

# BACHELOR OF ENGINEERING (CHEMICAL)

## PROGRAMME SPECIFICATIONS

The Bachelor of Engineering (Chemical) is offered either on a full-time or part-time basis. The full-time programme is offered only at the UTM Main Campus in Johor Bahru while the part-time programme is offered at various learning centres throughout Malaysia. The duration of study for the full-time programme is subjected to the student's entry qualifications and lasts between four (4) years to a maximum of six (6) years.

The programme is offered on full-time basis and is based on a 2-Semester per academic session. Generally, students are expected to undertake courses equivalent to between fifteen (15) to eighteen (18) credit hours per semester. Assessment is based on courseworks and final examinations given throughout the semester.

### General Information

1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Programme Name	Bachelor of Engineering (Chemical)			
4. Final Award	Bachelor of Engineering (Chemical) with Honours			
5. Programme Code	TK03			
6. Professional or Statutory Body of Accreditation	Board of Engineers Malaysia (BEM)			
7. Language(s) of Instruction	English and Bahasa Melayu			
8. Mode of Study	Conventional			
9. Mode of operation	Self-govern			
10. Study Scheme	Full Time			
11. Study Duration	Minimum : 4 years Maximum: 6 years			
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	8	-	14	-
Short	4	-	4	-

## Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses (a) General (b) Language (c) Entrepreneurship (d) Co-Curriculum	11 8 2 2	16.5%
ii.	Faculty/Programme Core	107	77.0%
iii.	Programme Electives	9	6.5%
	<b>Total</b>	<b>139</b>	<b>100%</b>
A	Engineering Courses (a) Lecture/Project/Laboratory (b) Workshop/Field/Design Studio (c) Industrial Training (d) Final Year Project	80 0 5 6	65.5%
<b>Total Credit Hours for Part A</b>		<b>91</b>	
B	Related Courses (a) Applied Science/Mathematic/Computer (b) Management/Law/Humanities/Ethics/Economy (c) Language (d) Co-Curriculum	17 21 8 2	34.5%
<b>Total Credit Hours for Part B</b>		<b>48</b>	
<b>Total Credit Hours for Part A and B</b>		<b>139</b>	<b>100%</b>
<b>Total Credit Hours to Graduate</b>		<b>139 credit hours</b>	

## Award Requirements

To graduate, students must:

- Attain a total of not less than 136 credit hours with a minimum CGPA of 2.0.
- Pass Industrial Training
- Complete all Professional Skills Certificate (PSC)
- Sit for Test of English Communication Skills (TECS) for graduating Students.
- Students from other approved programmes who wish to undertake a Minor in the programme must complete not less than 15 credit hours of specialized Chemical Engineering courses which form part of the core and/or electives of the programme, as listed in the minor programme list.

## Entry Requirements

The minimum qualifications for candidates who intend to do a Bachelor of Engineering (Chemical) are as follows:

- 1) Minimum results based on **the Malaysian High School Certificate (STPM)** (results would be based on the general requirements as well as other conditions as the pre-requisites for the programme set by the university).

### University General Requirements:

- i. Passed and obtained good results in the Malaysian Certificate Examination (SPM) or its equivalent.
- ii. Passed Bahasa Melayu/Bahasa Malaysia with credit in the SPM/ equivalent.
- iii. Passed the Malaysian High School Certificate (STPM) or its equivalent and obtained the following:
  - a) Grade C (NGMP 2.00) General paper, and
  - b) Grade C (NGMP 2.00) in two other subjects
- iv. Passed the Malaysian University English Test (MUET) with minimum result of Band 2.

### Special Requirements for the Programme

- i. Obtained a CGPA of 2.80; and Passed with a minimum Grade B- (NGMP 2.67) in two of the following subjects:
  - a) Mathematics T / Further Mathematics

- b) Physics/ Chemistry/ Biology
  - ii. Passed with a minimum Grade B at SPM/equivalent examination in the following subjects:
    - a) Mathematics
    - b) Physics
  - iii. Candidate who fulfill the requirements in Physics or Biology at STPM must obtained a minimum Grade B at SPM level in Chemistry.
  - iv. Passed the Malaysian University English Test (MUET) with minimum result of Band 2.
  - v. Not physically handicapped that can constrain practical work.
- 2) Minimum requirements for **Matriculation Certificates (KPM) / Asasi Sains UM/Asasi UiTM** (fulfil the general requirements set by the university as well as other conditions of the programme).

