

BACHELOR OF ENGINEERING (CHEMICAL-GAS)

PROGRAMME SPECIFICATIONS

The Bachelor of Engineering (Chemical-Gas) is offered on a full-time basis. The 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.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Programme Name	Bachelor of Engineering (Chemical-Gas)			
4. Final Award	Bachelor of Engineering (Chemical-Gas) with Honours			
5. Programme Code	TK30			
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) Entrepreneurship (d) Co-Curriculum	10 8 2 3	16.7%
ii.	Faculty/ Programme Core	106	76.8%
iii.	Programme Elective	9	6.5%
	Total	138	100%
A	Engineering Courses (a) Lectures (b) Laboratory/ Workshop (c) Industrial Training (d) Final Year Project (e) Integrated Design Project	75 7 5 6 4	70.3%
Total Credit Hours for Part A		97	
B	Related Courses (a) Applied Science/Mathematics/ Computer (b) Management/ Law/ Humanities / Ethics (c) Language (d) Co-Curriculum	18 12 8 3	29.7%
Total Credit Hours for Part B		41	
Total Credit Hours for Part A and B		138	100%
Total Credit Hours to Graduate		138 credit hours	

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 138 credit hours with a minimum CGPA of 2.00.
- Pass Industrial Training.
- Complete all Professional Skill Courses.
- 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-Gas) 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

- i. Candidate who fulfill the requirements in Physics or Biology at STPM must obtained a minimum Grade B at SPM level in Chemistry.
- ii. Passed the Malaysian University English Test (MUET) with minimum result of Band 2.
- iii. Does not possess severe colour blindness or 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. Does not possess severe colour blindness or not physically

handicapped that can constrain practical work.

3) Minimum qualifications for students with **Certificates/Diplomas**

There is no acceptance to the programme based on this qualification.

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
SKEU 2003	Electrical Technology	3	
SKTG 1233	Introduction to Chemical and Gas Engineering	3	
SKTG 1313	Mechanics of Engineering	3	
SKTG 1323	Engineering Drawing	3	
SSCE 1693	Engineering Mathematics I	3	
ULAB 1122	Academic English Skills	2	
	TOTAL CREDIT	17	
	CUMULATIVE CREDITS	17	

YEAR 1: SEMESTER 2			
Code	Course	Credit	Pre-requisite
SCSJ 1013	Programming Technique I	3	
SKTG 1333	Thermodynamics	3	
SKTG 1413	Mass Balance	3	
SSCE 1993	Engineering Mathematics II	3	
UICI 1012	Islamic and Asia Civilization (for Local Students)	2	
ULAM 1012	Malay Language Communication 2 (for International Students)		
UHAS 1172	Dinamika Malaysia (for Local Students)	2	
UHAK 1022	Malaysia Studies 3 (for International Students)		
	TOTAL CREDIT	16	
	CUMULATIVE CREDITS	33	

YEAR 2: SEMESTER 1			
Code	Course	Credit	Pre-requisite
SKTG 2343	Fluid Mechanics	3	
SKTG 2353	Introduction to Organic and Analytical Chemistry for Engineers	3	
SKTG 2423	Energy Balance	3	SKTG 1413
SSCE 1793	Differential Equations	3	
UHAK 1012	Graduate Success Attributes	2	
ULAB 2122	Advanced Academic English Skills	2	
	TOTAL CREDIT	16	
	CUMULATIVE CREDITS	49	

YEAR 2: SEMESTER 2			
Code	Course	Credit	Pre-requisite
SKTG 2133	Combustion Engineering and Gas Utilisation	3	
SKTG 2363	Material Engineering	3	SKTG 1313
SKTG 2433	Chemical Engineering Thermodynamics	3	SKTG 1333 SKTG 2423
SKTG 2443	Transport Processes	3	SKTG 2423
SKTG 2741	Fluid Mechanics Laboratory	1	SKTG 2343
UICL 2302	The Thought of Science and Technology	2	
UKQ* 2**2	Co-Curriculum Service Learning	2	
	TOTAL CREDIT	17	
	CUMULATIVE CREDITS	66	

