapter (SPE-UTM) has been among the most active in the Asia-Pacific region over the past few years. The presence of international students from Kazakhstan, Yemen, Somalia, Singapore, Nigeria, China, Sudan, Indonesia, Iran, Uganda, Indonesia, etc. at the Department of Petroleum Engineering has further complemented our effort in producing well-rounded petroleum graduates who are ready to face the challenges in global oil and gas industry.

# 5.4.1 PROGRAMME SPECIFICAITONS FOR BACHLEOR OF ENGINEERING (PETROLEUM)

1. Programme Name		Bachelor of Engineering	(Petroleum)					
2. Final Award		Bachelor of Engineering						
3. Awarding Institution		Universiti Teknologi Mala						
4. Teaching Institution		Universiti Teknologi Malaysia						
<ol> <li>Programme Code</li> <li>Professional or Statutory Body of</li> </ol>		TK31 Board of Engineers Malaysia (BEM)						
Accreditation		Engineering Accreditation						
7. Language(s) of Instruction		English and Malay						
8. Mode of Study (Conventional, Distance Learning, etc.)		Conventional						
9. Mode of Operation (Franchise, Self- govern, etc.)		Self-govern						
10. Study Scheme (Full Time/Part Time)		Full-Time						
11. Study Duration		Minimum: 4 years Maximum: 6 years						
Type of semester		No. of semesters	No. of weeks per semester					
Normal Short		8 4	14 8					
12. Entry Requirements		Mathematics/ Add Further Additional M Engineering Chem Engineering Physics/	A with minimum of B- in itional Mathematics/ athematics, Chemistry/ istry and Physics/ Biology with CPA 3.00					
		and not physically handicapped which makes him/her unable to conduct experimental/ practical work.						
13. Programme Educational Objectives (PEO	·	nd become important contributors to national						
development.	nd adaptable e place and socie							
14. Programme Outcomes (PO)								
Intended Learning Outcomes		and Learning Methods	Assessment					
<b>PLO 1</b> Able to acquire, practice and apply knowledge of mathematics, science, engineering fundamentals, and petroleum engineering principles to solve complex petroleum engineering problems.	laboratory v independent based lear	, tutorials, seminars, vorks, directed reading, research, and problem- ning, cooperative and porative learning.	Examinations, laboratory reports, presentations, discussion, problem- based exercises, group projects, and independent projects.					
<b>PLO2</b> Able to identify, formulate, research relevant literature and analyse complex petroleum engineering problems through effective thinking skills such as creative, innovative, lateral and critical thinking.	laboratory v undergra development learnin	, tutorials, seminars, vorks, directed reading, aduate project, field t project, problem-based g, cooperative and porative learning.	Examinations, reports, presentations, discussions, problem- based exercises, group projects, and individual research project.					

<b>PLO3</b> Able to provide design solutions for complex petroleum engineering problems that fulfil public health and safety, cultural, societal and environmental considerations.	Lecturers, seminars, laboratory works, directed reading, simulation exercises, computer-based, exercises, undergraduate project, field development project, problem- based learning, cooperative and collaborative learning.	Examinations, problem- based learning reports, laboratory reports, presentations, field development project, individual research project and assignments.
<b>PLO4</b> Able investigate complex petroleum engineering problems using research- related knowledge and methods to provide conclusive results.	Industrial training, industrial visit, geological field work, laboratory works, undergraduate project, workshop, and field development project.	Industrial training reports, external industrial training evaluations, laboratory reports, presentations, problem-based learning reports, individual undergradute project reports, field development project reports, and assignments.
<b>PL05</b> Able to develop or utilize appropriate techniques, resources and modern engineering and computational tools to complex petroleum engineering activities, with an understanding of the limitations.	Lectures, seminars, workshop, mentor-mentee guidance, industrial visit, and problem-based learning.	Field development plan and management reports, reservoir model simulation reports, well testing analysis, and presentation.
<b>PLO6</b> Able to apply reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.	Group projects, group discussion, problem-based learning, workshop, cooperative and collaborative learning, undergraduate project, seminar, and field development project.	Written assignments, laboratory reports, essays, thesis, and oral presentations.
<b>PLO7</b> Able to identify the impact of petroleum engineering solutions in societal and environmental contexts and demonstrate the needs for sustainable development.	Industrial training, undergraduate project, field development project, co-operative learning, and problem based learning.	Industrial training assessment by industrial supervisor, peer and lecturer evaluations seminars, and reports.
<b>PLO8</b> Able to demonstrate high ethical standards in professional practice, including concern over environmental and social issues.	File development project, tutorial, undergraduate projects, laboratory works, group assignments, geology field trip, problem-based learning, cooperative learning.	Groups reports and presentations, learning logs/ journal, peer and lecturer evaluations.
<b>PLO9</b> Able to communicate effectively and confidently on complex petroleum engineering activities through written and oral modes to all levels of society.	Industrial training, industrial visit, undergraduate project, field development project, and problem based learning.	Industrial training report, self-directed learning report, learning portfolios/ journal, and project report and presentation.

functior	Able to work independently and with confidence as an individual, both single and multi-disciplinary	uno develo	etures, industrial training, dergraduate project, field opment project, cooperativ rning, and problem-based learning.	e Report presentation e and lect evaluation industrial tr assessme industrial su	ns, peer urer s, and raining ent by		
	Able to perpetually seek, acquire, sent contemporary knowledge.	training	res, class projects, industri g, undergraduate project, a eld development project.	ind presentat industrial tu assessme industrial su examinat assignmen	ions, raining ent by pervisor, ions, ts, and		
principle skills.		training	res, class projects, industri g, undergraduate project, a eld development project.	ind presentat industrial tu assessme industrial su examinat assignmen	projects. Reports, presentations, industrial training assessment by industrial supervisor, examinations, assignments, and projects.		
15. Clas	ssification of Courses						
No.	Classification		Credit hours	Percentag	je		
i	University (a) General (b) Language (c) Co-Curriculum		12 8 2	16.0			
ii	Faculty Core		41	29.7			
iii	Programme Core		75	54.3			
	Total		138	100			
	Classification based on f	field (refe	r to the Statutory Body gui	delines)			
No	Classification		Credit Hours	Percentage	e		
A	Engineering Courses a. Lecture b. Laboratory/Workshop c. Industrial Training d. Final Year Project		71 15 5 6	70.1			
	Total credit hours for Part A		97				
В	Related Courses a. Applied Science/Maths/Comp b. Management/Law/Humanities c. Co-Curriculum d. Others Total credit hours for Part B		23 16 2 - 41	29.9			
	Total credit hours for Part B		138	100			
16	Total credit hours to graduate			edit hours			
	gramme Structures and Features, Cur	rriculum,					
beir	course is offered in full-time mode ang delivered and assessed in each se rsework.						

# Award requirements:

Students should:

- Achieve a total of 138 credit hours with minimum CPA of 2.00.
- Complete the undergraduate final year project.
- Pass industrial training.
- Complete UTM Professional Skill courses

### Minor in Petroleum Engineering

For students from different approved Programmes who wish to have a *Minor* in the Petroleum Engineering Programme, they must complete **18** credit hours of selected courses.

Core Courses for minor in Petroleum Engineering:

No.	Code	Courses	Credit
1	SKTP 1313	Introduction to Petroleum Engineering	3
2	SKTP 2213	Basic Geosciences	3
3	SKTP 2313	Reservoir Rock and Fluids Properties	3
4	SKTP 3313	Reservoir Engineering	3
5	SKTP 3413	Drilling Engineering	3
6	SKTP 3513	Petroleum Production Engineering	3
		Total credits for minor	18

#### 18. Our Uniqueness

- The Petroleum Engineering Programme has been offered by Universiti Teknologi Malaysia via the Department of Petroleum Engineering since 1975. Since 1986, the Petroleum Engineering Programme has received an accreditation from the Board of Engineer / Engineering Accreditation Council (EAC).
- All students in the Petroleum Engineering Department are members of the Society of Petroleum Engineers UTM Student Chapter (in short called SPE-UTM Student Chapter). SPE is an international organisation which is based in Dallas, USA. The student membership fees are paid by oil companies around the world
- SPE-UTM Student Chapter is one of the best SPE Student Chapters in the world won several The Gold Standard Awards and Outstanding Student Chapter Awards (2007 2015)
- Biannual event held by SPE-UTM since year 2004. Previously known as Oil and Gas Symposium. The main activities of this symposium are technical talks, interview sessions and exhibition by the oil and gas related companies. IOGS 2016 will serve as a platform to enrich soft skills and practice intelligence interaction among fellow graduates and professionals and also to keep abreast with the latest advancement in knowledge and technology in oil and gas world.

19. Career Prospects and Career Paths

Our petroleum graduates are hired by global oil and gas companies over the years. They can be assigned in various companies; working for major, fully-integrated international oil companies, smaller independent operators, specialized companies that provide services for the producing companies, or consulting firms in oil and gas or the environmental arena. Among the oil and gas companies are Petronas, Exxonmobil, Shell, Talisman, Murphy Oil, Newfield, Petrofac, Hess Oil, Nippon Oil, and Newfield, while the oil-related service providers are Schlumberger, Haliburton, Baker Hughes, UMW Drilling, Geowell, Dimension Bid, Dialog, and Scomi. As a petroleum engineer, you can expect to earn the highest starting salary among all the engineers. Salaries for petroleum engineers are, and will continue to be, among the highest paid of all professionals. We genuinely care about our students and their future. Over the last few decades, our graduates have been serving the society in key positions and have made tremendous impact to the development of Malaysia.

Several worldwide trends, namely exploring deep-water fields, development of marginal fields, implementation of Enhanced Oil Recovery (EOR) Programmes, etc., ensure that the strong demand for petroleum engineers will continue. The ever-increasing population of the Earth, when combined with the growing thirst for energy in the developing countries, is putting significant upward pressure on the demand for oil and gas production. This increasing demand for energy, and the simple fact that oil and gas resources are limited, places the petroleum engineer in a strong position now and for many years to come.

20. UTM Professional Skills Certificate and TECS

All undergraduates undergoing bachelor degree programmes are required to enrol for and follow four short courses and one test during their studies in UTM to obtain the UTM Professional Skills Certificate as part of the requirements for graduation. Those are: -

- How to Get Yourself Employed (HTGYE) xi.
- ISO 9001:2008 Quality Management System Requirement (ISO) xii.
- Occupational Safety and Health Awareness (OSHA) xiii.
- How to Manage Your Personal Finance (HTMYPF) xiv.
- Test of English Communication Skills for Graduating Students (TECS) xv.
  - e. Paper I Oral Interaction f. Paper II Writing

# 21. Assessment Tools

					Lear	ning	Outco	mes							
Measurement Tools	PL01	PL02	PL03	PL04	PLO5	PLO6	PL07	PL08	PL09	PL010	PL011	PL012	Duration	Action by	
Exam, quizzes	~	~	~	~	~	~	~	~	~	~	~	~	Continuous	Lecturer	
Peer teaching										~			Continuous	Lecturer, student	
e- Portfolio	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Continuous	Student	
Course Exit Survey	✓	~	~	~	~	~	~	~	~	~	~	~	End of sem	Lecturer	
Course Assessment Report	✓	~	~	~	~	~	~	~	~	~	~	~	End of sem	Lecturer	
Research Project Survey	~	~		~	~	~		~	~			~	End of sem	Coordinator	
Programme Assessment Report	~	~	~	~	~	~	~	~	~	~	~	~	End of sem	Head of Dept	
Alumni Survey	~	~	~	~	~	~	~	~	~	~	~	~	Once/3 years	Head of Dept	
Employer Survey	~	~	~	~	~	~	~	~	~	~	~	~	Once/3 years	Head of Dept	

	CODE	COURSES	CREDIT	Prerequisites
		SEMESTER 1		
	SSCE 1693	Engineering Mathematics 1	3	
	ULAB 1122	Academic English Skills	2	
	UICI 1012	Islamic and Asia Civilisation	2 3	
	SKTP 1313	Introduction to Petroleum Engineering*	3	
Y	SSCK 1203	Analytical Chemistry for Engineering	3	
E	SKTP 1113	Engineering Mechanics	3	
A		Subtotal	16	
R		SEMESTER 2		
	UHAK 1012	Graduate Success Attributes	2	
1	SSCE 1793	Differential Equations	3	SSCE 1693#
-	SKTP 1123	Fluid Mechanics*	3	
	SKTP 1133	Engineering Drawing	3	
	SKTP 1711	Fluid Mechanics Lab.	1	SKTP 1123
	ULA* 1**2	Foreign Language Elective	2	
	UHAS 1172/	Malaysian Dynamic (Local) / Malaysia Studies	2	
	UHAK 1022	3 (International student)		
		Sub total	16	
	CODE	COURSES	CREDITS	Prerequisites
		SEMESTER 1		
	ULAB 2122	Advanced Academic English Skills	2	
	SCSJ 1013	Programming Technique I	3	
	SKEU 2003	Electrical Technology	3	
	SKTP 2213	Basic Geosciences*	3	
	SKTP 2721	Geosciences Lab	1	SKTP 2213
Y	SKTP 2113	Thermodynamics	3	
E	SSCE 1993	Engineering Mathematics 2	3	SSCE 1693#
A		Sub total	18	
R		SEMESTER 2		
2	SSCE 2193	Engineering Statistics	3	SSCE 1693#
2	SKTP 2123	Mechanics of Materials	3	SKTP 1113#
	SKTP 2313	Reservoir Rock and Fluids Properties*	3	
	SKTP 2731	Thermodynamics & Mechanics of Material Lab.	1	SKTP 2123, SKTP 2113#
	UICL 2302	The Thought of Science and Technology	2	
		General Elective	2	
	U*** 2**2			
	U*** 2**2 UHAK 1032	Introduction to Entrepreneurship	2	
	-			