General University Requirements

- i. Passed the Malaysian Certificate Examination (SPM) with good results.
- ii. Passed in Bahasa Melayu/Bahasa Malaysia with credits in the SPM/equivalent examination.
- iii. Passed the Matriculation Certificate Examination (KPM) / Asasi Sains UM/ Asasi UiTM with a minimum CGPA of 2.00 and passed all the core subjects.
- iv. Passed the Malaysian University English Test (MUET) with minimum result of Band 2

Special Requirements of the Programme:

- i. Obtained a CGPA of 2.80; and Passed with a Grade B- (2.67) in two of the following subjects:
  - a) Mathematics
  - b) Chemistry/Engineering Chemistry/Physics/Engineering Physics/ Biology
- ii. Passed with a minimum Grade B at SPM/equivalent examination in the following subjects:
  - a) Mathematics
  - b) Physics
- iii. Candidate who fulfill the requirements in Physics or Biology at STPM must obtained a minimum Grade B at SPM level in Chemistry.

- iv. Passed the Malaysian University English Test (MUET) with minimum result of Band 2
- v. Not physically handicapped that can constrain practical work.

3) Minimum qualifications for students with **Certificates/Diplomas** (fulfill the general requirements set by the university as well as specific requirements of the programme).

General University Requirements

- i. Passed the Malaysian Certificate Examination (SPM) with good results.
- ii. Obtained a Diploma from UTM/equivalent

Special Requirements of the Programme:

- i. Obtained a Diploma in related field with minimum CGPA of 3.00 from UTM/equivalent; for candidates with a CGPA below 3.00 but have a minimum of two or more years of working experience in the related field of study will be eligible to apply for a place to study at the university.
- ii. Passed with credits at SPM level for the following subjects:

- a) Mathematics
- b) Physics

Or obtained a minimum grade C in any of the Mathematics and Physics Courses taken at the diploma level.

- iii. Passed the Malaysian University English Test (MUET) with minimum result of Band 2.
- iv. Not physically handicapped that can constrain practical work.

*Note :-*

Candidates are required to submit the results transcript of all their examinations taken during their Diploma study (semester one until the final semester) to UTM. A copy of the diploma or a letter of completion of study will also have to be submitted together with their applications.

Year of entry and duration of study will be based on the credit exemptions and credit transfer awarded by the university.

## **PROFESSIONAL SKILLS CERTIFICATE (PSC)**

Students are given a chance to enrol in certificate programmes offered by the Centres of Excellence in the University and the School of Professional and Continuing Education (SPACE) during semester breaks

1. How to Get Yourself Employed (HTGYE)
2. ISO 9001: 2008 Quality Management System Requirement (ISO)
3. Occupational Safety and Health Awareness (OSHA)
4. How to Manage Your Personal Finance (HTMYPF)
5. Test of English Communication Skills for Graduating Students (TECS):
  - (i) TECS 1001 (Paper I – Oral Interaction)
  - (ii) TECS 1002 (Paper II - Writing)

## **CROSS-CAMPUS PROGRAMME**

Students are given the opportunity to enrol in a few courses in participating universities. The grades and credits obtained during this period are transferable (up to 1/3 of the total credits of the curriculum). Currently, there are four participating universities i.e. Universiti Teknologi Malaysia, Universiti Sains Malaysia, Universiti Malaya and Universiti Malaysia Sarawak.

The programme is open to undergraduates who have undergone a minimum of two semesters of their studies with the following conditions:

- (i) The total number of credits allowed to be taken is between twelve (12) and sixteen (16) credits only.
- (ii) The student should hold a minimum CGPA of 3.00 at the time of application.
- (iii) The student is not a residence of or originated from the state where the university that he/she intends to attend is located.

