UNIVERSITI MALAYA

FAKULTI KEJURUTERAAN
Faculty of Engineering

PROGRAM GUIDEBOOK

SESSION 2024/2025

Bachelor of Chemical Engineering

DEPARTMENT OF CHEMICAL ENGINEERING

TABLE OF CONTENTS

UNIVERSITI MALAYA

Vision, Mission, Core Values, Tagline

VISION

A global university impacting the world.

MISSION

Pushing the boundaries of knowledge and nurturing aspiring leaders.

CORE VALUES

TAGLINE

Home of the Bright, Land of the Brave

Di Sini Bermulanya Pintar, Tanah Tumpahnya Berani

INTRODUCTION TO FACULTY OF ENGINEERING

> *"The profession in which a knowledge of the mathematical or natural sciences gained by study, experience and practice is applied with judgement to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind."*

Accreditation Board for Engineering and Technology
(FORMERLY The Engineers' Council for Professional Development (ECPD))

Engineering is not simply an academic field that deals with technology, statistics, and science. It is an exciting and rewarding discipline that has a much wider scope, ranging from basic science to applied technology. Engineers make a significant difference in the lives of millions of people. Through identifying problems and seeking new solutions, they create and design items that benefit the lives of everyone, from cars, computers, and buildings, through to life saving equipment, the generation of energy and medical procedures. Engineering is not about what the world is, it is about what the world can be.

i-LEAD

Innovative engineer with exceptional **L**eadership, **E**thical, **A**daptive and **D**ynamic values

Innovative

Innovative engineers possess the ability to use approaches, processes, resources, behave ours and mindsets of innovation culture using knowledge and expertise in emerging technologies.

Leadership

Effective leadership influences others to effectively collaborate to implement transformative change and innovation. It requires personal effectiveness and the ability to synthesize diverse expertise and skillsets to inspire people to engage with the organization's vision.

Ethical

Ethics in engineering practices is directed by respect for ethical beliefs and values, and for the dignity and rights of others. It promotes good practices through mutual respect and trust, integrity, honesty, accountability, transparency, equality and fairness.

Adaptive

Adaptive engineers embrace change, experimentation and innovation. They leverage on the creativity of an entire organization to adapt and thrive in a multitude and myriad of evolving environments.

Dynamic

Dynamic engineers are influencers, that understand the importance of inspiring others and achieving success through teamwork. They have the ability to properly analyze situations and take deliberate, calculated risks to move the team forward.

MESSAGES FROM DEAN

PROFESSOR IR. DR. NIK NAZRI BIN NIK GHAZALI

As we launch into another dynamic academic year at Universiti Malaya's Faculty of Engineering, I want to extend my warmest welcome to each of you. This is a time of great potential, where your creativity and determination can lead to groundbreaking advancements. The engineering field is rapidly evolving, and with it comes the responsibility to approach challenges with innovative solutions and a commitment to sustainability. I encourage you to explore the intersections of technology, ethics, and community engagement in your work. Let's harness this opportunity to not only advance your skills but also to become responsible engineers who contribute positively to society.

Moreover, I want to emphasize the value of collaboration and inclusivity in our faculty. Every voice matter, and the diversity of our community enriches our collective experience. I urge you to participate actively in campus life—join clubs, engage in workshops, and seek opportunities for interdisciplinary projects. Together, we can create a supportive environment where everyone feels empowered to share their ideas and pursue their passions. As we move forward, let's commit to uplifting one another, fostering innovation, and making the most of the resources available to us. I am excited to see the extraordinary contributions each of you will make to faculty and beyond.

THE MANAGEMENT

Prof. Ir. Dr. Nik Nazri Nik Ghazali
Dean

Assoc. Prof. Dr. Raja Ariffin Raja Ghazilla
Deputy Dean (Undergraduate)

Assoc. Prof. Ir. Dr. Ong Zhi Chao
Deputy Dean (Postgraduate)

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Deputy Dean (Research)

Dr. Mohd Usman Mohd Junaidi
Deputy Dean (Student Affairs)

Assoc. Prof. Ir. Dr. Nasrul Anuar Abd Razak
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MESSAGES FROM HEAD OF DEPARTMENT

DR. HANEE FARZANA BINTI HIZADDIN

Dear Students,

Welcome to the Department of Chemical Engineering! You are about to embark on a transformative journey in one of the most versatile and impactful fields of engineering. Our Chemical Engineering program is designed to equip you with a deep understanding of chemical processes, energy solutions, sustainable practices, and the innovation required to solve real-world challenges. From process design and optimization to environmental protection and renewable energy, chemical engineers play a crucial role in shaping industries that drive global progress.

Throughout your studies, you will be exposed to cutting-edge technologies, industry-relevant projects, and hands-on laboratory experiences. Our curriculum is tailored to help you build critical problem-solving skills and to prepare you for the diverse career paths chemical engineers can pursue—whether in oil & gas, biochemicals, green technology, or even entrepreneurship.

As you begin this exciting chapter, I encourage you to stay curious, ask questions, and take full advantage of the support and resources available. This is your opportunity to make a difference, not just in your career, but for society and the environment.

We are excited to see what you will accomplish!