YEAR 3: SEMESTER 1			
Code	Course	Credit	Pre-requisite
SKTG 3123	Gas Processing and Liquefaction	3	
SKTG 3373	Environmental Engineering and Sustainability	3	
SKTG 3453	Chemical Engineering Computation	3	SSCE 1693 SSCE 1993
SKTG 3463	Chemical Reaction Engineering	3	SKTG 2423
SKTG 3473	Separation Process	3	SKTG 2443
SKTG 3751	Thermodynamics and Material Engineering Laboratory	1	SKTG 2363 SKTG 1333
UKQ 3001	Extracurricular Experiential Learning (ExCEL)	1	
	TOTAL CREDIT	17	
	CUMULATIVE CREDITS	83	

YEAR 3: SEMESTER 2			
Code	Course	Credit	Pre-requisite
SKTG 3213	Gas Transmission and Distribution	3	SKTG 2343
SKTG 3383	Safety and Health in Petrochemical Industry	3	
SKTG 3483	Process Control and Instrumentation	3	SSCE 1793 SKTG 3473
SKTG 3721	Combustion Engineering and Gas Utilisation Laboratory	1	SKTG 2133
SKTG 3731	Separation Process Laboratory	1	SKTG 3473
SKTG 3812	Undergraduate Project I	2	
ULAB 3162	English for Professional Purpose	2	
ULA* 1112	Foreign Language Elective	2	
	TOTAL CREDIT	17	
	CUMULATIVE CREDITS	100	

YEAR 3: SEMESTER 3			
Code	Course	Credit	Pre-requisite
SKTG 3915	Industrial Training	5	
	TOTAL CREDIT	5	
	CUMULATIVE CREDITS	105	

YEAR 4: SEMESTER 1			
Code	Course	Credit	Pre-requisite
SKTG 4223	Gas Storage and Reticulation System	3	SKTG 3213
SKTG 4393	Engineering Economics and Project Management	3	
SKTG 4493	Plant Design	3	SKTG 3473
SKTG 4711	Gas Flow System Laboratory	1	SKTG 3213
SKTG 4761	Pollution Control and Reaction Laboratory	1	SKTG 3463 SKTG 3373
SKTG 4771	Process Control Laboratory	1	SKTG 3483
SKTG 4824	Undergraduate Project II	4	SKTG 3812
UHAK 2152	Energy Security (Soft Skill Elective)	2	
	TOTAL CREDIT	18	
	CUMULATIVE CREDITS	123	

YEAR 4: SEMESTER 2			
Code	Course	Credit	Pre-requisite
SKTG 4611	Gas Engineering Seminar	HW	
SKTG 4834	Plant Design Project	4	SKTG 3383 SKTG 4493
SKTG 4**3	Gas Engineering Elective I	3	
SKTG 4**3	Gas Engineering Elective II	3	
SKTG 4**3	Gas Engineering Elective III	3	
UHAK 1032	Introduction to Entrepreneurship	2	
	TOTAL CREDIT	15	
	CUMULATIVE CREDITS	138	

Elective Courses

1. Energy

- SKTG 4113 Carbon Capture and Sequestration
- SKTG 4143 Energy Management and Economics
- SKTG 4153 Energy Conversion Technology
- SKTG 4163 Green Energy Technology
- SKTG 4243 Non-Conventional Oil and Gas Exploitation