The student will not be charged tuition fees by the participating university but shall pay the regular tuition fees at UTM. However should the participating university provide accommodation, the student will need to pay accommodation fees

## COURSE MENU

YEAR 1: SEMESTER 1			
Code	Course	Credit	Pre-requisite
SKTK 1511	Industrial Seminar & Profession	1	
SKTK 1523	Introduction to Engineering	3	
SKTK 1213	Statics @	3	
SKTK 1533	Introduction to Computer Programming	3	
SKTK 1111	Engineering Drawings	1	
SSCE 1693	Engineering Mathematics I@	3	
ULAB 1122	Academic English Skills	2	
	<b>TOTAL CREDIT</b>	<b>16</b>	
	<b>CUMULATIVE CREDITS</b>	<b>16</b>	

YEAR 1: SEMESTER 2			
Code	Course	Credit	Pre-requisite
SKTK 1123	Mass Balance* <sup>@</sup>	3	
SKTK 1223	Thermodynamics <sup>@</sup>	3	
SSCE 1993	Engineering Mathematics II <sup>@</sup>	3	
SSCK 1623	Organic Chemistry for Engineering	3	
SSCK 1831	Organic Chemistry Practical	1	
UICI 1012	Islamic and Asian Civilization (for Local Students)	2	
ULAM 1**2	Malay Language Communication 2 (for International Students)		
UHAK 1012	Graduate Success Attributes	2	
	<b>TOTAL CREDIT</b>	<b>17</b>	
	<b>CUMULATIVE CREDITS</b>	<b>33</b>	

YEAR 2: SEMESTER 1			
Code	Course	Credit	Pre-requisite
SSCE 1793	Differential Equations	3	
SKTK 2133	Energy Balance* <sup>@</sup>	3	SKTK 1123#
SKTK 2233	Fluid Mechanics	3	
SKTK 2243	Materials Engineering	3	
SKTK 2711	Thermodynamics and Material Eng. Laboratory	1	
ULAB 2122	Advanced Academic English Skills	2	
UHAK 1032	Introduction to Entrepreneurship	2	
	<b>TOTAL CREDIT</b>	<b>17</b>	
	<b>CUMULATIVE CREDITS</b>	<b>50</b>	

<b>YEAR 2: SEMESTER 2</b>			
<b>Code</b>	<b>Course</b>	<b>Credit</b>	<b>Pre-requisite</b>
SSCK 1203	Analytical Chemistry for Engineering	3	
SSCK 1891	Analytical Chemistry Practical	1	
SKTK 2253	Chemical Engineering Thermodynamics	3	SKTK 1223
SKTK 2313	Transport Processes*	3	SKTK 2133#
SKTK 2721	Fluid Mechanics Laboratory	1	
SKTK 2543	Numerical Method & Optimization*	3	SKTK 1533
UHAS1172	Dinamika Malaysia (for Local Students)	2	
UHAK1022	Malaysia Studies 3 (for International Students)		
	<b>TOTAL CREDIT</b>	<b>18</b>	
	<b>CUMULATIVE CREDITS</b>	<b>68</b>	

<b>YEAR 3: SEMESTER 1</b>			
<b>Code</b>	<b>Course</b>	<b>Credit</b>	<b>Pre-requisite</b>
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	
SKEU 2003	Electrical Technology	3	
	<b>TOTAL CREDIT</b>	<b>18</b>	
	<b>CUMULATIVE CREDITS</b>	<b>86</b>	

<b>YEAR 3: SEMESTER 2</b>			
<b>Code</b>	<b>Course</b>	<b>Credit</b>	<b>Pre-requisite</b>
SKTK 3564	Process Control & Instrumentation*	4	SSCE 1793# SKTK 3323 SKTK 3263
SKTK 3334	Unit Operation & Industrial Processes	4	SKTK 2313#
SKTK 3741	Separation Processes Laboratory I	1	SKTK 3323
SKTK 3812	Undergraduate Project I**	2	
SKTK 3343	Engineering Economics and Project Management	3	
ULAB 3162	English for Professional Purposes	2	
ULA* 1112	Foreign Language Elective	2	
	<b>TOTAL CREDIT</b>	<b>18</b>	
	<b>CUMULATIVE CREDITS</b>	<b>104</b>	

<b>YEAR 3: SEMESTER 3</b>			
<b>Code</b>	<b>Course</b>	<b>Credit</b>	<b>Pre-requisite</b>
SKTK 3915	Industrial Training	5	
	<b>TOTAL CREDIT</b>	<b>5</b>	
	<b>CUMULATIVE CREDITS</b>	<b>109</b>	