# 5.4.2 CURICULLUM FOR BACHELOR OF ENGINEERING (PETROLEUM)

Note: \* - cornerstone course; \*\* - capstone course;

# - must pass (at least with grade D+) for prerequisite course

	Code	Courses	Credits	Prerequisites
		SEMESTER 1		
	SSCE 2393	Numerical Methods	3	SSCE 1693#
	SKTP 3413	Drilling Engineering*	3	
	SKTP 3741	Drilling Fluid Lab.	1	SKTP 3413
	SKTP 3213	Formation Evaluation	3	
	SKTP 3313	Reservoir Engineering*	3	SKT P2313#
	SKTP 3741	Reservoir Engineering Lab.	1	SKTP 3313
Y	SKTP 3921	Geology Field Work <sup>®</sup>	1	SKTP 2213#
E	ULAB 3162	English for Professional Purposes	2	
Α		Sub total	17	
R		SEMESTER 2		
	SKTP 3423	Well Completion	3	
3	SKTP 3113	Petroleum Economics	3	
-	SKTP 3513	Petroleum Production Engineering*	3	
	SKPP 3123	Health, Safety and Environment*	3	
	SKTP 3323	Reservoir Simulation	3	SKTP 3313#, SSCE 2393#
	SKTP 3812	Undergraduate Project I**	2	
		Subtotal	17	
		SEMESTER 3		
	SKTP 3915	Industrial Training	5	
		Subtotal	5	
	Code	Courses	Credits	Prerequisites
		SEMESTER 1		
	SKTP 4814	Undergraduate Project II * *	4	SKTP 3812#
	SKTP 4822	Field Development Plan I**	2	SKTP 4213, SKTP 3213#,
				SKTP 3313#, SKTP 3413#,
v			3	SKTP 3513#
Y E	SKTP 4213	Petroleum Geology	3	SKTP 2213#
	SKTP 4113	Petroleum Management and Entrepreneurship	3	SKTP 3113#,
A R	SKTP 4313	Well Testing		SKTP 3313#
, n		Subtotal	15	
4		SEMESTER 2		
	SKTP 4834	Field Development Plan II**	4	SKTP 4822#
	SKTP 4323	Secondary and Tertiary Oil Recovery	3	SKTP 3313#
	SKTP 4513	Gas Engineering	3	
	SKTP 4**3	Petroleum Eng. Elective	3	
	SKT* 4**3	Technical Elective	3	
		Subtotal	16	
		Total Credits	138	

Note: \* - cornerstone course; \*\* - capstone course; # - must pass (at least with grade D+) for prerequisite course

# 5.4.3 ELECTIVE PETROLEUM COURSES (choose 1 course only)

No.	Code	Courses
1	SKTP 4123	Petroleum Refining Technology
2	SKTP 4223	Geophysics
3	SKTP 4413	Advanced Drilling Engineering
4	SKTP 4423	Advanced Well Completion
5	SKTP 4523	Well Diagnosis and Treatment
6	SKTP 4533	Production Data Analysis

For Technical Elective, student can choose any course from other programme within FCEE.

5.4.4 PREREQUISITE

**BACHELOR OF ENGINEERING (PETROLEUM)** 

SEMESTER 1	SEMESTER 2	SEMESTER 3	SEMESTER 4	SEMESTER 5	SEMESTER 6	SEMESTER 7	SEMESTER 8
SKTP 1113*	SSCE 1693*	<ul> <li>SSCE 1993*</li> <li>SKTP 2123</li> <li>SKTP 2113*</li> </ul>		SKTP 3213* SSCE 2393 SKTP 3413*	SKTP 3513*	SKTP 4822*	SKTP 4834
		SKTP 2213*		SKTP 3921	SKTP 3113*	<ul> <li>SKTP 4313</li> <li>SKTP 4113</li> <li>SKTP 4213</li> <li>SKTP 4814</li> </ul>	SKTP 4323

Note: \* must pass the prerequisite course

# 5.4.5 MAPPING OF COURSES TO PROGRAMME LEARNING OUTCOMES (PLO)

				PF	ROGRA	MME	LEARN	ING OU	тсом	es (Pi	.0)		
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment & Sustainability	Ethics	Communication Skills	Leadership and Team Work	L Life Long Learning	Project Management and Finance
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	PLO6	PL07	PL08	PL09	PL010	PL011	PL012
UNIVERSITY G	ENERAL COURSE												
ULAB 1122	Academic English Skills									~			
ULAB 2122	Advanced Academic English Skills									~			
ULAB 3162	English for Professional Purposes									~			
ULA* 1112	Foreign Language									~			
UHAS 1172 / UHAK 1022	Dinamika Malaysia (Local)/Malaysia Studies 3 (International Student)												
UHAK 1012	Graduate Success Attributes												
UHAK 1032	Introduction to Entrepreneurship												
UICI 1012	Islamic and Asian Civilizations												
UICL 2302	The Thought of Science and Technology												
U*** ***2	General Elective												
UKQ ***2	Co-Curriculum											~	
MATH/SCIENC	E/TECHNOLOGY												
SSCE 1693	Engineering Mathematics I		~										
SSCE 1993	Engineering Mathematics II		~										
SSCE 1793	Differential Equations		~										
SSCE 2193	Engineering Statistics												
SSCE 2393	Numerical Methods												
SKEU 2003	Electrical Technology												
PROGRAM CO	RE COURSES		•	•	<u>.</u>				•				
SKTP 1313	Introduction To Petroleum Engineering	~	~							~	~		
SKTP 1113	Engineering Mechanics	~				~					~		
SKTP 1123	Fluid Mechanics	~	~								~		
SKTP 1711	Fluid Mechanics Lab	~	~							~	~		

		PROGRAMME LEARNING OUTCOMES (PLO)											
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment & Sustainability	Ethics	Communication Skills	Leadership and Team Work	Life Long Learning	Project Management and Finance
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	PLOG	PL07	PL08	PL09	PL010	PL011	PL012
SKTP 1133	Engineering Drawing	~			~							~	
SKTP 2113	Thermodynamics	~									~		
SKTP 2213	Basic Geosciences	~	~							~	~		
SKTP 2721	Geosciences Lab	~			~					~	~		
SKTP 2123	Mechanics of Materials	~				~							
SKTP 2711	Thermodynamics & Mechanics Material Lab	~	~	~						~	~		
SKTP 2313	Reservoir Rock and Fluids Properties	~	~							~			
SKTP 3731	Reservoir Engineering Lab	~				~				~	~		
SKTP 3413	Drilling Engineering	~	~					~		~			
SKTP 3741	Drilling Fluid Lab	~			✓					~	~		
SKTP 3213	Formation Evaluation	~	~							~			
SKTP 3313	Reservoir Engineering	~	~		~					~			
SKTP 3921	Geology Field Work	~	~							~	~		
SKTP 3423	Well Completion	~		~							~		
SKTP 4213	Petroleum Geology	~	~							~			
SKTP 3113	Petroleum Economics	~		~		~				~		✓	
SKTP 3513	Petroleum Production Engineering	~			~	~	~			~	~		~
SKTP 3123	Health, Safety and Environment	~	~							~			
SKTP 3915	Industrial Training	~	~	~	~	~	~	~	~	~	~		
SKTP 3812	Undergraduate Project I	~	~						~	~		~	~
SKTP 4822	Field Development Plan I	~	~	~	~	~	~	~	~	~	~	~	~
SKTP 4834	Field Development Plan II	~	~	~	~	~	~	~	~	~	~	~	~
SKTP 3323	Reservoir Simulation	~	~			~				~	~		
SKTP 4513	Gas Engineering	~	~							~			
SKTP 4814	Undergraduate Project II	~	~	~	~	~	~	~	~	~		~	~
SKTP 4313	Well Testing	~	~							~			

		PROGRAMME LEARNING OUTCOMES (PLO)											
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment & Sustainability	Ethics	Communication Skills	Leadership and Team Work	Life Long Learning	Project Management and Finance
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	PLOG	PL07	PL08	6014	PL010	PL011	PL012
SKTP 4323	Secondary and Tertiary Oil Recovery	~	~							~	~		
SKTP 4113	Petroleum Management and Entrepreneurship	~		~						~			
PROGRAMME ELECTIVE COURSES													
SKTP 4153	Petroleum Refining Technology	~	~							~			
SKTP 4253	Geophysics	~	~							~			
SKTP 4513	Well Diagnosis & Treatments	✓	~							~			
SKTP 4413	Advanced Drilling Engineering	~	~							~			
SKTP 4423	Advanced Well Completion	~	~							~			
SKTP 4233	Production Data Analysis	~	~							~			

# 5.4.6 SYNOPSIS OF PETROLEUM ENGINEERING COURSES

# SKTP 1313 Introduction to Petroleum Engineering

This course introduces students to various disciplines in petroleum engineering. The contents of the course includes the origin, migration, accumulation and the exploration of petroleum, the types and properties of reservoir rocks and reservoir fluid, and type of formation evaluation. This course also briefly discuss the operation and equipment used in drilling, well completion and production of petroleum. This course is conducted by normal lectures, classroom discussion, group project and presentation.

# SKTP 1113 Engineering Mechanics

This course has been designed to introduce students to the basic principles and concepts in statics and dynamics. The course is divided into two parts: the first part deals with the analysis of particle and rigid body in static, which covers the resultant and resolution of force(s) 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, and analysis of friction. The second part deals with the analysis of particle(s) in motion. It includes the kinematics and kinetics of particles and kinematics of rigid bodies. It will cover the rectilinear and curvilinear motion of particles, Newton's Second Law of particles and work and energy for particles.

# SKTP 1123 Fluid Mechanics

This course introduces students to basic concept and principles of fluid mechanics. The contents of the course include the physics of fluid, analysis of fluid in statics and in motion, friction in fluid flow, flow measurement, and dimensional analysis. This course is conducted by normal lectures, class exercise activities and group assignment.
#### SKTP 1711 Fluid Mechanics Laboratory

Co-Requisites: SKTP 1123 Fluid Mechanics

This course covers eight fluid mechanics-related experiments which are friction losses in pipe, stability of floating body, jet impact, flow measurement, water hammer, forced vortex flow, calibration of bourdon tube pressure gauge, and an open-ended laboratory work.

#### SKTP 1133 Engineering Drawing

This course provides a fundamental background in engineering drawing to the students, which will enable them to work more effectively in the various fields of engineering. This course aims at developing the skills needed for documenting designs using drawings and for performing graphical analysis of two dimensional and three-dimensional problems. The students will be exposed to different available CAD for engineering drawing with more emphasis on the utilization of QCAD and AutoCAD software. This course focuses on the introduction to engineering drawing, fundamentals of engineering drawing, geometry, orthographic and isometric drawing. This course also introduces the sectional and flowchart drawing and computer aided engineering drawing to the students. Besides that, this course also provides the basic skills and concept on the technical drawing of the gas engineering related Piping & Instrumentation Diagram (P&ID) that is essential for process industries.

#### SKTP 2213 Basic Geoscience

This course introduces students with the introduction of geosciences/geology and subtitles of physical geology. The course emphasis on the Earth physical & chemical characteristic, especially its surface and internal features. Then, turn to a discussion of Earth materials and the related processes. Next, Earth's internal structure and the processes that deform rocks and give rise to mountains will also be included. Finally, the course concludes with geologic time and Earth history.

### SKTP 2721 Geoscience Laboratory

#### Co-Requisites: SKTP 2213 Basic Geoscience

This course exposes the students the practical aspect of basic geosciences laboratory. It provides the students with the identification of minerals and rocks, geologic maps construction, particle size analysis of sediments and the use of Brunton compass in measuring strike and dip of geological structure planes.

#### SKTP 2113 Thermodynamics

Thermodynamics is an important basic engineering subject where concepts such as systems, boundaries, mass, heat, work and energy are introduced. These concepts are then related using the 1st and 2nd Law of Thermodynamics. In this subject property of common substances such as water, air and general working fluids are introduced using property tables and basic state equations. These concepts are applied in many engineering equipments, basic refrigeration and power cycles. Such basic concepts are vital because they form the fundamentals for future chemical engineering subjects.

#### SKTP 2123 Mechanic of Materials

#### Pre-Requisites: SKTP 1113 Engineering Mechanics (pass with at least D+)

The course covers both the theory and application of the fundamental principles of mechanics of materials. Emphasis is placed on the importance of satisfying equilibrium, compatibility of deformation, and material behavior requirement. Topics being covered include stress and strain under axial loading, torsion, bending, combined loadings, stress transformation, design of beams and shafts, and deflection of beams and shafts.

#### SKTP 2711 Thermodynamics and Mechanics of Material Laboratory

Co-Requisites: SKTP 2113 Thermodynamics, SKT 2123 Mechanic of Materials

Experiments performed in this laboratory include boiler tests, diesel engine performance test, equilibrium test, energy (heat engine), tensile test, metal metalography, determination of Young modulus, air compressor, cooling system, torsion testing, stress and strain analysis.