2. Gas

- SKTG 4173 Membrane Based Gas Separation Technology
- SKTG 4253 Gas Production Engineering
- SKTG 4263 Fire and Explosion Safety
- SKTG 4273 Gas Operation and Maintenance
- SKTG 4283 Corrosion 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
CHEMICAL-GAS ENGINEERING COURSES					
1	SKTG 1233	Introduction to Chemical and Gas Engineering	3	3	
2	SKTG 1313	Mechanics of Engineering	3	3	
3	SKTG 1323	Engineering Drawing	3	3	
4	SKTG 1333	Thermodynamics	3	3	
5	SKTG 1413	Mass Balance	3	3	
6	SKTG 2133	Combustion Engineering and Gas Utilisation	3	3	
7	SKTG 2343	Fluid Mechanics	3	3	
8	SKTG 2363	Material Engineering	3	3	
9	SKTG 2423	Energy Balance	3	3	
10	SKTG 2433	Chemical Engineering Thermodynamics	3	3	
11	SKTG 2443	Transport Processes	3	3	
12	SKTG 2741	Fluid Mechanics Laboratory	1	1	
13	SKTG 3123	Gas Processing and Liquefaction	3	3	
14	SKTG 3213	Gas Transmission and Distribution	3	3	
15	SKTG 3373	Environmental Engineering and Sustainability	3	3	
16	SKTG 3383	Safety and Health in Petrochemical Industry	3	3	
17	SKTG 3453	Chemical Engineering Computation	3	3	
18	SKTG 3463	Chemical Reaction Engineering	3	3	
19	SKTG 3473	Separation Process	3	3	
20	SKTG 3483	Process Control and Instrumentation	3	3	
21	SKTG 3721	Combustion Engineering and Gas Utilisation Laboratory	1	1	
22	SKTG 3731	Separation Process Laboratory	1	1	
23	SKTG 3751	Thermodynamics and Material Engineering Laboratory	1	1	
24	SKTG 3812	Undergraduate Project I	2	2	
25	SKTG 3915	Industrial Training	5	HL	
26	SKTG 4223	Gas Storage and Reticulation System	3	3	
27	SKTG 4393	Engineering Economics and Project Management	3	3	
28	SKTG 4493	Plant Design	3	3	

29	SKTG 4611	Gas Engineering Seminar	1	HL	
30	SKTG 4711	Gas Flow System Laboratory	1	1	
31	SKTG 4761	Pollution Control and Reaction Laboratory	1	1	
32	SKTG 4771	Process Control Laboratory	1	1	
33	SKTG 4824	Undergraduate Project II	4	4	
34	SKTG 4834	Plant Design Project	4	4	
35	SKTG 4**3	Gas Engineering Elective I	3	3	
36	SKTG 4**3	Gas Engineering Elective II	3	3	
37	SKTG 4**3	Gas Engineering Elective III	3	3	
		TOTAL CREDIT OF CHEMICAL-GAS ENGINEERING COURSES (a)	97	92	

**MATHEMATICS/ SCIENCE/ TECHNOLOGY COURSES
(Faculty of Science/ Faculty of Engineering)**

1	SCSJ 1013	Programming Technique I	3	3	
2	SKEU 2003	Electrical Technology	3	3	
3	SKTG 2353	Introduction to Organic and Analytical Chemistry for Engineers	3	3	
4	SSCE 1693	Engineering Mathematics I	3	3	
5	SSCE 1793	Differential Equations	3	3	
6	SSCE 1993	Engineering Mathematics II	3	3	
		TOTAL CREDIT OF MATHEMATICS/ SCIENCE/ TECHNOLOGY COURSES (b)	18	18	

UNIVERSITY GENERAL COURSES

**Cluster 1: Appreciation of Philosophy, Value & History
(Faculty of Social Sciences and Humanities)**

1	UHAS 1172	Dinamika Malaysia (Local Students)	2	2	
	UHAK 1022	Malaysia Studies 3 (for International Students)			
2	UICI 1012	Islamic and Asian Civilisation (for Local Students)	2	2	
	ULAM 1012	Malay Language Communication 2 (for International Students)			

Cluster 2: Generic Skills

1	UHAK 1012	Graduate Success Attribute	2	2	
2	UHAK 2152	Energy Security (Elective)	2	2	

Cluster 3: Expansion of Knowledge

1	UICL 2302	The Thought of Science and Technology	2	2	
---	-----------	---------------------------------------	---	---	--