YEAR 4: SEMESTER 1			
Code	Course	Credit	Pre-requisite
SKTK 4143	Chemical Product Design	3	
SKTK 4751	Process Control Laboratory	1	SKTK 3564
UICL 2302	The Thought of Science and Technology	2	
SKTK 4761	Separation Processes Laboratory II	1	SKTK 3323
SKTK 4153	Plant Design*	3	SKTK 3564
SKTK 4824	Undergraduate Project II**	4	SKTK 3812#
UHAK 2**2	Soft Skills Elective	2	
UKQ 3001	Extracurricular Experiential Learning (ExCEL)	1	
	<b>TOTAL CREDIT</b>	<b>17</b>	
	<b>CUMULATIVE CREDITS</b>	<b>126</b>	

YEAR 4: SEMESTER 2			
Code	Course	Credit	Pre-requisite
SKTK 4573	Process Safety & Operability	3	
SKTK 4834	Plant Design Project**	4	SKTK 4153
SKTK 4**3	Elective 2	3	
SKTK 4**3	Elective 3	3	
	<b>TOTAL CREDIT</b>	<b>13</b>	
	<b>CUMULATIVE CREDITS</b>	<b>139</b>	

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

### Elective Courses-Streaming (Choose ONE Stream only)

Apart from the core course, student must also take 9 credits of elective course. Students are advised to choose one stream and take 3 course from the same stream.

#### 1. Energy Management

- SKTK 4113 Sustainable Energy Management
- SKTK 4123 Thermal Energy Management
- SKTK 4133 Energy Planning for Sustainable Development

#### 2. Advanced Materials

- SKTK 4213 Polymer Composites
- SKTK 4223 Smart Materials
- SKTK 4233 Biomaterials

#### 3. Oil and Gas

- SKTK 4313 Introduction to Oil & Gas Industry
- SKTK 4323 Refinery & Petrochemical Technology
- SKTK 4333 Gas Transportation and Storage

4. Environment
  - SKTK 4413 Waste Management
  - SKTK 4423 Environmental Management
  - SKTK 4433 Environmental Sustainability
  
5. Occupational Safety and Health
  - SKTK 4513 OSH Legislations and Management
  - SKTK 4523 Industrial Hygiene
  - SKTK 4533 Human Factors in Process Industry
  
6. Polymer Science and Technology
  - SKTK 4613 Fundamentals of Polymer
  - SKTK 4623 Polymer Physics and Properties
  - SKTK 4633 Polymer Rheology and Processing
  
7. Bioprocess Engineering
  - SKTK 4643 Downstream Bioprocessing
  - SKTK 4653 Pharma and Nutraceutical Engineering
  - SKTK 4663 Food Process Engineering

### Courses for Minor Programme in Chemical Engineering

Code	Course	Credit	Pre-requisite
SKTK 1123	Mass Balance	3	
SKTK 2133	Energy Balance	3	SKTK 1123
SKTK 3323	Separation Processes	3	SKTK 2133
SKTK 3263	Chemical Reaction Engineering	3	SKTK 2133
SKTK 4573	Process Safety & Operability	3	
	<b>Total Credits For Minor</b>	<b>15</b>	

### GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the courses are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
<b>CHEMICAL ENGINEERING COURSES</b>					
1	SKTK 1111	Engineering Drawing	1	1	
2	SKTK 1213	Statics	3	3	
3	SKTK 1511	Industrial Seminar & Profession	1	1	