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General complaints	https://helpdesk.um.edu.my/
Academic programmes, entry requirements, applications	study@um.edu.my
Scholarships	bptajaan_aasd@um.edu.my
Visa	Kindly submit application to: Faculty: https://shorturl.at/5EdMR Central: bpvisa_aasd@um.edu.my
Student Confirmation Letter – Active Students	Kindly submit application to Faculty: https://shorturl.at/jxEOe
Problem with MAYA system	Kindly lodge your enquiry/complaint via https://helpdesk.um.edu.my/
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Industry-academia collaborations	industry@um.edu.my
Visit requests by student groups	Schools & local universities: study@um.edu.my International universities: study@um.edu.my
Rental of spaces in UM	Make your booking at https://umpoint.um.edu.my/

STUDENT AFFAIRS

Introduction

Deputy Dean (Student Affairs) Office Faculty of Engineering, Universiti Malaya, is dedicated to supporting the holistic development and well-being of the students. The office oversees various aspects of student life, providing essential services that enhance the student experience, including student welfare, competition, student associations, co-curricular activities, competition, exchange program, professional development opportunities/ upskilling program and scholarship information. We strive to ensure that every student receives the necessary resources and support throughout their academic journey.

Team

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Core Functions

Student Welfare

Our office is committed to student welfare, providing a range of services to address financial aid, counselling, and other support systems.

Co-Curricular Activities

In addition to academic excellence, we believe in the importance of well-rounded personal development. Our office provides resources and opportunities for students to participate in various co-curricular activities, enhancing university experience and preparing for a balanced professional life.

Competitions and Student Clubs

We actively support student participation in engineering competitions, both locally and internationally, to foster innovation and practical learning. Our office also encourages students to join and lead engineering clubs and societies, promoting leadership, teamwork, and co-curricular involvement.

Exchange Programs

We facilitate student exchange programs with universities worldwide, offering our students the opportunity to gain international exposure, broaden their perspectives, and enhance their learning experience in diverse academic and cultural settings.

Upskilling Programs

To ensure our students are equipped for the evolving demands of the engineering industry, we offer a range of upskilling programs, workshops, and training sessions. These initiatives focus on developing critical skills such as leadership, communication, and technical expertise to prepare students for future careers.

Scholarship Opportunities

The Deputy Dean's Office provides information and guidance on various scholarships available to our students. These scholarships aim to support academic excellence and alleviate financial burdens, allowing students to focus on their studies and professional development.

For any inquiries, feel free to reach out to us at fk_tdhep@um.edu.my.
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RULES AND REGULATIONS

All students are required to follow **Universiti Malaya (Bachelor's Degree) Rules & Regulations 2024**, which include key aspects such as registration, payment, duration of study, structure of programme of study, examination, appeal and graduation. For more detailed information on the university regulations, please meet your Programme Coordinator and/or visit:

https://engine.um.edu.my/um-wow-2024-2025#

ACADEMIC CALENDAR

SEMESTER I				
Orientation Week		29.09.2024	-	06.10.2024
Lectures	7 weeks*	07.10.2024	-	24.11.2024
Mid-Semester I Break	1 week	25.11.2024	-	01.12.2024
Lectures	7 weeks*	02.12.2024	-	19.01.2025
Revision Week	1 week*	20.01.2025	-	26.01.2025
Semester I Final Examination	3 weeks*	27.01.2025	-	16.02.2025
Semester I Break	4 weeks	17.02.2025	-	16.03.2025
	23 weeks			
SEMESTER II				
Lectures	7 weeks*	17.03.2025	-	04.05.2025
Mid-Semester II Break	1 week	05.05.2025	-	11.05.2025
Lectures	7 weeks*	12.05.2025	-	29.06.2025
Revision Week	1 week*	30.06.2025	-	06.07.2025
Semester II Final Examination	3 weeks*	07.07.2025	-	27.07.2025
Semester II Break	4 weeks	28.07.2025	-	24.08.2025
	23 weeks			
SPECIAL SEMESTER				
Lectures	7 weeks*	28.07.2025	-	14.09.2025
Special Semester Final Examination	1 week*	15.09.2025	-	21.09.2025
Break	1 week	22.09.2025	-	28.09.2025
	9 weeks			

Note:
(*) The Academic Calendar has taken into account public and festive holidays and is subject to change:

Deepavali	01 November 2024 (Friday)
Christmas Day	25 December 2024 (Wednesday)
New Year	01 January 2025 (Wednesday)
Chinese New Year	29 & 30 January 2025 (Wednesday & Thursday)
Federal Territory Day	01 February 2025 (Saturday)
Thaipusam	11 February 2025 (Tuesday)
Nuzul Al-Quran	17 March 2025 (Monday)
Eidul Fitri	31 March & 01 April 2025 (Monday & Tuesday)
Wesak Day	12 May 2025 (Monday)
His Majesty's King's Birthday	02 June 2025 (Monday)
Eidul Adha	06 June 2025 (Friday)
Awal Muharam	27 June 2025 (Friday)

BACHELOR OF CHEMICAL ENGINEERING

Introduction

The Department of Chemical Engineering has its roots in the Chemical Technology course which was established in the Department of Chemistry in 1965. The first intake of students was in 1967 and the first group of graduates emerged in 1971. In 1975 the course in Chemical Technology was renamed Chemical Engineering and was placed under the wings of the Faculty of Engineering, University of Malaya.

The Department runs an eight semesters (4 years) undergraduate programme in Chemical Engineering. The curriculum leading to the degree of Bachelor of Engineering (Chemical) is designed to provide a proper balance between the fundamental aspects of Chemical Engineering and applications to the operation, design, and analysis of engineering systems.

Programme Synopsis

The Department of Chemical Engineering, University of Malaya is the first chemical engineering department in Malaysia. The Chemical Engineering Programme in the University of Malaya is designed to provide a broad-based chemical engineering curriculum encompassing fundamentals and applications as well as development of soft skills and life-long learning attributes to prepare graduates to solve current and future global challenges. The Chemical Engineering Programme curriculum is divided into three major groups of courses: University courses, Faculty courses and Departmental courses.

