

# BACHELOR OF ENGINEERING (CHEMICAL-BIOPROCESS)

## PROGRAMME SPECIFICATIONS

The Bachelor of Engineering (Chemical-Bioprocess) is offered on a full-time basis. The full-time programme is offered only at the UTM Main Campus in Johor Bahru. 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.  
skills.

## General Information

1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Programme Name	Bachelor of Engineering (Chemical-Bioprocess)			
4. Final Award	Bachelor of Engineering (Chemical-Bioprocess) with Honours			
5. Programme Code	TK29			
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	-	8	-

## Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses (a) General (b) Language (c) Co-Curriculum	13 8 2	16.2%
ii.	School Core	65	45.8%
iii.	Programme Core	48	33.8%
iv.	Programme Electives	6	4.2%
	<b>Total</b>	<b>142</b>	<b>100%</b>
A	Engineering Courses (a) Lecture (b) Laboratory/Workshop (c) Industrial Training (d) Final Year Project	71 7 5 10	65.5%
<b>Total Credit Hours for Part A</b>		<b>93</b>	
B	Related Courses (a) Applied Science/Mathematic/Computer (b) Management/Law/Humanities/Ethics/Economy (c) Co-Curriculum (d) Others	26 12 2 9	34.5%
<b>Total Credit Hours for Part B</b>		<b>49</b>	
<b>Total Credit Hours for Part A and B</b>		<b>142</b>	<b>100%</b>
<b>Total Credit Hours to Graduate</b>		<b>142 credit hours</b>	

## PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

After having exposed to 3 to 5 years working experience, our graduates should become professionals who demonstrate the following competencies:

Code	Intended Educational Objectives
PEO1	Perform competently in chemical/ petroleum/ bioprocess/ gas/ nuclear Industries and become important contributors to national development.
PEO2	Become creative, innovative and adaptable engineers as leaders or team members in their organizations and society.
PEO3	Contribute professionally towards the environmental well-being and sustainable development

## PROGRAMME LEARNING OUTCOMES (PLO)

After having completed the programme, graduates should be able to demonstrate the following competencies

Code	Intended Learning Outcomes
PLO1 (KW)	Ability to apply knowledge of mathematics, natural science, engineering fundamentals, chemical/petroleum/bioprocess/gas/nuclear engineering principles to the solution of complex engineering problems.
PLO2 (THPA)	Ability to identify, formulate, conduct research literature, and analyze complex chemical/ petroleum/ bioprocess/ gas/ nuclear engineering problems using first principles of mathematics and engineering sciences.
PLO3 (THDS)	Ability to design solution for complex chemical/ petroleum/ bioprocess/gas/nuclear engineering problems and design system or process to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
PLO4 (THI)	Ability to conduct investigation of complex chemical/ petroleum/ bioprocess/ gas/ nuclear 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.

PLO5 (SCMT)	Ability to inculcate modern computational techniques and tools complex chemical/ petroleum/ bioprocess/ gas/ nuclear which include prediction and modeling to solve complex engineering problem with an understanding of the limitations.
PLO6 (AD)	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.
PLO7 (GCS)	Ability to explain and evaluate the sustainability and impact of professional engineering work in the solution of complex chemical/ petroleum/ bioprocess/ gas/ nuclear engineering problems in societal and environmental contexts.
PLO8 (GCE)	Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO9 (CS)	Ability to communicate effectively through written and oral modes to all levels of society
PLO10 (TW)	Ability to work independently, and as a member or a leader in a team to manage project in multi-disciplinary environment.
PLO11 (SC)	Ability to acquire knowledge and engage in independent and life-long learning.
PLO12 (ES)	Ability demonstrate knowledge of engineering management principles and entrepreneurial mindset to manage projects in multi-disciplinary environments.

Note: KW = Engineering Knowledge; THPA = Thinking Skills-Problem Analysis; THDS= Thinking Skills Design/Development of Solution; THI =Thinking Skills-Investigation; SCMT= Scholarship Modern Tool Usage; AD = Global Citizen Adaptability; GCS = Global Citizen Sustainability; GCE = Global Citizen Ethics; CS = Communicating Skills; TW = Leadership and Team Working; SC = Life Long Learning; ES = Enterprising Skills.

## Award Requirements

To graduate, students must:

- Attain a total of not less than 142 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.