#### SKTP 2313 Reservoir Rock and Fluids Properties

This course introduces students to the important concepts, theories, and methods of properties determinations (calculation, correlation, and laboratory method) of some reservoir rock and fluid properties. The topics in reservoir rock properties include porosity, permeability, fluid saturation, rock compressibility, rock wettability, relative permeability, capillary pressure, and electrical properties of reservoir rocks. In reservoir fluid properties, the topics cover one- and two-phase behaviors of both ideal and real systems, gas properties, liquid properties, and reservoir fluid properties.

#### SKTP 3921 Geology Fieldwork

Pre-requisites: SKTP 2213 Basic Geoscience (pass with at least D+)

This course exposes students to the practical aspect of field geology, and introduce geology of Malaysia. Students will be trained how to make geological observations including simple geological mapping using the compass-step method.

#### SKTP 3313 Reservoir Engineering

Pre-requisites: SKTP 2313 Reservoir Rock and Fluids Properties (pass with at least D+)

This course covers the fundamentals of reservoir engineering which include the description and characterizing of the oil and gas reservoir, calculation of fluid in-place and the recoverable reserves, theory and calculation of fluid flow in porous media, and the influence of aquifer on reservoir performance. Students are first introduced to the volumetric calculation method and the Material Balance Equation for the application in gas reservoirs. The methods are then extended to gas condendsate reservoirs, and to oil reservoirs (saturated and undersaturated). The concept of superposition is also discussed and the fundamental equations for the pressure transient analysis are derived. This course is conducted by normal lectures and student group project based on published reservoir data

#### SKTP 3731 Reservoir Engineering Laboratory

#### Co-Requisites: SKTP 3313 Reservoir Engineering

The content of this laboratory works can assist students to understand better the theories they learned from the Reservoir Rock and Fluid Properties course. Measurement of absolute permeability: gas permeameter and liquid permeameter. Measurement of viscosity: glass capillary, Brookfield apparatus and Kern balance. Measurement of porosity: helium porosimeter and Ruska pump apparatus. Measurement of relative permeability: core lab retorted. Measurement of density: gas density, hydrometer. Measurement of capillary pressure.

#### SKTP 3413 Drilling Engineering

This course introduces the activities involved in drilling operations. The contents of the course include the rig components and drilling systems, types of drilling fluid and properties, drilling fluid formulations and calculations, drilling problems, drilling hydraulics calculation, formation pressures and its effect to the drilling operations, well control and well configurations. This course is conducted through lectures, group assignments, and presentations.

#### SKPP 3741 Drilling Fluid Laboratory

#### Co-Requisites: SKTP 3413 Drilling Engineering

This course requires the students to perform hands-on preparing and measuring drilling fluids properties according to the API standard. Laboratory experiments are designed to help students better understand the factors controlling drilling fluid properties as well as familiarize students with field testing procedures of drilling fluids. This laboratory is equipped with complete drilling fluid testing and analysis. Equipment available include blenders, mud balances, marsh balances, rheometers, pH meters, resistivity meters, and the filter press unit, etc.

#### SKTP 3213 Formation Evaluation

This course exposes students to electric logging which covers the basic concept of reservoir resistivity, spontaneous potential, resistivity log, Gamma-ray log, neutron log, formation density log, and acoustic log. Lectures also cover open hole log analysis and interpretation, the use of Archie's equation and other methods to determine water saturation, lithology and porosity determination, and assessing the true formation resistivity prior to computing the hydrocarbon reserves.

#### SKTP 3812 Undergraduate Project I

This course is designed to train students on some important aspects of research management. In the first part of the undergraduate research project course, the students are not only required to carry out preliminary studies on the assigned petroleum engineering related topics but are also required to plan the research methodology that will be implemented in the following semester and maintain a log book. At the end of this course, students are required to prepare a complete research proposal, and subsequently present it. In addition, students will have the opportunity to gain important generic skills such as communication, team working, problem-solving and creative and critical thinking.

#### SKTP 3113 Petroleum Economics

This course introduces students to petroleum economics in evaluation of oil and gas development and production. The contents of the course include the principles, methods, and techniques of engineering

economic analysis, such as topics on interest and time value of money, depreciation and income tax calculations, cash flow, economic indicators, decision making, and risk and sensitivity analysis. This course will allow student to finally be able to generate cash flow of the project and perform an economic evaluation of the project.

#### SKTP 3423 Well Completion

The course covers casing design, cementing job, well completion practices, and completion and workover fluids in order to maintain well integrity. Lectures also cover types of perforations, tubing string and its accessories, production packer and tubing sealing assemblies that should be installed in production wells to produce oil and gas safely to the surface.

#### SKTP 3513 Petroleum Production Engineering

This course introduces students to complete petroleum production system of a petroleum well/field. The course will provide an overview of the well/field petroleum production system components including production philosophy and objectives, present and future well productivity and performance, single and multiphase flow system for surface delivery, artificial lift system and surface facilities. By the end of the course, students should be able to identify and describe the major components of the petroleum production system, understand the mechanism of delivering the reservoir fluid to the surface and the process involved for optimum production of petroleum sellable products. This course is conducted by normal lectures, classroom work and group project report and presentation with software utilization in the classroom and group project work.

### SKTP 3323 Reservoir Simulation

Pre-Requisites: SKTP 3313 Reservoir Engineering (pass with at least D+), SSCE 2393 Numerical Methods (pass with at least D+)

This course includes derivations of basic equations and underlying principles used in developing reservoir simulators. It covers the development of a simple governing equation, partial differential equations for single-phase and multiphase flow in porous media. Finite difference approximations are used to solve the equations. Input data requirements and applications of simulation models for history matching and prediction of field performance will be discussed. A spreadsheet, i.e. Microsoft Excel, would be used for many of the examples and exercises.

#### SKTP 3123 Health, Safety and Environment

The course presents fundamental principle of safety and risk assessment in petroleum engineering. It emphasizes on safety legislations, inherent safety design concept, methods of hazard identification, chemical health risk assessment and various methods of risk assessments. The course also covers health and environmental issues related to petroleum engineering. At the end of this course, it is expected that the students will be able to appreciate the theoretical and practical aspects of occupational safety, health and environment in petroleum engineering. Students should also be able to use the techniques of hazard identification and risk assessment in the design and operation of petroleum engineering projects.

#### SKTP 3915 Industrial Training

A 12-week training in industry. The main rational of introducing the programme is to provide UTM students with exposure to practical aspects of industry and their work practices. During the programme, the students will have the opportunity to relate their theoretical understanding to the real application in industry and to develop skills in work ethics, management, communication and human relations.

#### SKTP 4814 Undergraduate Project II

#### Pre-Requisites: SKTP 3812 Undergraduate Project I (pass with at least D+)

This course is a continuation of the Undergraduate Project I. The second part of Undergraduate Project requires students to implement the research proposal that has been prepared in the previous semester. This might involve practical activities such as laboratory works, data collection from industry and computer programming/simulation. At the end of the course, students should be able to prepare a full report compiling the first and second part of the Undergraduate Research Project and subsequently present their research findings. Finally, students must submit a bound thesis according to the UTM thesis-writing format. In addition, at the end of the course, students will have the opportunity to gain important generic skills such as communication, team working, problem-solving and creative and critical thinking.

#### SKTP 4822 Field Development Plan I

Pre-Requisites: SKTP 3213 Formation Evaluation (pass with at least D+), SKTP 3313 Reservoir Engineering (pass with at least D+), SKTP 3413 Drilling Engineering (pass with at least D+), SKTP 3513 Petroleum Production Engineering (pass with at least D+), Co-Requisites: SKTP 4213 Petroleum Geology

Field Development Plan courses expose students to the process and methods in developing an optimum plan for a petroleum field. It covers all aspects of field development planning, commencing with screening studies, after discovering hydrocarbons, to project sanction. The first part of the course covers collection and analysis of data, including proving of resources and reduction of uncertainty and risk. Students must build a model of geological layering of the subsurface to estimate the initial volume of oil and gas in the reservoir.

#### SKTP 4213 Petroleum Geology

# Pre-Requisites: SKTP 2213 Basic Geoscience (pass with at least D+)

This course exposes the students with the introduction of petroleum geology, sedimentology and applied geophysics to the search for and production of oil and gas. Explanation will be given on the source rocks, kerogen, the concept of maturity of organic matter, and the process of generation of petroleum. The topics on sedimentology and stratigraphy will also be included, to give the knowledge of reservoir rock characteristics and identifying areas of petroleum accumulation. The processes of migration, entrapment of petroleum, types of sedimentary basins and petroleum system will also be discussed to give an idea of the locations and distribution of oil and gas fields around the world as well as its relationship to the zone of seismicity.

### SKTP 4113 Petroleum Management and Entrepreneurship

#### Pre-Requisites: SKTP 3113 Petroleum Economics (pass with at least D+)

This course is pertinent to petroleum engineering and business topics. A group project evaluation utilized a widely used industry software package for economic evaluations. The project consisted of information regarding possible investments in oil and/or gas fields to determine the best options of development for the fields that would yield the maximum total return on investment. The knowledge of financing, costing, and budgeting will be considered in the analysis.

#### SKTP 4313 Well Testing

#### Pre-Requisites: SKTP 3313 Reservoir Engineering (pass with at least D+)

This course introduces students to well testing practices in oil and gas industries. The contents of the course include the concept and principles of well testing, equipment, well test interpretation methods and well test design. This course is conducted by normal lectures, class workshop, and application software activities.

#### SKTP 4834 Field Development Plan II

#### Pre-Requisites: SKTP 4822 Field Development Plan I (pass with at least D+)

The second part of the courses cover the simulation of the reservoir fluid flow behavior and optimize the field development scenario. This simulation leads to the design of an appropriate production system. An economic assessment is performed considering revenue according to production forecasts and the estimated development costs. Students are required to work in small groups, submit written plans, and present their proposals to a panel.

#### SKTP 4323 Secondary and Tertiary Oil Recovery

Pre-Requisites: SKTP 3313 Reservoir Engineering (pass with at least D+)

This course will provide the students with knowledge of advanced topics in Reservoir Engineering. The students are introduced to secondary and tertiary methods of oil production from reservoir rocks. The contents of course include the factors determining movement of oil in reservoirs, different Reservoir Drive Mechanisms and different methods of enhancing Production of Oil. This course conducted through lecture-oriented with assignments, tests and case studies.

#### SKTP 4513 Gas Engineering

The course introduces students to connect the relationship between upstream and downstream gas processing which covers both theories and calculations. The contents of the course include the gas well deliverability, gas well performance, gas pipeline flow, gas compressors, gas dehydration, gas treatment, and gas measurement. This course is conducted through lectures, group assignments, and presentations.

#### **ELECTIVE COURSES**

#### SKTP 4153 Petroleum Refining Technology

This course introduces the characteristics of crude oil and that each of the hydrocarbon compounds has its own boiling temperature. The principles of distillation are introduced leading to the separation into fractions according to cut points. Maximizations of cuts or fractions are achieved through processes like catalytic cracking, alkylation, catalytic reforming and hydro cracking. Gasoline blending is introduced to increase octane number for better performance and to provide designed vapor pressure in gasoline to cope with seasonal altitudinal needs

#### SKTP 4533 Production Data Analysis

The aim of this course is to provide familiarization of the principles and applications of various theories and techniques necessary to design, estimate and maximize production performance in a cost-effective manner within various constraints from the oil and gas well systems. Attempts will be made to understand how these techniques could be applied to identify the best way of exploiting petroleum reserves, as well as maximizing ultimate production. This course will address details of reservoir inflow performance, well flowing performance, design of artificial lift systems, familiarization of petroleum production facilities, and analysis and optimization of total petroleum production systems using conventional and nodal analysis.

#### SKTP 4253 Geophysics

This course introduces students with the introduction and application of applied geophysics in resource exploration and development, and pollution control. The course emphasis on the methods of geophysical techniques, especially seismic methods, including some of the modern interpretation techniques. It also discusses the general approach, equipment and field operations of the methods used. The course provides practice in carrying out a small-scale fieldwork project to investigate shallow geological features which are presumed to exist in the subsurface.

### SKPP 4413 Advanced Drilling Engineering

Pre-Requisites: SKTP3413 Drilling Engineering (pass with at least D+))

This course covers the special operations such as coring and fishing, identification of kick or blow out and methods of well control, advance drilling operations used in the industry, drilling optimization and procedures and legislation of well abandonment.

#### SKTP 4423 Advanced Well Completion

#### Pre-Requisites: SKTP3423 Well Completion (pass with at least D+)

Upon completion of this course, students should be able to prepare well space-out for single and dual completions. This course also exposes students to a safe slick line and completion operations, and preparation of a completion report after the respective well has been released to production and slick line report upon completion of its operation. The content delivered also covers deep sea completion and slick line operations, and completion in unconventional hydrocarbon energy sources.

#### SKTP 4513 Well Diagnosis & Treatment

Pre-Requisites: SKTP3413 Drilling Engineering (pass with at least D+)

The course covers problem wells, diagnosis of problem wells, through tubing production tubing, formation damage, work over planning, sand control, and stimulation.