University courses are intended to contribute to the general education of the students. In addition, the University courses also provide education in entrepreneurship, information and communication skills, and professional ethics. The faculty courses provide the students with basic understanding of engineering science principles, and mathematics. These courses also include communication skills, economics, ethics, and law related to engineering profession.

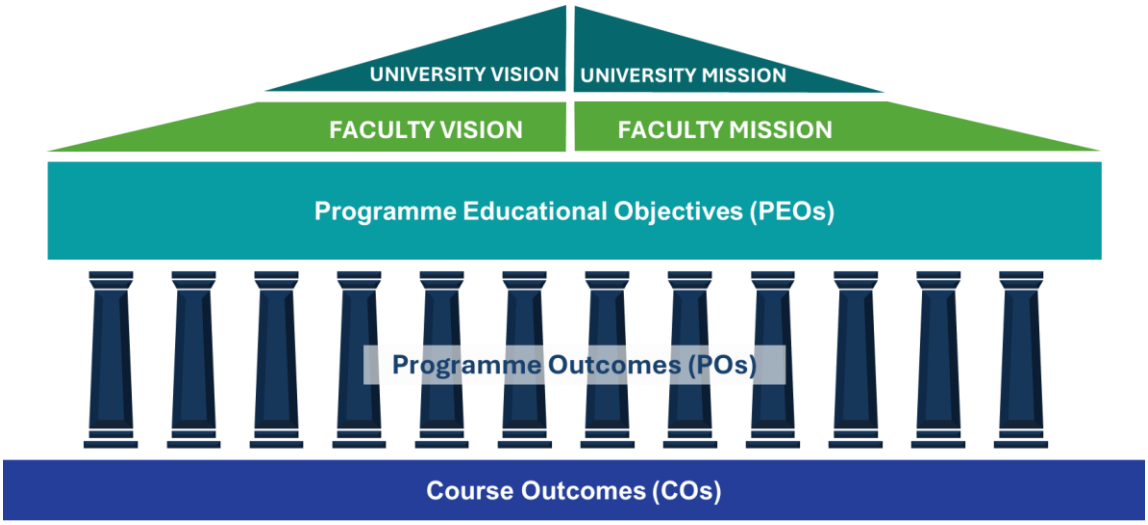
The Department courses provide the students with essential elements of core chemical engineering enhanced with advanced chemical engineering elements through final year electives. Furthermore, the curriculum provides adequate exposure to laboratory work and professional engineering practice. A minimum of four (4) years or eight (8) semesters including one special semester is required to complete a full-time study of the Chemical Engineering Programme.

There is a variety of teaching-learning (delivery) modes of lectures, project work, design projects, research projects, experiments, seminars, fieldwork, and practical training, that encourages innovation and creativity among students. The curriculum structure requires a minimum of 143 credits to graduate, with an average of 18 to 22 credit hours in a semester. The programme also requires an Industrial Training attachment of 10 weeks, which enables students to gain first-hand exposure to the industry and to have an insight on how theories are put to practice in real situations. To expand students' experience beyond the classroom, the programme also requires the students to undergo several industrial visits and attend research and industrial talk given by the industries. Graduates who have completed the course of study successfully will be awarded with the degree Bachelor of Chemical Engineering which is accredited by the Engineering Accreditation Council (EAC) in Malaysia and the Institution of Chemical Engineers (IChemE) based in the United Kingdom..

Outcome-Based Education (OBE)

Outcome-Based Education (OBE) had been implemented in the Faculty of Engineering since 2004, in accordance with the directives of the Ministry of Higher Education Malaysia and the Board of Engineers Malaysia (BEM). This is also one of the requirements for Malaysia to become a full member of the Washington Accord (WA), an international agreement to mutually recognize Bachelor degrees in the field of engineering.

OBE is an internationally practised educational model that focuses on the measurement of student outcomes and the implementation of corrective measures to overcome deficiencies in course delivery methods/assessment/student attitude, etc. Curriculum is designed with specific course outcomes (COs) to prepare the graduates to achieve the graduate attributes/programme outcomes (POs) at the point of graduation. The POs are designed to produce graduates who are well-prepared to achieve the programme educational objectives (PEOs) 3 - 5 years after they have graduated. The PEOs and POs had been formulated in consultation with all major stakeholders (employers, alumni and students), to meet the demands of a challenging and globalized workplace.



PROGRAMME STRUCTURE

BACHELOR OF CHEMICAL ENGINEERING

Courses	Content	Credit Hours
University Courses	GIG1012: Philosophy and Current Issues* / GLT1049: *Bahasa Melayu Komunikasi***	2
	GIG1013: Appreciation of Ethics and Civilization	2
	GIG1003: Basic Entrepreneurship Enculturation	2
	GLTXXXX: English Communication Programme ‡	4
	University Elective Courses (Student Holistic Empowerment)	8
	Co-Curriculum	2
Sub-total Credit Hours		**20**
Faculty Courses	Faculty Core Courses	12
Sub-total Credit Hours		**12**
Department Courses	Department Core Courses	101
	Department Elective Courses	10
Sub-total Credit Hours		**111**
TOTAL CREDIT HOURS		**143**

* Compulsory for local students.
** Compulsory for international students.
‡ Students are required to complete the courses based on their English Proficiency qualification (MUET/IELTS/TOEFL), as stipulated in the respective PATH on page 30.