Cluster 4: Co-Curriculum and Service Learning

1	UKQ* 2**2	Co-Curriculum	2	2	
2	UKQ 3001	Extracurricular Experiential Learning (ExCEL)	1	1	

**Cluster 5: Language Skill
(Language Academy, Faculty of Social Sciences and Humanities)**

1	ULAB 1122	Academic English Skills	2	2	
2	ULAB 2122	Advanced English Academic Skills	2	2	

3	ULAB 3162	English for Professional Purposes	2	2	
4	ULA* 1112	Foreign Language Elective	2	2	
Cluster 6: Entrepreneurship					
1	UHAK 1032	Introduction to Entrepreneurship	2	2	
		TOTAL CREDIT of UNIVERSITY GENERAL COURSES (c)	23	23	
		TOTAL CREDIT TO GRADUATE (a + b + c)	138	133	
OTHER COMPULSORY COURSES					
Professional Skills Certificate (PSC) (UTMSPACE/ School)					
1	GLL 1001	How to Get Your Self Employed			
2	GLL 1029	ISO 9001:2008 Quality Management System Requirement (ISO)			
3	GLL 1040	Occupational Safety and Health Awareness (OSHA)			
4	GLL 1041	How to Manage Your Personal Finance (HTMYPF)			
Test of English Communication Skill (TECS) (Language Academy, Faculty of Social Sciences and Humanities)					
1	TECS 1001	Oral Interaction			
2	TECS 1002	Writing			

COURSE SYNOPSIS

CORE 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 deal 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. Besides lectures, the course has tutorial classes.

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. Besides lectures, the course has tutorial classes.

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. Besides lectures, the course has tutorial classes.

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 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 2363 Material Engineering

Pre-requisite: SKTG 1313 Mechanics of Engineering (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 2423 Energy Balance

Pre-requisite: SKTG 1413 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. Besides lectures, the course has tutorial classes.

SKTG 2433 Chemical Engineering Thermodynamics

Pre-requisites: SKTG 1333 Thermodynamics (pass with at least D+)

SKTG 2423 Energy Balance (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 Energy Balance (taken)

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

SKTG 2741 Fluid Mechanics Laboratory

Pre-requisite: SKTG 2343 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.

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 3213 Gas Transmission and Distribution

Pre-requisite: SKTG 2343 Fluid Mechanics (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 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 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 3453 Chemical Engineering Computation

Pre-requisites: SSCE 1693 Engineering Mathematics I (taken)

SSCE 1993 Engineering Mathematics II (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 3463 Chemical Reaction Engineering

Pre-requisite: SKTG 2423 Energy Balance (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-requisite: SKTG 2443 Transport Processes (pass with at least D+)

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

SKTG 3483 Process Control and Instrumentation

Pre-requisites: SSCE 1793 Differential Equations (taken)

SKTG 3473 Separation Process (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 plant-wide control systems design are taught qualitatively. This course employs Active Learning (AL).

SKTG 3721 Combustion Engineering and Gas Utilisation Laboratory

Pre-requisite: SKTG 2133 Combustion Engineering and Gas Utilisation (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-requisite: SKTG 3473 Separation Process (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 3751 Thermodynamics and Material Engineering Laboratory

Pre-requisites: SKTG 1333 Thermodynamics (taken)

SKTG 2363 Material Engineering (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 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 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 School's supervisor and Industrial's supervisor.

SKTG 4223 Gas Storage and Reticulation System

Pre-requisite: SKTG 3213 Gas Transmission and Distribution (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 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 4493 Plant Design

Pre-requisite: SKTG 3473 Separation Process (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 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 4711 Gas Flow System Laboratory

Pre-requisite: SKTG 3213 Gas Transmission and Distribution (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 4761 Pollution Control and Reaction Laboratory

Pre-requisites: SKTG 3373 Environmental Engineering and Sustainability (taken)

SKTG 3463 Chemical Reaction Engineering (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-requisite: SKTG 3483 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.

SKTG 4824 Undergraduate Project II

Pre-requisite: SKTG 3812 Undergraduate Project I (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 4834 Plant Design Project

Pre-requisites: SKTG 3383 Safety and Health in Petrochemical Industry (taken)

SKTG 4493 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, 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 4113 Carbon Capture and Sequestration

This course enables students to examine CO₂ separation and capture technologies and also monitoring and verification. It provides 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 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 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.

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 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.

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 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 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 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 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 protection. Different types of corrosion, methods of corrosion protection and prevention standard 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.