# 5.5 BACHELOR OF ENGINEERING (NUCLEAR)

It is accepted fact that the energy demand is set to rise dramatically in the 21st century, especially in



ise dramatically in the 21st century, especially in developing countries. Meeting global energy demand will require a 75% expansion in primary energy supply by 2050. If no steps are taken to reduce emissions, the energy-related CO2 emissions would nearly double in the same period. Nuclear power is currently the third largest source of energy type after thermal and hydro power, contributing to 12.32 % of total world electricity generation. Despite public scepticism which arose following the March 2011 Fukushima Daiichi nuclear accident, a number of countries are going ahead with plans to implement or expand their nuclear power programmes because of the climate change, limited fossil fuel supply, and concerns

about energy security. The IAEA's latest projections of nuclear power growth show a steady rise in the number of nuclear power plants in the world in the next 20 years. They projected growth in nuclear power capacity is 23% by 2030.

Closer to home, depletion of the country's petroleum and gas reserves has given a strong hint to the country to look for alternative sources of energy. Nuclear energy is one of the best alternative sources of energy. Rapid developments in the application of nuclear engineering in other sectors, such as in defence, medical, agriculture and others requires more nuclear engineers. It has been shown that one of the critical conditions for the successful introduction of a nuclear power programme and other nuclear related industries is the availability of trained manpower of the required quality and quantity. For these reasons, it should be preceded by a thorough assessment and upgrading of among other things, the education/training infrastructures and establish national education and training capabilities in engineering and science in order to develop qualified personnel for the nuclear power programme.

Nuclear engineering concerns with the science of nuclear processes and their application to the

development of various technologies. Nuclear processes are fundamental in the medical diagnosis and treatment fields, and in basic and applied research concerning accelerator, laser and superconducting magnetic systems. Currently, the major commercial application is the utilization of nuclear fission energy for the production of electricity. Therefore, nuclear engineers are concerned with maintaining expertise in the design, development and safe operation of advanced fission reactors, such as Generation IV reactors, developing both institutional and technical options for a safe handling of nuclear radioactive waste and materials management, and in fostering research in nuclear



science and applications, with emphasis on and not limited to bioengineering, detection and instrumentation and environmental science.

Apart from the technical competencies, this program is also designed to improve students' generic skills. These include critical thinking, communication, leadership, team working, life-long learning, ethics, and entrepreneurship. For nuclear courses, a few new laboratories are being established to fostering the development of our future nuclear engineers. In the meantime, existing laboratory facilities at the Faculty of Science are available to the students to carry out nuclear-related experiments. Arrangements have also been made for the students to use laboratory facilities at the Malaysian Nuclear Agency. All laboratories are equipped with modern experimental equipment and facilities that could provide students with first-hand experience with course concepts, and with an opportunity to explore relevant methods currently applied by the industries.

# 5.5.1 PROGRAMME SPECIFICATION FOR BACHELOR OF ENGINEERING (NUCLEAR)

1. Programme Name						
I. Flogramme Name		Bachelor of Engir	neering (Nuclear)			
2. Final Award		Bachelor of Engir	neering (Nuclear)			
3. Awarding Institution		Universiti Teknolo	ogi Malaysia			
4. Teaching Institution		Universiti Teknolo	ogi Malaysia			
5. Programme Code		TK21				
6. Professional or Statutor	y Body of Accreditation	Board of Enginee	rs Malaysia (BEM)			
7. Language(s) of Instructi	on	English and Baha	asa Malaysia			
8. Mode of Study (convent	ional, distance learning	g, etc.) Conventional				
9. Mode of Operation (Fra	nchise, self-govern, etc.	.) Self-govern				
10. Study Scheme (Full time	e / Part time)	Full-time				
11. Study Duration		Minimum: 4 year	S			
-		Maximum: 6 year	rs			
Type of Semester		No. of semesters	No. of weeks per semester			
Normal		8	14			
Short		4	8			
to national d PEO2 Graduates b position as le PEO3 Graduates or development	erform competently in r evelopment. ecome creative, innova eaders or team membe ontribute professionally t.	in Mathematic Further Additic Engineering C Engineering Pl and must not handicapped v to conduct exp Possesses an (Mechanical/ equivalent wit an Engineering Chemical) fror minimum CGP years of exper	d society.			
14. Programme Learning O						
Intended Learning Ou		ching and Learning Metho				
<b>PLO 1</b> Ability to apply k mathematics, natural engineering fundamenta engineering principles to th complex engineering proble	science, labor ls, nuclear simula le solution of exer ms. de	ectures, tutorials, seminars ratory works, directed read tion exercises, computer-b cises, undergraduate proje sign project, problem-base g, cooperative and collabo learning.	ased based exercises, group projects, and independent			
<b>PLO2</b> Ability to identify conduct research literature, complex engineering proble	and analyse directe	se directed reading, simulation exercises, learning reports,				

principles of mathematics and engineering sciences.	undergraduate project, design project, problem-based learning, cooperative	presentations, individual research
<b>PLO3</b> Ability to design solution for complex engineering problems and design system or process to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	and collaborative learning. Lectures, tutorials, seminars, laboratory works, directed reading, simulation exercises, computer-based exercises, undergraduate project, design project, problem-based learning, group projects.	project, thesis. Examinations, problem-based learning reports, laboratory reports, presentations, design project, individual research project and thesis.
<b>PLO4</b> Ability to conduct investigation of complex engineering problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.	Lectures, seminars, laboratory works, directed reading, simulation exercises, computer-based exercises, undergraduate project, design project, problem-based learning project.	Problem-based learning reports, laboratory reports, presentations, thesis.
<b>PL05</b> Ability to inculcate modern computational techniques and tools which include prediction and modelling to solve complex engineering problem with an understanding of the limitations.	Lectures, tutorials, seminars, laboratory works, simulation exercises, computer-based exercises, undergraduate project, design project, problem-based learning, group projects.	Examinations, presentations, design project, individual research project, computer project and assignment.
<b>PLO6</b> Ability to responsibly act as well as respond to the societal health, safety, environment, legal and cultural issues that are relevant to the professional engineering practice.	Seminars, group projects, group discussion, problem-based learning, cooperative and collaborative learning, tutorials, undergraduate project, and design project	Written assignments, laboratory reports, essays, thesis, forum and oral presentations.
<b>PLO7</b> Ability to explain and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.	Lectures, seminar, industrial training, undergraduate project, design project.	Written reports and presentations, learning logs/journal, peer and lecturer evaluations.
<b>PLO8</b> Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.	Lectures, seminar, industrial training, undergraduate project, design project, problem-based learning project.	Technical reports and presentations, learning logs/journal, peer assessment and lecturer evaluations.
<b>PLO9</b> Ability to communicate effectively through written and oral modes to all levels of society.	Group projects, group discussion, problem-based learning, laboratory work, undergraduate project, and design project.	Written assignments, laboratory reports, essays, thesis, forum and oral presentations.
<b>PLO10</b> Ability to work independently, and as a member or a leader in a team to manage project in multi-disciplinary environment.	Undergraduate project, Industrial training, design project, co-operative learning, and problem-based learning.	Group reports and presentations, learning logs/journal, peer assessment and lecturer evaluations.
<b>PLO11</b> Ability to acquire knowledge and engage in independent and life-long learning.	Industrial training, industrial visit, undergraduate project, design project, and problem-based learning.	E-portfolio, Industrial training report, self- directed learning, report, reflection journal, and project report and presentation.
PLO12 Ability to demonstrate knowledge of engineering management principles and entrepreneurial mind-set to manage projects in multi-disciplinary environments.	Lectures, class projects, industrial training, undergraduate project, and design project.	Forum, presentations, assessment by industrial supervisor, and examinations.

		_			
No. Classification	Credit Hours	Percentage			
i. University Course					
g. Social Science/Humanities	12	8.7			
h. Language	8	5.8			
i. Co-Curriculum	2	1.5			
ii. Mathematics, Science and Technology	15	10.9			
iii. Programme Core	95	68.8			
iv. Programme Elective	6	4.3			
Total	138	100			
Classification based on field (refer	to the Statutory Body guid	elines)			
No Classification	Credit Hours	Percentage			
Engineering Courses					
k. Lectures	75				
I. Laboratory/Workshop	6				
A m. Industrial Training	5	69.6			
n. Undergraduate Project	6	09.0			
<ul> <li>Integrated Design Project/Capstone</li> </ul>	4				
Total credit hours for Part A	96				
Related Courses					
i. Applied Science/Math/Computer	20				
B j. Management/Law/Humanities/Ethics	20	30.4			
k. Co-Curriculum	2				
I. Others	-				
Total credit hours for Part B	42				
Total credit hours for Part A and B	138	100			
<ol><li>Total credit hours to graduate</li></ol>	138 credit hours				
7. Programme structures and features, curriculum a					

This programme is offered on full-time mode and is based on a 2-Semester Academic Session with several courses being delivered and assessed in each semester. Assessment is based on coursework, final examination, lab reports, presentations, industrial training, final year project, and design project.

# Award requirements:

To graduate, students must:

- achieve a total of 138 credit hours with minimum CPA of 2.00
- pass Industrial Training
- complete all Professional Skill Courses
- sit for Test of English Communication Skills for Graduating Students (TECS)

# 18. Our Uniqueness

- To date, Nuclear Engineering Programme of UTM is the first and the only Bachelor of Nuclear Engineering programme in Malaysia.
- The programme was designed in such a graduate should be able to perform tasks and functions for a nuclear power program that require primarily nuclear-related qualifications, both in design and construction and in the operation of a nuclear power plant and in other nuclear related industries.
- The programme received strong support from local and international government bodies, agencies, industries such as Agensi Nuklear Malaysia, Malaysian Nuclear Power Corporation (MNPC), Atomic Energy Licensing Board (AELB), Malaysian Nuclear Society (MNS), International Atomic Energy Agency (IAEA), Japanese Atomic Energy Agency (JAEA), China National Nuclear Corporation (CNNC), Korean Global Institute for Nuclear Initiative Strategy (INIS), etc. which aim to improve the academic quality of graduates in term of providing academic support in term of seminars, industrial training, licensing, and technical support.

19. Career Prospects and Career Paths

The main objective of this Bachelor in Nuclear Engineering programme is to train and prepare students to become nuclear engineers with the capability in the design, construction, maintenance, consultancy, education, and training in the safe and efficient operation of a nuclear power plant and in other nuclear related industries. This will contribute quickly and effectively to the development of nuclear science and technology in Malaysia and the region, and to create a benchmark educational programme that can serve as a model in Malaysia. Nuclear safety, monitoring, and safeguards are of great concern today and require a generation of nuclear engineers to contribute to the development of new non-destructive detection and monitoring systems. Upon graduation, graduates of this program can find work opportunities in industries/sectors such as in the Electric power generation, transmission and distribution; in various regulatory bodies of the Federal government; in management, scientific, and technical consulting services; in architectural, engineering and related services; in scientific research and development services, food and agriculture and medical. Nuclear engineers are also on the forefront of developing uses of nuclear material for medical imaging devices, such as positron emission tomography (PET) scanners. They also may develop or design cyclotrons, which produce a high-energy beam that the healthcare industry uses to treat cancerous tumours.

20. UTM Professional Skills Certificate and TECS

All undergraduates undergoing bachelor degree programmes are required to enrol for and follow four short courses and one test during their studies in UTM to obtain the *UTM Professional Skills Certificate* as part of the requirements for graduation. Those are:

- xvi. How to Get Yourself Employed (HTGYE)
- xvii. ISO 9001:2008 Quality Management System Requirement (ISO)
- xviii. Occupational Safety and Health Awareness (OSHA)
- xix. How to Manage Your Personal Finance (HTMYPF)
- xx. Test of English Communication Skills for Graduating Students (TECS)
  - g. Paper I Oral Interaction
    - h. Paper II Writing

21. Assessment Tools

Measurement Tools	PL01	PL02	PL03	PL04	PLO5	PLOG	PL07	PL08	PL09	PL010	PL011	PL012	Duration	Action by
Exam, quizzes, peer teaching	~	~	~	~	~		~	~			~	~	Continuous	Lecturer, student
Peer Assessment										~			Continuous	Student
e- Portfolio	~										~		Continuous	Student
Course Exit Survey	~	~	~	~	~	~	~	~	~	~	~	~	End of semester	Lecturer
Course Assessment Report	~	~	~	~	~	~	~	~	~	~	~	~	End of semester	Lecturer
Research Project Survey	~	✓	~	~	✓	~	~	~	~		~	~	End of semester	Faculty
Programme Exit Survey	~	~	~	~	~	~	~	~	~	~	~	~	4th year	Faculty
Industrial Training Survey	~	~	~	~	~	~	~	~	~		~	~	End of session	Faculty
Employer Survey	~	~	~	~	~	~	~	~	~	~	~	~	Once/3 years	Head of Dept.