ACADEMIC PLANNER

INTAKE SESSION 2024/2025

YEAR 1						
CODE	**COURSE**	**S1**	**S2**	**SS**	**TOTAL CREDIT**	**PRE-REQUISITE**
UNIVERSITY COURSES						
GIG1012 / GLT1049	Philosophy And Current Issues* / *Bahasa Melayu Komunikasi***	2				
GLTXXXX	English Communication I	2				
GIG1013	Appreciation of Ethics and Civilisations		2			
Sub-total Credit Hours		**4**	**2**		**6**	
UNIVERSITY ELECTIVE COURSES (STUDENT HOLISTIC EMPOWERMENT)						
Cluster 1 GBXXXXX	Thinking Matters: Mind and Intellect	2				
Cluster 2 GDXXXXX	Emotional, Physical and Spiritual Intelligence: Heart, Body & Soul					
Cluster 3 GFXXXXX	Technology/Artificial Intelligence and Data Analytics: I-Techie					
Cluster 4 GQXXXXX	Global Issues and Community Sustainability: Making The World A Better Place					
Sub-total Credit Hours		**2**			**2**	
FACULTY COURSES						
KIX1001	Engineering Mathematics 1	3				
KIX1002	Engineering Mathematics 2		3			
Sub-total Credit Hours		**3**	**3**		**6**	
DEPARTMENT CORE COURSES						
KIL1002	Chemical Process Principles I	3				
KIL1004	Engineering Drawing	2				
KIL1010	Physical And Analytical Chemistry	3				
KIL1001	Chemical Engineering Thermodynamics I		3			
KIL1005	Numerical Methods for Engineering		3			
KIL1006	Fluid Mechanics I		3			
KIL1009	Physical And Analytical Chemistry Laboratory		2			
KIL3001	Basic Material Science for Chemical Engineering		3			
Sub-total Credit Hours		**8**	**14**		**22**	
TOTAL CREDIT HOURS		**17**	**19**		**36**	

* Compulsory for local students.
** Compulsory for international students.

YEAR 2						
CODE	**COURSE**	**S1**	**S2**	**SS**	**TOTAL CREDIT**	**PRE-REQUISITE**
UNIVERSITY COURSES						
GLTXXXX	English Communication II	2				
GIG1003	Basic Entrepreneurship Enculturation	2				
Sub-total Credit Hours		**4**			**4**	
UNIVERSITY ELECTIVE COURSES (STUDENT HOLISTIC EMPOWERMENT)						
Cluster 1 GBXXXXX	Thinking Matters: Mind and Intellect		2			
Cluster 2 GDXXXXX	Emotional, Physical and Spiritual Intelligence: Heart, Body & Soul					
Cluster 3 GFXXXXX	Technology/Artificial Intelligence and Data Analytics: I-Techie					
Cluster 4 GQXXXXX	Global Issues and Community Sustainability: Making The World A Better Place					
Sub-total Credit Hours			**2**		**2**	
FACULTY COURSES						
KIX2006	Engineering Economics and Project Management		3			
Sub-total Credit Hours			**3**		**3**	
DEPARTMENT CORE COURSES						
KIL2001	Chemical Process Principles II	2				KIL1002
KIL2002	Organic Chemistry	2				
KIL2005	Chemical Engineering Thermodynamics II	3				KIL1001
KIL2006	Heat Transfer	3				
KIL2007	Mass Transfer	2				
KIL2012	Chemical Engineering Computing	2				
KIL2004	Laboratory And Communications I		2			
KIL2008	Separation Processes I		3			
KIL2009	Reaction Engineering I		3			
KIL2010	Biochemistry		3			
KIL2011	Applied Statistics for Engineering		3			
Sub-total Credit Hours		**14**	**14**		**28**	
TOTAL CREDIT HOURS		**18**	**19**		**37**	

YEAR 3						
CODE	**COURSE**	**S1**	**S2**	**SS**	**TOTAL CREDIT**	**PRE-REQUISITE**
FACULTY COURSES						
KIX2005	Law, Ethics and Sustainability for Engineers	3				
Sub-total Credit Hours		**3**			**3**	
DEPARTMENT CORE COURSES						
KIL3002	Fluid Mechanics II	2				KIL1006
KIL3003	Modelling Of Chemical Processes	2				KIL1005
KIL3006	Process Synthesis and Simulation	3				
KIL3007	Separation Processes II	3				
KIL3009	Laboratory And Communication II	2				
KIL3013	Integrated Design Exercise	2				
KIL3004	Process Control		3			
KIL3005	Particle Technology		3			
KIL3008	Process Safety and Loss Prevention		3			
KIL3011	Reaction Engineering II		2			KIL2009
KIL3014	Integrated Design		3			
KIL3015	Design Of Process Equipment		3			
KIL3010	Industrial Training			5		
Sub-total Credit Hours		**14**	**17**	**5**	**36**	
TOTAL CREDIT HOURS		**17**	**17**	**5**	**39**	