## Entry Requirements

The minimum qualifications for candidates who intend to do a Bachelor of Engineering (Chemical-Bioprocess) 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
SKTB 1011	Industrial Career & Seminar	1	
SKTB 1021	Engineering Drawing	1	
SKTB 1023	Introduction to Chemical & Bioprocess Engineering	3	
SKTB 1123	Statics & Biomaterial <sup>@</sup>	3	
SKEU 2003	Electrical Technology	3	
SSCE 1693	Engineering Mathematics I <sup>@</sup>	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
SKTB 1113	Mass Balance* <sup>@</sup>	3	
SKTB 1133	Microbiology	3	
SKTB 1721	Bioprocess Engineering Laboratory : Upstream	1	
SSCE 1993	Engineering Mathematics II <sup>@</sup>	3	SSCE 1693
SSCK 1603	Organic Chemistry: Functional Group	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)		
UKQ ***2	Co-curriculum Service Learning	2	
	<b>TOTAL CREDIT</b>	<b>18</b>	
	<b>CUMULATIVE CREDITS</b>	<b>34</b>	

YEAR 2: SEMESTER 1			
Code	Course	Credit	Pre-requisite
SKTB 2113	Introduction to Programming	3	
SKTB 2123	Energy Balance* <sup>@</sup>	3	SKTB 1113#
SKTB 2033	Thermodynamics <sup>@</sup>	3	
SKTB 2043	Fluid Mechanics	3	
SKTB 2721	Fluid Mechanics Laboratory	1	
SSCE 1793	Differential Equations	3	SSCE 1693
ULAB 2122	Advanced Academic English Skills	2	
	<b>TOTAL CREDIT</b>	<b>18</b>	
	<b>CUMULATIVE CREDITS</b>	<b>52</b>	

YEAR 2: SEMESTER 2			
Code	Course	Credit	Pre-requisite
SKTB 2133	Chemical Engineering Computation	3	
SKTB 2213	Chemical Engineering Thermodynamics	3	SKTB 2033
SKTB 2313	Transport Processes*	3	SKTB 2123#
SKTB 2711	Thermodynamics and Material Eng. Laboratory	1	SKTB 2033
SSCK 1203	Analytical Chemistry for Engineering	3	
SSCK 1891	Analytical Chemistry Practical	1	
ULAB 3162	English for Professional Purposes	2	
	<b>TOTAL CREDIT</b>	<b>16</b>	
	<b>CUMULATIVE CREDITS</b>	<b>68</b>	

YEAR 3: SEMESTER 1			
Code	Course	Credit	Pre-requisite
SKTB 3213	Biochemistry	3	
SKTB 3123	Molecular Biology & Genetic Engineering	3	
SKTB 3223	Chemical Reaction Engineering	3	
SKTB 3323	Separation Processes*	3	SKTB 2313#
SKTB 3413	Environmental Eng. and Sustainability	3	
SKTB 3721	Pollution Control and Reaction Laboratory	1	
UHAK 2**2	Soft Skills Elective	2	
	<b>TOTAL CREDIT</b>	<b>18</b>	
	<b>CUMULATIVE CREDITS</b>	<b>86</b>	

YEAR 3: SEMESTER 2			
Code	Course	Credit	Pre-requisite
SKTB 3113	Bioseparation Technology	3	
SKTB 3133	Bioreactor Design & Analysis	3	
SKTB 3143	Process Control*	3	SSCE 1793#, SKTB 3323
SKTB 3173	Engineering Economics and Project Management	3	
SKTB 3812	Undergraduate Project I**	2	
SKTB 3731	Separation Processes Laboratory	1	SKTB 3323
SKTB 3741	Bioprocess Engineering Laboratory : Downstream	1	
ULA* 1112	Foreign Language Elective	2	
	<b>TOTAL CREDIT</b>	<b>18</b>	
	<b>CUMULATIVE CREDITS</b>	<b>104</b>	

YEAR 3: SEMESTER 3			
Code	Course	Credit	Pre-requisite
SKTB 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
SKTB 4741	Process Control Laboratory	1	
SKTB 4814	Undergraduate Project II**	4	SKTB 3212#
SKTB 4153	Plant Design*	3	SKTB 3143
SKTB 4163	Safety and Health in Chemical & BioIndustry	3	
SKTB 4**3	Bioprocess Courses Elective 1	3	
UICL 2302	The Thought of Science and Technology	2	
UKQ 3001	Extracurricular Experiential Learning (ExCEL)	1	
	<b>TOTAL CREDIT</b>	<b>17</b>	
	<b>CUMULATIVE CREDITS</b>	<b>136</b>	

YEAR 4: SEMESTER 2			
Code	Course	Credit	Pre-requisite
SKTB 4824	Plant Design Project**	4	SKTB 4153, SKTB 4163
SKTB 4133	Quality Management in BioManufacturing	3	
SKTB 4**3	Bioprocess Courses Elective 2	3	
UHAK 1032	Introduction to Entrepreneurship	2	
UHAS 1172	Dinamika Malaysia (for Local Students)	2	
UHAK 1022	Malaysia Studies 3 (for International Students)		
UHAK 1012	Graduate Success Attributes	2	
	<b>TOTAL CREDIT</b>	<b>16</b>	
	<b>CUMULATIVE CREDITS</b>	<b>142</b>	