	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		
	SKTN 1143	Introduction to Engineering	3	
	SKTN 1113	Modern Physics	3 3	
	SKTN 1243	Statics <sup>®</sup>	3	
X	UHAS 1172	Malaysian Dynamics, or	2	
Y	UHAS 1162	Art, Culture and Beliefs		
_	SSCE 1693	Engineering Mathematics I <sup>®</sup>	3	
E	ULAB 1122	Academic English Skills	2	
		Sub total	16	
A		SEMESTER 2		
R	SKTN 2213	Nuclear Physics	3	SKTN 1113#
R	SKTN 1123	Fluid Mechanics <sup>®</sup>	3	
1	SSCE 1993	Engineering Mathematics II <sup>®</sup>	3	SSCE 1693
Т	SCSJ 2273	Programming for Engineers	3	
	SKTN 1224	Electrical Engineering Fundamentals with Lab	4	
	UICI 1012	TITAS	2	
		Sub total	18	
	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		
	SKTN 2243	Nuclear Engineering Fundamentals	3	
	SKTN 2123	Strength of Materials	3	
	SKTN 2113	Thermodynamics <sup>®</sup>	3	
	SSCE 1793	Differential Equations <sup>®</sup>	3 3	SSCE 1993
Y	SKTN 1133	Engineering Drawing	3	
	SKTN 1711	Fluid Mechanics Lab	1	SKTN 1123
E	ULAB 2122	Advanced Academic English Skills	2	
		Sub total	18	
Α		SEMESTER 2		
	SKTN 2393	Numerical Methods for Nuclear Engineers	3	SSCE 1793
R	SKTN 2223	Heat Transfer	3	SKTN 2113#
	SKTN 2133	Dynamics <sup>®</sup>	3	SKTN 1243
2	SSCE 2193	Engineering Statistics	3	
	• • • • • • • • • • •	Thermodynamics & Mechanics of Material Lab	1	SKTN 2113, SKTN 2123
	SKTN 2711			
	UHAK 1012	Graduate Success Attribute	2	

# 5.5.2 CURICULLUM FOR BACHELOR OF ENGINEERING (NUCLEAR)

Note: \* - cornerstone course; \*\* - capstone course; @ - with tutorial

# - must pass (at least with grade D+) for pre-requisite course

	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1		•
	SKTN 3233	Radiation Detection and Measurement	3	
	SKTN 3113	Nuclear Radiation Protection	3	
	SKTN 3213	Nuclear Reactor Theory	3	
	ULAB 3162	English for Professional Purposes	2	
	SKTN 4453	Nuclear Power Plant System	3	
Y	UICL 2302	Thought of Science and Technology	2	
	SKTN 3711	Nuclear Physics Lab	1	SKTN 2213
Е		Sub total	17	
_		SEMESTER 2	-	
Α	SKTN 3223	Instrumentation and Control Engineering	3	
	UHAK 2**2	Soft skill Electives	2	
R	SKTN 3224	Thermal Hydraulics with Lab	4	SKTN 2223, SKTN 1123
	SKTN 3721	Nuclear Reactor Lab	1	SKTN 3213
3	SKTN 3123	Nuclear Reactor Material	3	SKTN 2123
	SKTN 4812	Undergraduate Project I	2	
	U***3**2	Foreign language	2	
		Sub total	17	
		SEMESTER 3		
	SKTN 3915	Industrial Training	5	
		Sub total	5	
	CODE	COURSES	CREDIT	Prerequisite
		SEMESTER 1	-	
	SKTN 4824	Undergraduate Project II*	4	SKTN 4812#
	SKTN 4113	Nuclear Fuel Cycle and Waste Management	3	
	SKTN 3173	Engineering Economics & Project Management	3	
Y	SKTN 4833	Nuclear Engineering System and Design I	3	SKTN 4453
	SKTN 3253 SKTN 4711	Nuclear safety, Safeguard, Security & Regulation	3	
Е	5KIN 4/11	Radiation, Detection & Measurement Lab	1	SKTN 3233
		Sub total	17	
Α		SEMESTER 2		
_	SKTN 4834	Nuclear Engineering System and Design II**	4	SKTN 4833
R	SKTN 4**3	Elective Nuclear I	3	
	SKTN 4**3	Elective Nuclear II	3	
4	SKTN 4611	Nuclear Engineering Professional Practice	1	
	UHAK 1032	Introduction to Entrepreneurship	2	
		Sub total	13	
		Total credit	138	

Note: \* - cornerstone course; \*\* - capstone course; @ - with tutorial

 $\ensuremath{\texttt{\#}}$  - must pass (at least with grade D+) for prerequisite course

# 5.5.3 ELECTIVE COURSES (choose 2 courses)

No.	Code	Courses			
1	SKTN 4483	Radiographic Testing			
2	SKTN 4413	Sustainable Energy			
3	SKTN 4423	Ultrasonic Testing			
4	SKTN 4433	Chemistry in Nuclear Engineering			
5	SKTN 4443	Risk Assessment			

SEMESTER 8	SKTN 4834
SEMESTER 7	SKTN 4833
SEMESTER 6	SKTN 3721 SKTN 4812* SKTN 3224 SKTN 3224
SEMESTER 5	SKTN 3711 SKTN 3213 SKTN 4453
SEMESTER 4	<ul> <li>&gt; SKTN 2393</li> <li>&gt; SKTN 2133</li> <li>&gt; SKTN 2223</li> <li>&gt; SKTN 2711</li> </ul>
SEMESTER 3	<pre>&gt; SSCE 1793 &gt; SKTN 1711 SKTN 2113* SKTN 2123 SKTN 2123</pre>
SEMESTER 2	SkTN 2213 SSCE 1993
SEMESTER 1	SKTN 1113* SSCE 1693 SKTN 1243 SKTN 1123

BACHELOR OF ENGINEERING (NUCLEAR)

5.5.4 PREREQUISITE

Note: # must pass the prerequisite course (minimum of grade D+

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# 5.5.5 MAPPING OF COURSES TO PROGRAMME LEARNING OUTCOMES (PLO)

				PF	ROGRA	MME	LEARN	ING OU	тсом	es (pi	.0)		
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment & Sustainability	Ethics	Communication Skills	Leadership and Team Work	Life Long Learning	Project Management and Finance
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	PL06	PL07	PL08	PL09	PL010	PL011	PL012
UNIVERSITY G	ENERAL COURSE												
ULAB 1122	Academic English Skills									✓			
ULAB 2122	Advanced Academic English Skills									~			
ULAB 3162	English for Professional Purposes									~			
UL** 1**2	Foreign Language									~			
UHAS 1172/ UHAS 1162	Dinamika Malaysia/Arts, Custom and Beliefs (International Student)												
UHAK 1012	Graduate Success Attributes												
UHAK1032	Introduction to Entrepreneurship												~
UICI 1012	Islamic and Asian Civilizations												
UICL 2302	The Thought of Science and Technology												
U*** ***2	Soft Skill Elective												
UKQ ***2	Co-Curriculum and Service Learning											~	
MATH/SCIENC	E/TECHNOLOGY												
SSCE 1693	Engineering Mathematics I		~										
SSCE 1993	Engineering Mathematics II		~										
SSCE 1793	Differential Equations		~										
PROGRAM CO	RE COURSES												
SKTN 1143	Introduction to Engineering	✓	~			~	~	$\checkmark$		~			
SKTN 1113	Modern Physics	~	~									~	
SKTN 1243	Statics	~									~		
SKTN 2213	Nuclear Physics	~	~								~		
SKTN 1123	Fluid Mechanics	✓	~								~		
SCSJ 2273	Programming for Engineer	~	~								~		
SKTN 1224	Electrical Eng. Fundamental with Lab	✓	~								~		
SKTN 2243	Nuclear Engineering Fundamentals	✓				~	~						

# UNDERGRADUATE GUIDE BOOK 2017/2018

				PF	OGRA	MME I	EARN	NG OU	тсом	es (pl	.0)		
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment & Sustainability	Ethics	Communication Skills	Leadership and Team Work	Life Long Learning	Project Management and Finance
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	PL06	PL07	PL08	PL09	PL010	PL011	PL012
SKTN 2123	Strength of Materials	~									~		
SKTN 2113	Thermodynamics	~	~								✓		
SKTN 1133	Engineering Drawing	~				✓							
SKTN 1711	Fluid Mechanics Lab		~							~			
SKTN 2393	Numerical Methods for Nuclear Eng.	✓				✓							
SKTN 2223	Heat Transfer	✓	✓								✓		
SKTN 2133	Dynamics	✓	✓									✓	
SKTN 2711	Thermo & Mechanics of Material Lab	~			✓								
SKTN 3233	Radiation Detection and Measurement	✓	~								~		
SKTN 3113	Nuclear Radiation Protection	✓	~							~	✓		
SKTN 3213	Nuclear Reactor Theory	~	~	~						~			
SKTN 4453	Nuclear Power Plant System	~	~				~						
SKTN 3711	Nuclear Physics Lab			✓						~	✓		
SKTN 3223	Instrumentation and Control Eng.	~	~								~		
SKTN 3224	Thermal Hydraulics with Lab	~	~							~			
SKTN 3721	Nuclear Reactor Lab	~			✓	✓				~			
SKTN 2123	Nuclear Reactor Materials	~	~							~			
SKTN 4812	Undergraduate Project I	~	~	✓			~	~			~	✓	
SKTN 4824	Undergraduate Project II	~	~	✓					✓	~	~	✓	
SKTN 4113	Nuc. Fuel Cycle & Waste Management	✓								~			
SKTN 3173	Eng. Economics & Proj. Management	~	~				~	~					✓
SKTN 4833	Nuc. Eng. System & Design I	~	~								~		
SKTN 3253	Nuc. Safety, Safeguard, Security & Reg.	~	~								~	~	
SKTN 4711	Rad. Detection & Measurement Lab	1	~	1			1			~	✓		
SKTN 4611	Nuclear Eng. Professional Practice						~		~	~	~	~	
SKTN 4834	Nuclear Eng. System and Design II	✓	~	✓	~	✓	~	✓	~	~	~	✓	✓

#### UNDERGRADUATE GUIDE BOOK 2017/2018

				PF	Rogra	MME	LEARN	ING OU	тсом	es (pl	.0)		
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment & Sustainability	Ethics	Communication Skills	Leadership and Team Work	Life Long Learning	Project Management and Finance
CODE	COURSE	PL01	PL02	PL03	PL04	PLO5	PL06	PL07	PL08	PL09	PL010	PL011	PL012
PROGRAMME	ELECTIVE COURSES												
SKTN 4483	Radiographic Testing	✓									✓	$\checkmark$	
SKTN 4413	Sustainable Energy		~					✓				~	
SKTN 4423	Ultrasonic Testing	~									✓	~	
SKTN 4433	Chemistry in Nuclear Engineering	✓									✓	~	
SKTN 4443	Risk Assessment	~									~	~	

# 5.5.6 SYNOPSIS OF NUCLEAR ENGINEERING COURSES

# SKTN 1143 Introduction to Engineering

The objective of this course is to introduce and prepare students for learning engineering and how to become engineers of the future. This course serves to bridge pre-university education to university life and provide support for adjusting to learning and expectations in tertiary education. This course introduces the students to the engineering profession, how to prepare for an exciting engineering career, the design process, engineering communication, thinking skills and ethics. The students will also be introduced with systematic approaches to deal with basic engineering problems. Special emphasis will be on enhancing students' communication skills. Problem-Based Learning (PBL) case study on sustainable development will be implemented for a mini project consists of three stages.

# SKTN 1113 Modern Physics

The course begins with a brief discussion on the nature of science in the quest of better understandings of the natural phenomena the inadequacy and failures of classical physics. It is then followed by introductory lesson on Special Relativity Theory and relevant consequences of this theory. A modern quantum mechanics interpretation on blackbody radiation, photoelectric and Compton effect will also be discussed. It will then proceed to the lesson on atomic models and quantum numbers. Finally, formalities of quantum mechanics are introduced by discussing the 1-D time independent Schrodinger equation (TISE), applied to an idealized infinite square potential well.

#### SKTN 1243 Statics

This course is designed to introduce students to the basic principles and concepts in mechanics. It deals with the resultant and resolution of force(s) acting on a particle, the equilibrium of a particle, the effect of force(s) on rigid bodies, how to replace a force system with equivalent system and the equilibrium of rigid bodies. This course also includes the determination of centroid, analysis of structure and friction. At the end of the course, students should be able to demonstrate and apply the knowledge by solving various problems in Statics, which forms the basis of further engineering subjects especially Mechanics of Materials and Fluid Mechanics.

#### SKTN 2213 Nuclear Physics

#### Pre Requisite: SKTN 1113 Modern Physics (pass with at least D+)

The course introduces to some major concepts and theories of nuclear physics. The course begins with understanding the basic knowledge of the constituents of nucleus and the properties of nuclear forces. Nuclear models such as liquid drop model, shell model and optical model of the nucleus will be introduced afterward. The next topic of the course is introducing the radiation sources and the types of ionizing radiations. Nuclear decay process and the properties of ionizing radiations will be discussed in this topic. The interactions of nuclear radiations with matter and mechanism of nuclear reaction are also covered in this subject. The next topic is providing the students with some basic concept on radioactivity including radioactive decay law, radioactive decay series and radioactive equilibriums. In general, the course provides a basic concept of interaction processes of nuclear radiation in order to widening the appreciation of nuclear physics to the students.

#### SKTN 1123 Fluid Mechanics

This course introduces students to physics of fluid: what is fluid, some definitions, surface tension, compressible and Incompressible flow, classes of flow, and physical classification. Fluid statics: pressure, differential equations of fluid statics, manometry, fluid force on submerge bodies, buoyancy and stability of floating bodies, and liquid in relative equilibrium. Fluid in motion: continuity equation, energy and mass equilibrium, Euler, Bernoulli and Momentum equations. Friction in fluid flow: velocity profile in pipes, roughness, friction factor, Moody chart. Flow measurement: venturi and pitot tube, orifice, notches and weirs. Pump and pumping: principle, types, selection, and application of pumps. Dimensional analysis, similitude in fluid mechanics, parameters of incompressible and compressible flow.