YEAR 4						
CODE	**COURSE**	**S1**	**S2**	**SS**	**TOTAL CREDIT**	**PRE-REQUISITE**
UNIVERSITY COURSES						
GKXXXXX	Co-Curriculum		2			
Sub-total Credit Hours			**2**		**2**	
UNIVERSITY ELECTIVE COURSES (STUDENT HOLISTIC EMPOWERMENT)						
Cluster 1 GBXXXXX	Thinking Matters: Mind and Intellect	2	2			
Cluster 2 GDXXXXX	Emotional, Physical and Spiritual Intelligence: Heart, Body & Soul					
Cluster 3 GFXXXXX	Technology/Artificial Intelligence and Data Analytics: I-Techie					
Cluster 4 GQXXXXX	Global Issues and Community Sustainability: Making The World A Better Place					
Sub-total Credit Hours		**2**	**2**		**4**	
DEPARTMENT CORE COURSES						
KIL4002	Design Project	3	3			KIL3014
KIL4003	Research Project	3	3			KIL3009
KIL4018	Sustainable Development in Engineering	3				
Sub-total Credit Hours			**2**		**2**	
DEPARTMENT ELECTIVE COURSES						
KIL4XXX	ELECTIVE COURSE I	2				
KIL4XXX	ELECTIVE COURSE II	2				
KIL4XXX	ELECTIVE COURSE III	2				
KIL4XXX	ELECTIVE COURSE IV		2			
KIL4XXX	ELECTIVE COURSE V		2			
Sub-total Credit Hours		**6**	**4**		**10**	
TOTAL CREDIT HOURS		**17**	**14**		**31**	

DEPARTMENT ELECTIVE COURSES

TYPE	CODE	COURSE NAME	CREDIT HOURS	PRE-REQUISITE
GENERAL	KIL4004	AIR POLLUTION FUNDAMENTAL	2	
	KIL4007	SOLID WASTE MANAGEMENT	2	
	KIL4008	WASTE WATER TREATMENT	2	
	KIL4010	PETROLEUM ENGINEERING	2	
	KIL4013	MEMBRANE TECHNOLOGY AND PROCESSES	2	
	KIL4022	NANOTECHNOLOGY FOR ENERGY CONVERSION AND STORAGE	2	
	KIL4023	TECHNOLOGY, GLOBALIZATION AND SUSTAINABLE DEVELOPMENT	2	KIL4018
	KIL4025	CURRENT TECHNOLOGIES IN OLEOCHEMICALS INDUSTRY	2	KIL2008
	KIL4027	NATURAL GAS ENGINEERING	2	
ADVANCE	KIL4005	PROCESS INTEGRATION	2	
	KIL4006	ADVANCED PROCESS CONTROL	2	KIL3004
	KIL4009	ADSORPTION IN POROUS SOLID	2	
	KIL4011	ADVANCED PROCESS SAFETY AND LOSS PREVENTION	2	KIL3008
	KIL4016	REACTION ENGINEERING FOR BIOREACTORS	2	KIL2010
	KIL4019	ADVANCED FLUIDIZATION ENGINEERING	2	KIL3005
	KIL4020	ADVANCED FUNCTIONAL MATERIALS	2	KIL3001
	KIL4021	CHEMICAL DECOMPOSITION PROCESSES	2	KIL2009
	KIL4024	OPTIMAL CONTROL	2	KIL3004
	KIL4026	MATERIALS CHARACTERIZATION	2	

UNIVERSITY COURSES

The list of university courses offered for each semester could be found through the following link:

https://citra.um.edu.my/list-of-university-courses

A. Student Holistic Empowerment (SHE)

The Student Holistic Empowerment (SHE) courses are categorized into four () clusters:

Cluster 1

Thinking Matters: Mind and Intellect

Cluster 2

Emotional, Physical and Spiritual Intelligence: Heart, Body & Soul

Cluster 3

Technology/Artificial Intelligence and Data Analytics: i-Techie

Cluster 4

Global Issues and Community Sustainability: Making the World a Better Place

All students are required to register one (1) course from each cluster.

B. Co-curricular Courses

The list of co-curricular courses available is as follows:

CODE	COURSE
GKA1001	Attach@Industry
GKI1001	Independent Research
GKK1001	Community Services
GKP1001	Talent Development
GKS1001	Volunteerism
GKU1001	Entrepreneurship

PATH FOR ENGLISH COMMUNICATION PROGRAMME

ENGLISH COMMUNICATION PROGRAMME (UNIVERSITY COURSE) LIST OF COURSES TO BE COMPLETED BY ALL STUDENTS			
PATH 1	**PATH 2**	**PATH 3**	**PATH 4**
• **MUET BAND 2** • **IELTS Band 4.0** • **TOEFL Paper – Based Test (437 – 473)** • **TOEFL Computer – Based Test (123 – 150)** • **TOEFL Internet – Based Test (41 – 52)** • **PTE (Academic) – (10 – 28)**	• **MUET BAND 3** • **IELTS Band 4.5 – 5.0** • **TOEFL Paper – Based Test (477 – 510)** • **TOEFL Computer – Based Test (153 – 180)** • **TOEFL Internet – Based Test (53 – 64)** • **PTE (Academic) – (29 - 41)**	• **MUET BAND 4** • **IELTS Band 5.5 – 6.0** • **TOEFL Paper – Based Test (513 – 547)** • **TOEFL Computer – Based Test (183 – 210)** • **TOEFL Internet – Based Test (65-78)** • **PTE (Academic) – (42 – 57)** • **FCE (B & C)** • **GCE A Level (English) (Minimum C)** • **IGCSE/GCSE (English) (A, B & C)**	• **MUET BAND 5 & BAND 6** • **IELTS Band 6.5 – 9.0** • **TOEFL Paper – Based Test (550 – 677)** • **TOEFL Computer – Based Test (213 – 300)** • **TOEFL Internet – Based Test (79 – 120)** • **PTE (Academic) (58 – 90)** • **FCE (A)** • **GCE A Level (English) (B & A)**
Students need to complete 2 courses (2 courses x 2 credits each) from this PATH	Students need to complete 2 courses (2 courses x 2 credits each) from this PATH	Students need to complete 2 courses (2 courses x 2 credits each) from this PATH	Students need to complete 2 courses (2 courses x 2 credits each) from this PATH
COMPULSORY GLT1018 – Proficiency in English I	**COMPULSORY** GLT1021 – Proficiency in English II	**COMPULSORY** GLT1024 – Proficiency in English III	**CHOOSE TWO:** • GLT1027 – Advanced Oral Communication* • GLT1028 – Advanced Business Writing* • Alternative courses - Foreign Language *Students can only register for one course per semester
** **CHOOSE ONE**: • GLT1019 – Let's Speak • GLT1020 – Fundamental Writing	** **CHOOSE ONE**: • GLT1022 – Speak Up • GLT1023 – Effective Workplace Writing	** **CHOOSE ONE**: • GLT1025 – Effective Oral Communication • GLT1026 – Writing at the Workplace	