4	SKTK 1523	Introduction to Engineering	3	3	
5	SKTK 1533	Introduction to Computer Programming	3	3	
6	SKTK 1123	Mass Balance	3	3	
7	SKTK 1223	Thermodynamics	3	3	
8	SKTK 2133	Energy Balance	3	3	
9	SKTK 2233	Fluid Mechanics	3	3	
10	SKTK 2243	Material Engineering	3	3	
11	SKTK 2711	Thermodynamics and Material Eng. Laboratory	1	1	
12	SKTK 2253	Chemical Engineering Thermodynamics	3	3	
13	SKTK 2313	Transport Processes	3	3	
14	SKTK 2721	Fluid Mechanics Laboratory	1	1	
15	SKTK 2543	Numerical Method & Optimization	3	3	
16	SKEU 2003	Electrical Technology	3	3	
17	SKTK 3263	Chemical Reaction Engineering	3	3	
18	SKTK 3323	Separation Processes	3	3	
19	SKTK 3413	Pollution Control Engineering	3	3	
20	SKTK 3731	Pollution Control and Reaction Laboratory	1	1	
21	SKTK 3552	Occupational Safety and Health in Industry	2	2	
22	SKTK 3334	Unit Operation & Industrial Processes	4	4	
23	SKTK 3343	Engineering Economics and Project Management	3	3	
24	SKTK 3564	Process Control & Instrumentation	4	4	
25	SKTK 3741	Separation Process Laboratory I	1	1	
26	SKTK 3812	Undergraduate Project I	2	2	
27	SKTK 3915	Industrial Training	5	HL	
28	SKTK 4143	Chemical Product Design	3	3	
29	SKTK 4153	Plant Design	3	3	
30	SKTK 4751	Process Control Laboratory	1	1	
31	SKTK 4761	Separation Processes Laboratory II	1	1	
32	SKTK 4824	Undergraduate Project II	4	4	
33	SKTK 4573	Process Safety & Operability	3	3	
34	SKTK 4834	Plant Design Project	4	4	
35	SKTK 4**3	Elective 1	3	3	
36	SKTK 4**3	Elective 2	3	3	
37	SKTK 4**3	Elective 3	3	3	
		TOTAL CREDIT OF CHEMICAL ENGINEERING COURSES (a)	99	94	
<b>MATHEMATICS AND SCIENCE COURSES (Faculty of Science)</b>					
1	SSCE 1693	Engineering Mathematics I	3	3	
2	SSCE 1793	Differential Equations	3	3	
3	SSCE 1993	Engineering Mathematics II	3	3	
4	SSCK 1623	Organic Chemistry for Engineering	3	3	
5	SSCK 1831	Organic Chemistry Practical	1	1	
6	SSCK 1203	Analytical Chemistry for Engineering	3	3	
7	SSCK 1891	Analytical Chemistry Practical	1	1	

		TOTAL CREDIT OF MATHEMATICS & SCIENCE COURSES (b)	17	17	
<b>UNIVERSITY GENERAL COURSES</b>					
<b>Cluster 1: Appreciation of Philosophy, Value &amp; History (Faculty of Social Sciences and Humanities)</b>					
1	UHAS 1172	Dinamika Malaysia (for Local Students)	2	2	
	UHAK 1022	Malaysia Studies 3 (for International Students)			
2	UICI 1012	Islamic and Asian Civilization (for Local Students)	2	2	
	ULAM 1**2	Malay Language 2 (for International Students)			
<b>Cluster 2: Generic Skills</b>					
1	UHAK 1012	Graduate Success Attributes	2	2	
2	UHAK 1032	Introduction to Entrepreneurship	2	2	
3	UHAK 2**2	Soft Skills Elective	2	2	
<b>Cluster 3: Expansion of Knowledge</b>					
1	UICL 2302	The Thought of Science and Technology	2	2	
<b>Cluster 4: Co-Curriculum and Service Learning</b>					
1	UKQ *2**2	Co-Curriculum & Service Learning	2	2	
2	UKQ 3001	Extracurricular Experiential Learning (ExCEL)	1	1	
<b>Cluster 5: Language Skill (Language Academy, Faculty of Social Sciences and Humanities)</b>					
1	ULAB 1122	Academic English Skills	2	2	
2	ULAB 2122	Advanced Academic English Skills	2	2	
3	ULAB 3162	English for Professional Purposes	2	2	
4	ULA* 1112	Elective of Foreign Language	2	2	
		<b>TOTAL CREDIT of UNIVERSITY GENERAL COURSES (c)</b>	<b>23</b>	<b>23</b>	
		<b>TOTAL CREDIT TO GRADUATE (a + b + c)</b>	<b>139</b>	<b>134</b>	
<b>OTHER COMPULSORY COURSES</b>					
<b>Professional Skills Certificate (PSC) (UTMSPACE/ School)</b>					
1	GLL 1001	How to Get Your Self Employed			
2	GLL 1029	ISO 9001:2008 Quality Management System Requirement			
3	GLL 1040	Occupational Safety, Health and Environment			
4	GLL 1041	How to Manage Your Personal Finance			
<b>Test of English Communication Skill (TECS) (Language Academy, Faculty of Social Sciences and Humanities)</b>					
1	TECS 1001	Oral Interaction			
2	TECS 1002	Writing			

## **COURSE SYNOPSIS**

### **CORE 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 plant-wide 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 ever-increasing 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.