#### SCSJ 2273 Programming for Engineers

This course formally introduces the concept of computers, algorithms, programming languages, pseudocode, and problem solving. The two programming languages introduced in this course are Fortran and MATLAB. Topics covered in this course include data types, constants, variables, arithmetic operations, assignment statement, looping, formatted I/O, functions, arrays, matrix operations, data structures, plotting, and model building.

#### SKTN 1224 Electrical Engineering Fundamentals with Lab

This course introduces students to the fundamentals of electrical and electronic engineering through lecture and laboratory sessions. It covers components (passive, active, semiconductor-based), circuits (AC, DC, analogue, digital) and the methods for analyzing circuitry. The laboratory sessions reinforce students' understanding of the theory and electronic expose them to electronics test and measurement equipment. At the completion of this course students are expected to be able to understand electrical and electronic engineering, draw and analyze electronic circuits, use test and measurement instruments, and design basic analogue and digital electronic circuits using active and passive components.

#### SKTN 2243 Nuclear Engineering Fundamentals

This course introduces students to the fundamentals of nuclear engineering. The course provides a broad overview of the fundamental aspects of nuclear engineering and an introductory comparative analysis of nuclear power and other energy sources. The course also provides comparative analysis between different types of nuclear reactors. Other topics covered include theory and thermal hydraulics of nuclear reactors, nuclear power generations, nuclear fuel cycle and control, Radiation and radiation control and nuclear safety.

#### SKTN 2123 Strength of Materials

The first part of this course is introductory to Materials Engineering. Topics include classification of materials (metals, ceramics, polymers, composites and semiconductors); atomic bonds; crystal structure; crystalline defects and solid solutions; and phase diagrams. Main emphasis is on metals because metals are structurally the simplest to characterize and a sound knowledge of structure-property relation of metals can be extended to the study of ceramics and polymers. The second part of the course deals with Mechanics of Materials. Topics cover stress and deformation of members under axial loading, torsion in circular shafts, analysis and design of beams for bending, and stress transformation. Throughout the course, strong emphasis is placed on drawing a free-body diagram, selecting appropriate coordinate system, using the correct sign convention.

#### SKTN 2113 Thermodynamics

Thermodynamics is a fundamental engineering subject where thermodynamic system, boundaries, mass, heat, work, internal energy and enthalpy are explained. Properties of common fluid, such as water, air, and refrigerants are determined either using tables of properties or equations. These are then related to the

concepts of 1<sup>st</sup> Law of Thermodynamics for energy balance calculation and analysis. To further analyze whether a process is possible or not requires a knowledge of 2<sup>nd</sup> Law of Thermodynamics where another thermodynamic property known as entropy is introduced. All these concepts are then applied to a more integrated and complex power and refrigeration cycle systems.

# SKTN 1133 Engineering Drawing

This course provides a fundamental background in engineering drawing to the students, which will enable them to work more effectively in the various fields of engineering. This course aims at developing the skills needed for documenting designs using drawings and for performing graphical analysis of two dimensional and three-dimensional problems. The students will be exposed to different available CAD for engineering drawing with more emphasis on the utilization of QCAD and AutoCAD software. This course focuses on the introduction to engineering drawing, fundamentals of engineering drawing, geometry, orthographic and isometric drawing. This course also introduces the sectional and flowchart drawing and computer aided engineering drawing to the students. Besides that, this course also provides the basic skills and concept on the technical drawing of the gas engineering related Piping & Instrumentation Diagram (P&ID) that is essential for process industries.

#### SKTN 1711 Fluid Mechanics Lab

#### Pre Requisite: SKTN 1123 Fluid Mechanics (taken)

This laboratory course contains 7 experiments that cover basic concepts in Fluid Mechanics. Laboratory experiments are designed for hands-on experience to understand the engineering principles. The experiment includes Flow Measurement, Bernoulli's Principles, Stability of Floating Body, Jet Impact, Forced Vortex Flow, Minor and Major Losses in Pipes. This course also emphasizes the technical writing aspect where all students' observation and arguments of each experiment must be reported in proper format.

#### SKTN 2393 Numerical Methods for Nuclear Engineers

This course formally introduces the steps involved in engineering analysis (mathematical modeling, solving the governing equation, and interpretation of the results). Example of case studies in applied mechanics, strength of materials, thermal science, and fluid mechanics are presented. Methods for solving the nonlinear equations, simultaneous linear algebraic equations, eigenvalue problem, interpolation, numerical differentiation, numerical integration, initial value problems, boundary value problem and Monte Carlo method are introduced.

#### SKTN 2223 Heat Transfer

In this course, three basic modes of heat transfer, namely conduction, convection and radiation, will be covered. Emphasis will be on developing a physical and analytical understanding of the three modes of heat transfer, as well as its applications. Students will develop an ability to apply governing principles and physical intuition to solve single and multi-mode heat transfer problems for one or two-dimensional system of either steady or transient state. This course also introduces methods for calculating rates of heat transfer by these three modes. The concepts of thermal resistance network will be developed for the analysis of heat flows.

# SKTN 2133 Dynamics

This course is designed to introduce students to the second part of mechanics which deals with the analysis of particles and bodies in motion. It will include the kinematics and kinetics of particles. It will cover the rectilinear and curvilinear motion of particles, Newton second law of particles, and work and energy for particles. At the end of the course, students should be able to demonstrate and apply the knowledge by solving various problems involving kinematics and kinetics of particles and kinematics of rigid bodies, which forms the basis of further engineering subjects.

#### SKTN 2711 Thermodynamics & Mechanics of Material Lab

Pre Requisite: SKTN 2113 Thermodynamics and SKTN 2123 Strength of Materials (taken)

This laboratory course contains 6 experiments that covered basic concepts in Thermodynamics and Strength of Material. Laboratory experiments are designed for hand-on experience to understand the engineering principles. The experiments application includes First Law of Thermodynamics, Second Law of Thermodynamics, Properties of Pure Substance and Properties and Strength of Materials. This course also emphasizes the technical writing aspect where all students' observation and arguments of each experiment must be reported in proper format.

#### SKTN 3233 Radiation Detection and Measurement

The important detection techniques for radiations are introduced in this course. The discussion begins with introducing the principles of radiation detection related to radiation units, radiation sources and radiation interactions. Nuclear radiation detector parameters such as detector model, detector efficiency, energy resolution, counting curve and counting statistics are discussed. The next topic will emphasize on the principles of operation and basic characteristics of various detection systems. Various nuclear detectors such as gas filled detector, scintillation detector and semiconductor detector are main concerned of the subject. The course also emphasizes on the principle and operation of thermal and fast neutron detector. The principle of radiation dosimetry such as thermolumeniscent dosimetry, chemical dosimetry, film dosimetry and calorimeter are also discussed at the end of the course.

#### SKTN 3113 Nuclear Radiation Protection

This course is designed to ground students in the principles of radiation protection, that is, on justification, optimization and dose limits. It will emphasize on the theories, the techniques and the procedures for external dose control that is the use of distance, shielding and time; and internal dose control, including introduction to the physics of aerosol, use of unsealed sources, primary and secondary containments, radioactive laboratories and leak tests. The course will also discuss organization and radiation protection programmes; emergency procedures, monitoring, radiological protection in radiation devices, transport regulations and radioactive waste management. Upon completion, students should have an overall grasp of the radiation protection principles and practice; and most importantly the safety culture required.

#### SKTN 3213 Nuclear Reactor Theory

The course starts with discussion on neutron physics related to production, absorption and scattering of neutron, neutron cross sections and nuclear fission. The next topics will emphasize on the principle of neutron moderation and neutron multiplication leading to steady state fission reactor core design based on diffusion theory. The next topic will emphasize on the reactor equation solutions of neutron flux, maximum to average flux and power for rectangular, cylindrical and spherical reactor. In general, the course provides on the general concepts of neutron physics and it application in nuclear reactor for energy generation. The course will solve the point reactor dynamic equation and apply safety characteristics using point kinetics models.

#### SKTN 4453 Nuclear Power Plant System

The degree program in Nuclear Power Plant System Engineering comprises a wide range of power engineering titles aimed at theoretical and practical exposure. This program has been developed to train highly qualified professionals to design, operate and maintain power plants. Students are required to describe sources of energy and types of power plants. The analysis of different types of steam cycles and estimation of the efficiencies in a steam power plant will be carried out. The basic working principles of gas turbine and diesel engine power plants are also described in terms of the performance characteristics and components of such power plants. Evaluation on cycle efficiency and performance of a gas cooled reactor power plant are included in this course by listing the different types of fuels used in power plants and estimating their heating values. Further, the calculation on the present worth depreciation, cost of different types of power plants and estimation on the cost of producing power per kW will be done.

#### SKTN 3711 Nuclear Physics Lab

#### Pre Requisite: SKTN 2213 Nuclear Physics (taken)

The course covers eight nuclear physics-related experiments. Experiments of health physics and radiation safety are performed and laboratory reports are written by students. Experiments are performed at UTM. Topics of experiment include: 1. Geiger Muller Tube detector, 2. Resolving time 3. Counting statistics, 4. Linear absorption coefficient and inverse square law, 5. Attenuation of betas in aluminium, 6. Limitation of dose system, 7. Absolute efficiency of Geiger Muller.

#### SKTN 3223 Instrumentation and Control Engineering

This course introduces students to the concept of electrical measurement using analogue and digital instruments, methods for mathematical model building of physical systems and processes, control systems and the use of software in analyzing system and controller performance. Transducers that are used in instruments for measuring common parameters such as temperature and pressure are presented. Instrumentations used in nuclear facilities such as nuclear reactors are covered. This course will also show students the methods to obtain mathematical model of actual physical system such as electrical, mechanical, thermal, and nuclear systems. Further the fundamental ideas and structures of control system such as open loop and feedback controls, transfer functions, block diagrams, and controller responses will

be covered. The use of transfer functions for controller construction and analysis of controller performance in time domain using MATLAB and Simulink will also be introduced.

#### SKTN 3224 Thermal Hydraulics with Lab

This course covers the thermo-fluid dynamic phenomena and analysis methods for conventional and nuclear power stations. Fundamental processes of heat generation and transport in nuclear reactors. Effects of boiling and critical heat flux. Fundamentals of reactor thermal and hydraulic design. Specific topics include: kinematics and dynamics of two-phase flows, boiling, and critical conditions, single channel transient analysis, loop analysis including single and two phase natural circulation, and sub-channel analysis. Students will also perform laboratory experiments to reinforce understanding of thermal hydraulic phenomena.

#### SKTN 3721 Nuclear Reactor Lab

# Pre Requisite: SKTN 3213 Nuclear Reactor Theory (taken)

A series of nuclear reactor related experiments are performed in Malaysia Nuclear Agency (MNA) research facilities. The students will be given hands-on experience in dealing with nuclear reactor system and instrumentation. Student will carry out experiments on site and are required to prepare technical reports for each experiment.

#### SKTN 2123 Nuclear Reactor Materials

This course will provide a valuable insight on some of the key issues facing the nuclear power generation industry. Many of these are related to the materials involved, their response to, and their reliability under extreme conditions. The effects of radiation on various properties of materials in nuclear applications will be dealt with to get an appreciation of the materials' limitations on the operation of reactors. Students will first be introduced to the basic concepts of materials science. The basic aspects of the nuclear fuel cycle, current and future nuclear reactor designs, and the materials problems associated with nuclear energy production will be discussed. The key issues in materials failures and the requirements for efficient and safe operation of current reactor designs as well as design of novel materials for future reactors will be discussed. A few applications of radiation effects will then be treated with this newfound framework, including the change of material properties under irradiation, void swelling, embrittlement and loss of ductility. At the end of this course, students will be familiar with the basic issues concerning the selection of materials for various components in nuclear reactors.

#### SKTN 4812 Undergraduate Project I

This course is designed to train students on the important aspects of research management. Student will be assigned to a nuclear engineering related topic and required to prepare a research proposal that will be implemented in the following semester. At the end of this course, students should be able to present their proposal. In addition, students will have opportunity to gain important generic skills such as communication, team working, problem-solving and creative and critical thinking.

#### SKTN 3915 Industrial Training

This course is a core course which will assign students to industries, governments or semi-governments agencies and organizations for a period of 12 weeks. The training aims to expose students to real nuclear engineering practices while enhancing their knowledge and working experiences as well as improving their interpersonal skills. The students also have the opportunities to apply learned theories into real nuclear engineering practices. Students will be supervised by the faculty and industrial supervisors.

#### SKTN 4824 Undergraduate Project II

#### Pre Requisite: SKTN 4812 Undergraduate Project I (taken)

This course is a continuation of the Undergraduate Research Project I (SKTN 4812). The second part of Undergraduate Research Project requires students to implement the research proposal that has been prepared in the previous semester. This might involve practical activities such as laboratory works, data collection from industry and computer programming / simulation. At the end of this course, students should be able to prepare a full report compiling the first and second part of the Undergraduate Research Project and subsequently present their research findings. Finally, students must submit a working paper and a bound thesis according to the UTM thesis-writing format. In addition, students will have opportunity to gain important generic skills such as communication, problem-solving and creative and critical thinking.