** These courses have prerequisites and students can only register for them after obtaining a PASS in the compulsory course as stipulated in the respective PATH.

LIST OF FOREIGN LANGUAGE COURSES

Alternative Courses for Path 4

No.	Course Code	Course Name	Credit Hours
1	GLT1029	Bahasa Arab Asas 1 / *Basic Arabic Language 1*	2
2	GLT1030	Bahasa Arab Asas 2 / *Basic Arabic Language 2*	2
3	GLT1031	Bahasa Jepun Asas 1 / *Basic Japanese Language 1*	2
4	GLT1032	Bahasa Jepun Asas 2 / *Basic Japanese Language 2*	2
5	GLT1033	Bahasa Korea Asas 1 / *Basic Korean Language 1*	2
6	GLT1034	Bahasa Korea Asas 2 / *Basic Korean Language 2*	2
7	GLT1035	Bahasa Parsi Asas / *Basic Persian Language*	2
8	GLT1036	Bahasa Portugis Asas 1 / *Basic Portuguese Language 1*	2
9	GLT1037	Bahasa Portugis Asas 2 / *Basic Portuguese Language 2*	2
10	GLT1038	Bahasa Rusia Asas 1 / *Basic Russian Language 1*	2
11	GLT1039	Bahasa Rusia Asas 2 / *Basic Russian Language 2*	2
12	GLT1040	Bahasa Sepanyol Asas 1 / *Basic Spanish Language 1*	2
13	GLT1041	Bahasa Sepanyol Asas 2 / *Basic Spanish Language 2*	2
14	GLT1042	Bahasa Thai Asas 1 / *Basic Thai Language 1*	2
15	GLT1043	Bahasa Thai Asas 2 / *Basic Thai Language 2*	2
16	GLT1044	Bahasa Turki Asas / *Basic Turkish Language*	2

COURSE INFORMATION

University Courses

GIG1012: Falsafah dan Isu Semasa / *Philosophy and Current Issues*

Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Melayu *Malay*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menjelaskan isu semasa berlandaskan ilmu falsafah, Falsafah Pendidikan Kebangsaan dan Rukun Negara. 2. Menerangkan isu semasa berdasarkan aliran pemikiran utama dalam pelbagai aliran falsafah. 3. Menghuraikan isu semasa melalui perspektif perbandingan falsafah sebagai asas bagi menjalinkan dialog antara budaya. *At the end of the course, students are able to:* 1. *Explain current issues based on philosophy, the Philosophy of National Education and the Rukunegara.* 2. *Explain current issues based on the main of thoughts from the various streams of philosophy.* 3. *Explain current issues through a comparative perspective of philosophy as a basis for establishing inter-cultural dialogue.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini merangkumi hubungan ilmu falsafah dengan Falsafah Pendidikan Kebangsaan dan Rukunegara. Penggunaan falsafah sebagai alat untuk memurnikan budaya pemikiran dalam kehidupan melalui seni dan kaedah berfikir serta konsep insan. Topik utama dalam falsafah iaitu epistemologi, metafizik dan etika dibincangkan dalam konteks isu semasa. Penekanan diberi kepada falsafah sebagai asas bagi menjalin dialog antara budaya serta memupuk nilai sepunyai. Di hujung kursus ini pelajar akan mampu melihat disiplin-disiplin ilmu sebagai satu badan ilmu yang komprehensif dan terkait antara satu sama lain. *This course covers philosophical relations with the Philosophy of National Education and Rukunegara. The use of philosophy as a tool to purify the culture of thought in life through the arts and methods of thinking and human concepts. The main topics in philosophy are epistemology, metaphysics and ethics discussed in the context of current issues. Emphasis is given to philosophy as a basis for fostering intercultural dialogue and fostering one's values. At the end of this course students will be able to see the disciplines of science as one comprehensive body of knowledge and related to each other.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 70% Peperiksaan Akhir / *Final Examination*: 30%

GIG1013: Penghayatan Etika dan Peradaban / *Appreciation of Ethics and Civilisations*

Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Melayu (pelajar warganegara) / Bahasa Inggeris (pelajar bukan warganegara) *Malay (local students) and English (international students)*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menjelaskan konsep etika dari peradaban yang berbeza. 2. Membandingkan sistem, tahap perkembangan, kemajuan sosial dan kebudayaan merentas bangsa. 3. Membincangkan isu kontemporari berkaitan ekonomi, politik, sosial, budaya dan alam sekitar daripada perspektif etika dan peradaban. *At the end of the course, students are able to:* *1. Explain the ethical concepts of different civilizations.* *2. Compare systems, levels of development, social progress and culture across nations.* *3. Discuss contemporary issues related to economic, political, social, cultural and environmental from the perspective of ethics and civilization.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini menerangkan tentang konsep etika daripada perspektif peradaban yang berbeza. Ia bertujuan bagi mengenal pasti sistem, tahap perkembangan, kemajuan dan kebudayaan sesuatu bangsa dalam mengukuhkan kesepaduan sosial. Selain itu, perbincangan berkaitan isuisu kontemporari dalam aspek ekonomi, politik, sosial, budaya dan alam sekitar daripada perspektif etika dan peradaban dapat melahirkan pelajar yang bermoral dan profesional. Penerapan amalan pendidikan berimpak tinggi (HIEPs) yang bersesuaian digunakan dalam penyampaian kursus ini. Di hujung kursus ini pelajar akan dapat menghubungkaitkan etika dan kewarganegaraan berminda sivik. *This course discusses ethical concepts from different civilization perspectives. It aims to identify the systems, developmental stages, progress and culture of a nation in strengthening social cohesion. In addition, discussions on contemporary issues in the economic, political, social, cultural and environmental aspects from an ethical and civil perspective can produce students who are morally and professionally sound. The application of appropriate High Impact Education Practices (HIEPs) is used in the delivery of this course. At the end of this course students will be able to relate ethics and civic-minded citizenship.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 70% Peperiksaan Akhir / *Final Examination*: 30%

GIG1003: Asas Pembudayaan Keusahawanan / *Basic Entrepreneurship Enculturation*

Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menerangkan konsep asas keusahawaan. 2. Menghasilkan idea keusahawanan yang kreatif dan inovatif. 3. Membangunkan kerangka rancangan perniagaan. *At the end of the course, students are able to:* *1. Explain the basic concepts of entrepreneurship.* *2. Producing creative and innovative entrepreneurial ideas.* 3. *Develop a business plan framework.*
Sinopsis Kandungan Kursus / *Synopsis of Course Contents*	Kursus ini menerapkan elemen asas pembudayaan keusahawanan kepada semua pelajar. Inisiatif ini diambil untuk membuka minda dan merangsang semangat keusahawanan kepada kumpulan sasar yang berpotensi. Antara topik yang akan diajar termasuklah konsep dan perkembangan keusahawanan, faktor yang menggalakkan keusahawanan, perkembangan keusahawanan di Malaysia, etika keusahawanan, kreativiti dan inovasi dalam keusahawanan dan merancang perniagaan. Di samping itu, kursus ini juga memberikan pelajar latihan yang lebih bermakna dan berkesan mengenai pemikiran, kemahiran dan kecekapan keusahawanan. *The course will attempt to inculcate the basic elements of entrepreneurship in the students. Initiatives are taken to open their minds and motivate the entrepreneurial spirit in this potential target group. The course encompasses theory and development of entrepreneurship, factors affecting entrepreneurship, entrepreneurship development in Malaysia, ethics of entrepreneurship, creativity and innovation in entrepreneurship and developing business plans. This course also incorporates a direct exposure to entrepreneurial mindset, skills and competencies.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*: 0%

English Communication Programme (Path 1)

GLT1018: Proficiency in English I

Credit	2
Course Pre-requisite(s) / Minimum Requirement(s)	CEFR A2+ • MUET BAND 2 • IELTS Band 4.0 • TOEFL Paper-Based Test (437 – 473) • TOEFL Computer-Based Test (123 – 150) • TOEFL Internet-Based Test (41 – 52) • PTE (Academic) – (10 – 28)
Course Learning Outcomes	At the end of the course, students are able to: 1. Identify information in short, simple reading texts. 2. Present ideas related to everyday topics. 3. Use grammar correctly to express ideas.
Synopsis of Course Contents	This course is designed for students with basic proficiency in English. Focus is on building speaking and reading competence with an emphasis on accuracy in grammar and on vocabulary building.
Assessment Weightage	Continuous Assessment: 60% Final Examination: 40%

GLT1019: Let's Speak

Credit	2
Course Pre-requisite(s) / Minimum Requirement(s)	GLT1018
Course Learning Outcomes	At the end of the course, students are able to: 1. Organise a speech in stages. 2. Apply appropriate skills and strategies when delivering a short speech. 3. Present a short speech.
Synopsis of Course Contents	This course focuses on preparing a speech in English accurately and coherently. It also develops students' speech planning skills in stages. Students will learn to speak accurately using the appropriate language strategies to a selected audience.
Assessment Weightage	Continuous Assessment: 100% Final Examination: 0%

GLT1020: Fundamental Writing

Credit	2
Course Pre-requisite(s) / Minimum Requirement(s)	GLT1018
Course Learning Outcomes	At the end of the course, students are able to: 1. Write short, connected texts on familiar subjects. 2. Organise ideas effectively for different purposes.
Synopsis of Course Contents	This course is designed for students with a pre-intermediate level of proficiency in English. It focuses on writing skills, with an emphasis on accuracy in grammar and vocabulary building. Students will be exposed to writing strategies that will enable them to write short texts effectively for different purposes.
Assessment Weightage	Continuous Assessment: 100% Final Examination: 0%

English Communication Programme (Path 2)