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

## 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

## 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-BIOPROCESS ENGINEERING COURSES</b>					
1	SKTB 1011	Industrial Career & Seminar	1	1	
2	SKTB 1021	Engineering Drawing	1	1	
3	SKTB 1023	Introduction to Chemical & Bioprocess Engineering	3	3	
4	SKTB 1123	Statics & Biomaterial	3	3	
5	SKTB 1721	Bioprocess Engineering Laboratory : Upstream	1	1	
6	SKTB 1133	Microbiology	3	3	
7	SKTB 1113	Mass Balance	3	3	
8	SKTB 2113	Introduction to Programming	3	3	
9	SKTB 2123	Energy Balance	3	3	
10	SKTB 2043	Fluid Mechanics	3	3	
11	SKTB 2721	Fluid Mechanics Laboratory	1	1	
12	SKTB 2033	Thermodynamics	3	3	
13	SKTB 2133	Chemical Engineering Computation	3	3	
14	SKTB 2213	Chemical Engineering Thermodynamics	3	3	
15	SKTB 2313	Transport Processes	3	3	
16	SKTB 2711	Thermodynamics and Material Eng. Laboratory	1	1	
17	SKTB 3213	Biochemistry	3	3	
18	SKTB 3123	Molecular Biology & Genetic	3	3	

		Engineering			
19	SKTB 3223	Chemical Reaction Engineering	3	3	
20	SKTB 3323	Separation Processes	3	3	
21	SKTB 3413	Environmental Eng. and Sustainability	3	3	
22	SKTB 3721	Pollution Control and Reaction Laboratory	1	1	
23	SKTB 3113	Bioseparation Technology	3	3	
24	SKTB 3133	Bioreactor Design & Analysis	3	3	
25	SKTB 3812	Undergraduate Project I	2	2	
26	SKTB 3731	Separation Processes Laboratory	1	1	
27	SKTB 3143	Process Control	3	3	
28	SKTB 3741	Bioprocess Engineering Laboratory : Downstream	1	1	
29	SKTB 3173	Engineering Economics and Project Management	3	3	
30	SKTB 3915	Industrial Training (YEAR 3/SHORT SEM.) for 12 weeks/3 months	5	HL	
31	SKTB 4741	Process Control Laboratory	1	1	
32	SKTB 4814	Undergraduate Project II	4	4	
33	SKTB 4153	Plant Design	3	3	
34	SKTB 4163	Safety and Health in Chemical & BioIndustry	3	3	
35	SKTB 4824	Plant Design Project	4	4	
36	SKTB 4133	Quality Management in BioManufacturing	3	3	
37	SKTB 4**3	Bioprocess Courses Elective 1	3	3	
38	SKTB 4**3	Bioprocess Courses Elective 2	3	3	
		<b>TOTAL CREDIT OF CHEMICAL-BIOPROCESS ENGINEERING COURSES (a)</b>	<b>99</b>	<b>94</b>	
<b>APPLIED SCIENCE/ MATHEMATICS COURSES (Faculty of Science)</b>					
1	SSCE 1693	Engineering Mathematics I	3	3	
2	SSCE 1993	Engineering Mathematics II	3	3	
3	SSCE 1793	Differential Equations	3	3	
4	SKEU 2003	Electrical Technology	3	3	
5	SSCK 1603	Organic Chemistry: Functional Group	3	3	
6	SSCK 1831	Organic Chemistry Practical	1	1	
7	SSCK 1203	Analytical Chemistry for Engineering	3	3	
8	SSCK 1891	Analytical Chemistry Practical	1	1	
		<b>TOTAL CREDIT OF APPLIED SCIENCE/ MATHEMATICS COURSES (b)</b>	<b>20</b>	<b>20</b>	

<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 Communication 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* 1122	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>142</b>	<b>137</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**

#### **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 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 1721 Bioprocess Engineering Laboratory : Upstream**

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 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 (passed)***

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 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 submerged 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, centrifugal 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 (passed)***

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 (passed)***

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 3731 Separation Processes Laboratory**

#### ***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 3741 Bioprocess Engineering Laboratory : Downstream**

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 (passed), 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 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 rationale 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 (passed)***

Students are required to do research project where they are required to collect data from the apparatus in laboratory and pilot plant under the supervision 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 & BioIndustry (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.

## **ELECTIVE COURSES**

### **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.

### **SKTB 4243 Biopharmaceutical Manufacturing**

This course describes the application of biotechnology procedures in the field of Pharmacy. It emphasizes on consolidating the fundamental understanding in biotechnology and phytochemical processing involved in the development and production of pharmaceutical products. The technologies covered in the course are methods to enhance the production, bioavailability and safety of biopharmaceutical products or services. Element of businesses driven through biopharmaceutical discoveries and understanding of specific quality issues in compliance with regulatory requirements throughout the clinical development and post-approval processes are exposed to students.