#### SKTN 4113 Nuclear Fuel Cycle and Waste Management

This course consists of two parts: Nuclear Fuel Cycle and Waste Management. The first part introduces students to the front-end of the fuel cycle: ore extraction, conversion and enrichment, fuel fabrication and

use in the power plant, spent fuel reprocessing. In the second part, the back-end of the fuel cycle will be discussed. It is including the radioactive waste management, ranging from waste characteristics, waste treatment technologies, radioactive materials transportation and decontamination and decommissioning related to radioactive e processes and materials. At the successful completion of this course the students will be able to describe the following features of a Nuclear Fuel Cycle and Waste Management: Nuclear fuel resources, Uranium enrichment, Nuclear fuel fabrication, Spent fuel storage, Nuclear fuel reprocessing, Waste disposal, Radioactive materials transportation, and Decontamination and decommissioning.

#### SKTN 3173 Engineering Economics & Project Management

This is a two-in-one course covering both Engineering Economy and Project Management topics. Engineering economy is the application of economic factors and criteria to evaluate alternatives, considering the time value of money. The engineering economy study involves computing a specific economic measure of worth for estimated cash flows over a specific period of time. Project Management is the art of planning, scheduling, and monitoring of project activities to achieve performance, cost, and time objectives, for a given scope of works, while using resources efficiently and effectively.

# SKTN 4833 Nuclear Engineering System and Design I

#### Pre Requisite: SKTN 4453 Nuclear Power Plant System (taken)

This course introduces students to nuclear engineering systems, particularly nuclear reactors and their systems, subsystems, and major components. It also introduces students to systematic engineering design approach including needs definition, concept generation and selection, technical specifications, and design trade-offs. With respect to nuclear reactor design, the course focuses on core design, safety systems, fuel elements, and cooling systems. Students will be introduced to software packages for thermal hydraulics and core design, particularly MCNP code. Economics and financial aspect in the design of nuclear systems will also be introduced. This course is also aimed at preparing students with good knowledge and understanding of nuclear systems design.

#### SKTN 3253 Nuclear Safety, Safeguard, Security & Regulation

This course introduces students to safety, safeguards, security and regulations pertaining to nuclear activities. The focus of the course is on administrative and technical approaches to enhance nuclear safety, national and international safeguard regimes, and security measures to ensure safe use of nuclear technologies. National and international legal instruments and agencies will be introduced. Engineered and inherent safety features, reliability enhancement through redundancy, methods of safety and risk analysis such as probabilistic safety analysis, fault tree and event trees, FMEA will be covered. Students are expected to develop understanding on the importance of nuclear safety, security, safeguards and the legal instruments that are in place to ensure conformance to peaceful uses of nuclear technology.

#### SKTN 4711 Radiation, Detection & Measurement Lab

#### Pre Requisite: SKTN 3233 Radiation Detection and Measurement (taken)

The course covers seven nuclear experiments. Experiments of radiation detection and measurement are performed and laboratory reports are written by students. Topics of experiment include energy calibration of detector, resolution of detector, efficiency calibration of detector, gamma spectroscopy, radon measurement, alpha spectrometry, and liquid scintillation.

#### SKTN 4834 Nuclear Engineering System and Design II

#### Pre Requisite: SKTN 4833 Nuclear Engineering System and Design I (taken)

This capstone course is a group design project, with nuclear industrial based case, involving integration of knowledge in nuclear physics, neutron transport, heat transfer, safety, materials, environmental impact and economic analysis. It provides opportunities to synthesize knowledge acquired in nuclear engineering and apply this knowledge to complex problems of current interest in nuclear power plant design. Students are required to present interim design project, final design presentation and submit the final design report.

#### SKTN 4611 Nuclear Engineering Professional Practice

This course emphasizes the nuclear engineering ethics and engineer's responsibilities towards safety, health and welfare of the public from professional point of view. Few speakers from nuclear-related areas such as from Agensi Nuklear Malaysia (ANM), Malaysian Nuclear Power Corporation (MNPC), and Atomic Energy Licencing Board (AELB) will be invited to give talks to the students. The talks will place emphasis on the engineer as a professional man, engineers in society, code of ethics and professional conducts, standards, laws and regulations pertaining to professional engineering practice. At the end of this course, students will acquire the concept of professionalism and ethical responsibility and be able to demonstrate and apply engineering professional ethics in their career as an engineer.

### ELECTIVE COURSES

#### SKTN 4483 Radiographic Testing

This course describes Non-Destructive Testing (NDT) which is the process of inspecting, testing or evaluating materials, components or assemblies for discontinuities without destroying their serviceability. The course introduces the six most common NDT methods which are Visual Testing, Liquid Penetrant Testing, Magnetic Particle Testing, Radiographic Testing, Ultrasonic Testing and Eddy Current Testing. Emphasis will be given to Radiographic Testing which is also known as Industrial Radiography. Metal forming and manufacturing processes and possible defects present in each process will be described. The most widely used industry inspection and acceptance standards for NDT such as ASME V, VIII and API 1104 will be described.

#### SKTN 4413 Sustainable Energy

In the context of depleting fossil fuel reserves and environmental consequences, the concept of sustainable energy warrants to be a contemporary subject matter. This course explains the concepts of sustainable energy technology based on ethics, environments and economy (E<sup>3</sup>) and the role of sustainability in practical system applications and innovation. The course recognizes the effects from the fossil dominated energy systems over economics, environment and the society. The course provides the latest review of the most important renewable energy resources, advanced technologies, and explains the sustainability basis for harnessing them. The course also demonstrates evaluating the energy technologies and systems to be economically feasible, environmentally bearable and socially acceptable. Comprehension of the issues associated with sustainable energy technology are achieved through lectures, discussions, combined with reports and student presentations on the literature reviewed.

#### SKTN 4423 Ultrasonic Testing

The course starts with the introduction of the underlying science of ultrasonic and acoustic wave propagation in elastic media, and its application to non-destructive evaluation. Students will be introduced to the mathematical equations that govern the propagation of ultrasonic and acoustic waves. The student will be expose to different ultrasonic probes, their types and construction. This is followed calibration of the testing device and sensitivity adjustment. The theoretical material will be covered in a number of illustrated lectures, reinforced by worked example classes. In parallel with the theoretical aspect of the course, students will undertake a number of experimental tasks to demonstrate how the theory translates into practice. In general, these tasks will be drawn from examples from the field of non-destructive evaluation, using standard industrial procedure.

#### SKTN 4433 Chemistry in Nuclear Engineering

The subject focuses on the chemistry aspects of nuclear engineering. The physico-chemical properties in radioactivity and binding energy are presented in this course. The occurrence of radionuclide in nature as well as the stability and radioactivity of the radionuclides are evaluated. The chemical effects of radiation on the radiolysis of various organic and inorganic matters are also discussed. The production and separation methods of radionuclides and their chemical behaviors are also covered in this course. The applications of these radionuclides in qualitative and quantitative chemical analysis are included. This course also discusses the production of hydrogen gas as alternative fuel using nuclear energy. The final part of this course deals with the emerging application of nuclear reaction for transmutation of elements and isotopes.

#### SKTN 4443 Risk Assessment

Fundamental safety principles in nuclear industry require assessment of safety for all facilities and activities that potentially give rise to radiation risks. Safety assessment in particular is a systematic process that is carried out to ensure that all safety requirements are met. This course addresses the fundamental aspects of safety assessment providing the basis for specialized training in the area of deterministic and probabilistic safety assessments. This course also discusses safety assessment of main system design that include reactor core, coolant and containment system. It provides for introductory and preparatory knowledge necessary for engineers and regulatory personnel engaged in safety analysis performance.

# 6.0 GRADING SYSTEM

### 6.1 GRADES, MARKS AND GRADE POINT

The performance of a student in a course is represented by the grade obtained. The relationship between the marks, grade and grade point is as listed in Table below;

Marks	Grade	Grade Point
90-100	A+	4.00
80-89	А	4.00
75-79	A-	3.67
70-74	B+	3.33
65-69	В	3.00
60-64	В-	2.67
55-59	C+	2.33
50-54	С	2.00
45-49	C-	1.67
40-44	D+	1.33
35-39	D	1.00
30-34	D-	0.67
00-29	E	0.00

- The passing grade of a course is subject to the requirements of the faculty with the Senate's approval. Generally, **Grade D+** is the minimum passing grade.
- Besides the grades listed above, the following grading is also used:

TS (Incomplete)	-	Grade given to students who did not sit for the final examinations or were unable to complete their coursework due to illness or other reasons accepted by the University.
HS (Audit) HL (Pass) HG (Fail)		Grade given to registered audit courses. Passing Grade given to course registered with HW Status. Failing Grade given to course registered with HW Status.

#### 6.2 ACADEMIC STANDING

 Performance of students is evaluated based on TWO (2) measurements namely PNG and PNGK which are as follows:

PNG = Total Grade Point per Semester / Total No. of Attempted Credit per Semester

PNGK = Total Grade Point for all Semesters/Total No. of Credit Counted for all Semesters

Academic Standing	PNGK
Good Status (KB)	PNGK ≥ 2.00
Probation Status (KS)	1.70 ≤ PNGK < 2.00
Fail Status (KG) (Study Terminated)	PNGK < 1.70

- Students who obtain PNG < 1.00 even though the PNGK  $\geq$  1.70 may, with the Senate's approval;
  - (i) continue his/her study; or
  - (ii) be instructed to defer his/her study to the following semester; or
  - (iii) have his/her study be terminated.
- Students who obtained THREE (3) consecutive Probation Status [KS] will be given a Fail Status [KG] and the student will be terminated from his/her study

# 7.0 ACADEMIC ADVISORY

# 7.1 ACADEMIC ADVISOR

An academic advisor is assigned to students to assist them in their course and career planning to provide advice degree requirements and options, to provide advice on academic policies and procedures and to help them reach their academic goals.

Productive academic advising is a collaborative activity in which both the student and advisor have particular responsibilities. Having faculty-student contact at least once per semester is especially important because:

- Informal student-faculty contact can enhance the quality of the undergraduate experience.
- Course offerings and curricula requirements are sometimes subject to change.
- Undergraduate Plan of Study and Graduation Requirements sometimes need review and/or change that advisors can often be helpful with.
- Regular contact with an advisor will help provide a good source for recommendations later in your career.

#### Advisor's Responsibilities

- To be accessible to students throughout the year during designated office hours. Names of alternate advisors should be posted during extended absence of an advisor from campus.
- To set aside designated times for registration advising and individual discussions.
- To be knowledgeable about curriculum requirements, academic policies and procedures, referrals and resources on campus, and career opportunities in the major field.
- To guide students through academic programs that will complement their personal, educational and professional interests.

#### Student's Responsibilities

- To know your advisor's office hours and advising schedule
- To make an appointment and prepare for registration advising by reviewing the Curriculum, Class-Hour Schedule, and Pre-requisite requirements.
- To formulate questions regarding curriculum, course selections, career options, etc.
- To be aware of academic and personal needs and to seek assistance when needed.
- To understand that the role of your advisor is to *advise*, not to make decisions for you. Final decisions should be made by you, with advisement, since it's your education.

#### 7.2 INTEGRATED ACADEMIC ADVISORY SYSTEM (IAAS)

FCEE has developed an online IAAS for academic advising. Academic Advisor will able to monitor the performance of students througout their studies. Students can access their progress and activities. They can also upadate their co-curicullum and academic activities as well as academic achievement. The system can be accessed through web link **webapp.fcee.utm.my/advisory/.** 

# **8.0 STUDENT SOCIETY**

Student societies are also set-up to encourage interactions among students and staffs and to inculcate positive genetic skills in students. Student Society has been set up in this faculty. These are Chemical Engineering Students Society (ChESS-AlChE), Bioprocess Engineering Student Society (BIOSS), Gas Engineering Student Society (GESS), Society of Petroleum Engineering (SPE), and Nuclear Engineering Student Society (NESS).

#### 8.1 Chemical Engineering Students Society (ChESS-AIChE)



The society is meant for chemical engineering students of the faculty. This society is a platform for students to conduct activities related to their professional fields and voice their opinion concerning students' welfare. ChESS receives strong support from the Institution of Chemical

Engineering of Malaysia (ICheME) in conducting academic activities related to the chemical engineering field.

#### 8.2 Bioprocess Student Society (BIOSS)



All students in the Chemical-Bioprocess Engineering programme are members of the Bioprocess Engineering Student Society (BIOSS). This student society has been actively participating and organizing various activities with full support from the department. These activities were aimed to provide experience in management and governance, representation in

education and related matters and social activities. Apart from encouraging overall participation, the Department of Bioprocess Engineering guides and monitors all BIOSS activities closely and systematically to ensure that students achieve the required generic skills. Among the activities are: International Biotechnology Competition and Exhibition (IBCEx), BIOSS Community Service, BIOSS Novice Camp and UTM Night Run with Pride.

#### 8.3 Gas Engineering Student Society (GESS)

GESS is a student body for Chemical-Gas Engineering undergraduates chartered by UTM's Office of Student Affairs and Alumni (HEMA). With the support of Department of Energy Engineering, the club was established by the pioneering group of Chemical-Gas Engineering undergraduates in the early 90's. Since its establishment, the club strives to:



- (1) Provide quality career, academic, and social services to its members through the organization of events, specially catering to the student's needs.
- (2) Enhance the premium Bachelor of Engineering (Chemical-Gas) programme by closely working with the FCEE and Oil and Gas companies on various fronts.

Many of the events organized by GESS have gained enormous support and accolades from its members, alumni, faculty, participated sponsors and industrial partners as they do find that these events are of mutual benefit to all parties involved. The important annual events that GESS have been organizing are as follows:

- (1) Freshmen Induction Camp.
- (2) Talk, Seminar, Workshop of different areas, such as self-development, career, engineering and technology, and academic.
- (3) GESS Annual Dinner, GESS Alumni Night, and Grand Faculty Dinner (co-organized with FPREE and Department of Petroleum Engineering).
- (4) Global Outreach Programme.
- (5) Industrial visits.

A board of committee is elected annually by its members in the club's general election to administrate the club's activities. As a student society, GESS depends greatly on volunteering students in helping to organize various events as well as for the contribution of ideas. In another word, GESS is a student body

that provides a platform and opportunities for all of its members to take charge, practice to be leaders, and participate in achieving the club's mission.

#### 8.4 UTM Society of Petroleum Engineers (SPE-UTM Student Chapter)



The Society of Petroleum Engineers (SPE) is the largest individual-member organization serving managers, engineers, scientists and other professionals worldwide in the upstream segment of the oil and gas industry. Based in the United States of America, is also known as SPE Dallas. The organization actively offers a unique opportunity to contribute to the profession through programs and activities driven by dedicated members.

SPE-UTM was originally known as Petro Club in 1974. In 1998, the club members made a unanimous decision to affiliate the Petro Club to SPE International as one of its branches in Malaysia. Since then, the club was rebranded to SPE-UTM Student Chapter and continues to strengthen its relationship with SPE-Kuala Lumpur, SPE-Asia Pacific as well as the major oil and gas players, such as Petronas, Shell, Talisman, Hess Oil, Murphy Oil, Baker Hughes, Schlumberger, etc.

Among the major programs organized by SPE-UTM Student Chapters are Oil & Gas Symposium (OGS), Shell Inter-varsity Student Paper Presentation Contest (SSPEC), Oil & Gas Technology Expo & Conference (OGTEC) and SPE-Student Chapter Malaysia Oil and Gas Convention (SMOGC). This is followed by Global Outreach Programs (GOP) to Indonesia, Singapore, China, Australia, Vietnam, Cambodia and Thailand. SPE-UTM members also are active in participating international events such as International Petroleum Technology Conference (IPTC) in Bangkok, Thailand, and Young Professional Engineers (YPE), Oil Expo, Oil & Gas International Parade (OGIP) in Jakarta, Indonesia to list a few.

Since its establishment, SPE-UTM Student Chapter has been made the proud recipient for the most Outstanding Student Chapter Award for the year of 2007, 2008, and 2009. This is followed by the Gold Standard Award for the year of 2010, 2011, 2012, 2013, 2014, 2015 and 2017. On top of that, SPE-UTM Student Chapter also was awarded with the Past President Award for year 2011. For more information please visit our website <u>www.speutm.org</u>.

# 8.5 Nuclear Engineering Student Society (NESS)



The Nuclear Engineering Student Society (NESS) is the student society for nuclear engineering undergraduates, which officially established in March 2014. The society is registered with the office of student welfare (HEP), UTM, and managed by the nuclear engineering undergraduates. NESS is basically one of the platforms in UTM for nuclear engineering undergraduates to gain basic organizational

management experience and improve their generic skills. Such activities aim to enrich student experiences, fostering their personal development as well as preparing them for responsible leadership.

NESS has also been accepted as a student chapter affiliated to Malaysian Nuclear Society (MNS). NESS has received strong support from local and international government bodies, agencies, industries such as Agensi Nuklear Malaysia, Malaysian Nuclear Power Corporation (MNPC), Atomic Energy Licensing Board (AELB), Malaysian Nuclear Society (MNS), International Atomic Energy Agency (IAEA), Japanese Atomic Energy Agency (JAEA), China National Nuclear Corporation (CNNC), Korean Global Institute for Nuclear Initiative Strategy (INIS), etc. which contributed to the success of all NESS events and activities.

NESS has marked their success to local and international students in nuclear field by hosting invited speakers from around industry and government, professional development activities and workshops, student socials, a wide variety of intramural sports teams, and many other events throughout the year. Among the most successful events are Nuclear Delegation to Bangkok 2014, Nuclear Science, Technology and Engineering Conference (NuSTEC 2014), Nuclear Youth Congress 2015, Nuclear Awareness Camp (NuCamp), De Fermi Debate Competition (2015-2017) and recently, Nuclear Youth Summit 2017. Aligned with NESS's vision (Empowering NESS as key player in nuclear industry) and core values (sustainability, professionalism, and integrity), NESS has initiated a Strategic Partnership Program in order to strengthen and facilitate the mobility of the society. A few companies have been officially become NESS's strategic partners which includes, Nusantara Technologies Sdn. Bhd., Elnet Training Academy, Selera Permata Catering, and Daiman Sri Skudai Sport Centre.

# 9.0 RESEARCH ACTIVITY

As research university, UTM fosters a culture of collaboration across disciplines and encourages research over a multitude of boundaries. In line with this policy, research in the Faculty of Chemical and Energy Engineering (FCEE) has become almost borderless due to the breadth covered by our technical backgrounds and the fact that much of research activities ventured by the dedicated and well experienced researchers residing our laboratories converge with those of many other fields.

In FCEE, research activities stretch along both macroscopic and microscopic frontiers of scale. Lecturers and students are actively involved in research activities. There are research centres and groups that have been established as follows:

- Institute of Bioproduct Development (IBD)
- Advanced Membrane Technology Research Centre (AMTEC)
- Centre of Hydrogen Energy (CHE)
- UTM-MPRC Institute for Oil and Gas
- Centre of Lipid Engineering and Applied Research (CLEAR)
- Process Systems Engineering Centre (PROSPECT)
- Chemical Reaction and Engineering Group (CREG)
- Advanced Material and Separation Technologies (AMSET)
- Sustainable Waste Management (SWAM)
- Process System Engineering Group (PSE)
- Green Technology Research Group
- Enhanced Polymer Research Group (ENPRO)
- Food and Biomaterial Engineering Research Group (FoBERG)
- Biopolymer Research Group
- BioMolecular and Microbial Process Research Group (BIOMIP)
- Drilling & Production Enhancement Research Group (DPEG)
- Reservoir Management Group (RMG)
- Energy Management Group (EMG)
- Membrane Technology Research Group (MTRG)
- Renewable Energy Research Group (RERG)

FCEE researchers have won numerous awards at university, national and international level such as Islamic Development Bank (IDB) Award, Top Research Scientist Malaysia (TRSM), Malaysia's Rising Star Award, ITEX, Inatex, UTM Research Award, UTM Publication Award.





CENTRE OF HYDROGEN ENERGY(CHE) Production, Storage, Utilization & Safety of Hydrogen Energy

# 10.0 FACILITY AND SUPPORT SYSTEM

### **10.1 FCEE FACILITIES**

FCEE is equipped with various facilities in order to provide conducive teaching and learning environment. Currently, FCEE has 33 laboratories, a workshop, a mini library and qualified staffs to assist in teaching, research, consultation, publications and various forms of services. The laboratories include teaching laboratories for students to learn the practical aspects in chemical processes, research and service laboratories for research and consultancy activities of this faculty. Softwares such as BASIC, FORTRAN, PASCAL, C-LANGUAGE, HYSIS, MATLAB, ASPEN PLUS, CHEMSHARE DESIGN II, SUPERPRO, PLASCAM, FLACS, ECLIPSE, PETREL, T-NAVIGATOR, PROSPER, MBAL, Cfast v.6, PV Elite, Cadwork and Extensive Commercial Software Specialized in Petroleum Engineering Modelling and Simulation are also available to fulfil learning and research needs.

### • Lecture Theatres, Halls, and Classrooms

FCEE has made continuous efforts to provide top class facilities for students. Each year, we raised the

quality of our lecture theatres, classrooms and laboratories and increased the number of general purposes infrastructures in FCEE for the convenience of FCEE community. We believed that by providing state-of-the-art facilities it (1) may attract good students i.e. (undergraduates and postgraduates) world wide to study in our faculty, (2) promote interactive and exciting teaching and learning activity and last but not least, (3) it would facilitate a relaxing and comfortable teaching and learning enviroment at FCEE. The faculty is a free WiFi zone: the lecture theatres, classrooms and laboratories are fully covered by WiFi.



#### Prayer Room

Prayer rooms are available for the convenience of Muslim students to perform prayer. Two prayer rooms for the male students are located in N01-280-01 and in N11a. Meanwhile, a prayer room in N01-342-01 is allocated for the female Muslim students.

# Faculty Mini Library

This is a mini library (resource centre) in the faculty, located at block N11a. It can accommodate 30 students at a time. This room is equipped with Internet and Audio Visual service for students. Reference materials, magazines and thesis from previous students, final year projects are also available. It is opened weekdays from 9.00 am until 4.00 pm.

#### **FCEE Laboratories**

#### **Basic Engineering Laboratories**

- Fluid Mechanics Laboratory
- Thermodynamic & Strength of Material Laboratory
- Computer Aided Design Laboratory
- Computer Laboratories
- Workshop
- Analytical Laboratory

#### **Chemical Engineering Laboratories**

- Pollution Control Laboratory
- Unit Operation I Laboratory



Unit Operation Lab

- Unit Operation II Laboratory
- Process Control Laboratory
- Chemical Reaction Engineering Laboratory

# **Bioprocess Engineering Laboratories**

- Applied Biology Laboratory
- Bioprocess Engineering Downstream Laboratory
- Genetic Engineering Laboratory
- Biotransformation Laboratory
- Tissue Culture Engineering Laboratory

# Gas Engineering Laboratory

- Combustion and System Laboratory
- Gas Laboratory
- Calibration System Laboratory
- Gas Testing and Utilization Laboratory
- Membrane Research Laboratory

# Petroleum Engineering Laboratories

- Geology Laboratory
- Reservoir Engineering Laboratory
- Drilling Engineering Laboratory
- Heavy Duty Laboratory
- Petroleum Testing/Analysis Laboratory
- Petroleum Engineering Modeling and Simulation Laboratory

# **Nuclear Engineering Laboratories**

- Nuclear Reactor Simulator Laboratory
- Eddy Current Laboratory
- Gamma-ray Spectroscopy Laboratory
- Nuclear Physics Laboratory
- Radiochemistry Laboratory
- Radon/Thoron Research Laboratory
- Ultrasonic Testing Laboratory

# **10.2 UTM FACILITIES**

# 10.2.1 Library

There are two main libraries in UTM;

**9** Perpustakaan Sultanah Zanariah (PSZ) The newly developed digital library system to support INFOLAN, the library's automated system is complemented with easy access to the electronic information. PSZ was awarded the MS ISO 9001:2008, Certification in 2010

Workshop

- **10** Perpustakaan Raja Zarith Sofia (PRZS)
  - PRZS is the newest branch of University Teknologi Malaysia (UTM) Library. It is a designated research library for the university.

# 10.2.2 Online Learning System (e-Learning)

Students can have access lecture notes, quizzes and assignments of all courses offered online. The elearning can also serves as platform for students to conduct educational forum or discussions with other students or interact with their lecturer after class. This e-learning website can be access via <u>http://elearning.utm.my/.</u>



Process Control Lab







# 10.2.3 Academic Information Management System

An academic information management system called AIMS2000 has been used for registration, course scheduling, management of students' course grades and record keeping of every student in UTM. The system can be assessed by students as well as academic staff via <a href="https://my.utm.my">https://my.utm.my</a>

#### 10.2.4 Student Support Facilities

#### (a) Hostel

There are 11 residential colleges in UTM Johor Bahru main campus to accommodate all undergraduate and postgraduates students. Among the facilities provided at each residential college are a cafeteria, a multipurpose hall, a Muslim prayer room, tennis courts, an internet and computer center, a convenient store and a common room besides other facilities in the students' rooms. During first year, since students are not allowed to have their own vehicle, all FCEE students are placed at Kolej Tun Hussein Onn (KTHO).

#### (b) Sport and Recreational Centres

UTM houses ten different recreational centers and gardens for the purpose of students and staff recreational and motivational outdoor activities. These include recreational forest, orchard and nursery, herbal garden, tropical garden, deer garden, equestrian center, golf driving range, children playground and camping area.

There are various sport facilities available at UTM. The indoor sports facilities include squash and badminton courts and a gymnasium, whilst the outdoor facilities include volleyball, netball, basketball and tennis courts, as well as full-sized fields for soccer, rugby and cricket. UTM has its own sport stadium and swimming pool. In addition, the university also provides a varied array of clubs and societies ranging from cultural to recreational to suit the varied interests of the students.

#### (c) Health Centre

The health center in UTM offers various services such as dental, outpatient, maternity and pediatric clinics. It also caters for emergency and haemodialysis treatments and radiology checkups. The health center is open from Monday to Saturday and closed on Sunday as well as public holidays.

#### (d) Student Centres

Student Centres are located at Student Union Building (SUB). All student societies have an office for their administration. All student activities are governed by the Office of Student Affairs and Alumni (HEMA).

#### (e) Centre for Student Innovation (CSI)

**UTM-CSI** is a centre to encourage the UTM students to think creative and innovative with the conducive facilities to plan any innovation activity. The centre is responsible to plan innovation projects for the university to produce the innovative generation. UTM-CSI also works as a *'one-stop-centre'* to generate creative and innovative ideas from the students on various field of study in UTM faculties to create and innovate a student innovation products.

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