GLT1021: Proficiency in English II

Credit	2
Course Pre-requisite(s) / Minimum Requirement(s)	CEFR B1 • MUET BAND 3 • IELTS Band 4.5 – 5.0 • TOEFL Paper-Based Test (477 – 510) • TOEFL Computer-Based Test (153 – 180) • TOEFL Internet-Based Test (53 – 64) • PTE (Academic) – (29 - 41)
Course Learning Outcomes	At the end of the course, students are able to: 1. Write clear connected texts on a wide range of topics. 2. Present ideas and opinions clearly and coherently. 3. Interpret information from texts on various topics.
Synopsis of Course Contents	This course is designed to improve students' English Language proficiency in terms of accuracy and language use at the intermediate level. Students will be exposed to a variety of reading texts in order to improve their reading skills. They will also be given ample speaking practice to develop their confidence in communicating and interacting with others in a multitude of situations. The course improves students' skills in writing texts coherently on various topics.
Assessment Weightage	Continuous Assessment: 60% Final Examination: 40%

GLT1022: Speak Up

Credit	2
Course Pre-requisite(s) / Minimum Requirement(s)	GLT1021
Course Learning Outcomes	At the end of the course, students are able to: 1. Present ideas clearly and accurately. 2. Employ appropriate communication strategies to converse effectively.
Synopsis of Course Contents	This course focuses on speaking English accurately and coherently at the intermediate level. It develops students' communication strategies that enable them to interact appropriately in a variety of informal situations.
Assessment Weightage	Continuous Assessment: 100% Final Examination: 0%

GLT1023: Effective Workplace Writing

Credit	2
Course Pre-requisite(s) / Minimum Requirement(s)	GLT1021
Course Learning Outcomes	At the end of the course, students are able to: 1. Use appropriate format and language structures in correspondence writing. 2. Apply appropriate tone and style according to purposes of correspondence.
Synopsis of Course Contents	This course introduces writing strategies at the intermediate level. Students will be exposed to a range of workplace communication. They will learn how to produce effective written communication and improve their overall skills in writing.
Assessment Weightage	Continuous Assessment: 100% Final Examination: 0%

English Communication Programme (Path 3)

GLT1024: Proficiency in English III

Credit	2
Course Pre-requisite(s) / Minimum Requirement(s)	CEFR B2 • MUET BAND 4 • IELTS Band 5.5 – 6.0 • TOEFL Paper – Based Test (513 – 547) • TOEFL Computer – Based Test (183 – 210) • TOEFL Internet – Based Test (65-78) • PTE (Academic) – (42 – 57) • FCE (B & C) • GCE A Level (English) (Minimum C) • IGCSE/GCSE (English) (A, B & C)
Course Learning Outcomes	At the end of the course, students are able to: 1. Demonstrate an understanding of complex texts on concrete topics. 2. Write clear, detailed texts on a wide range of subjects. 3. Share opinions fluently and spontaneously.
Synopsis of Course Contents	This course is designed to fortify students' English Language proficiency in terms of accuracy and effectiveness at a developing upper intermediate level. Students will be taught the four language skills with a focus on reading, writing and speaking. They will be exposed to a variety of texts to develop a higher level of proficiency that will allow them to apply the skills learnt.
Assessment Weightage	Continuous Assessment: 60% Final Examination: 40%

GLT1025: Effective Oral Communication

Credit	2
Course Pre-requisite(s) / Minimum Requirement(s)	GLT1024
Course Learning Outcomes	At the end of the course, students are able to: 1. Write relevant outlines for presentations. 2. Present an impromptu speech. 3. Adhere to appropriate strategies in oral communication.
Synopsis of Course Contents	The course encompasses different aspects of oral communication used in delivering speeches and presentations at the high intermediate level. Appropriate examples from a variety of situations are used as practice materials for students to analyse, discuss and apply the strategies taught.
Assessment Weightage	Continuous Assessment: 100% Final Examination: 0%

GLT1026: Writing at the Workplace

Credit	2
Course Pre-requisite(s) / Minimum Requirement(s)	GLT1024
Course Learning Outcomes	At the end of the course, students are able to: 1. Write texts using appropriate tone and style. 2. Complete an informal report for workplace purposes. 3. Prepare a formal report for workplace purposes.
Synopsis of Course Contents	This course will introduce students to effective writing skills at the workplace. Using relevant materials, students will be taught in stages how to produce documents within a workplace context.
Assessment Weightage	Continuous Assessment: 100% Final Examination: 0%

English Communication Programme (Path 4)

GLT1027: Advanced Oral Communication

Credit	2
Course Pre-requisite(s) / Minimum Requirement(s)	CEFR C1 • MUET BAND 5 & BAND 6 • IELTS Band 6.5 – 9.0 • TOEFL Paper – Based Test (550 – 677) • TOEFL Computer – Based Test (213 – 300) • TOEFL Internet – Based Test (79 – 120) • PTE (Academic) (58 – 90) • FCE (A) • GCE A Level (English) (B & A)
Course Learning Outcomes	At the end of the course, students are able to: 1. Integrate the effective use of language structures in communication 2. Present a persuasive speech 3. Develop appropriate interpersonal communication skills.
Synopsis of Course Contents	The course encompasses different aspects of oral communication used in delivering speeches and presentations at the high intermediate level. Appropriate examples from a variety of situations are used as practice materials for students to analyse, discuss and apply the strategies taught.
Assessment Weightage	Continuous Assessment: 100% Final Examination: 0%

GLT1028: Advanced Business Writing

Credit	2
Course Pre-requisite(s) / Minimum Requirement(s)	CEFR C1 • MUET BAND 5 & BAND 6 • IELTS Band 6.5 – 9.0 • TOEFL Paper – Based Test (550 – 677) • TOEFL Computer – Based Test (213 – 300) • TOEFL Internet – Based Test (79 – 120) • PTE (Academic) (58 – 90) • FCE (A) • GCE A Level (English) (B & A)
Course Learning Outcomes	At the end of the course, students are able to: 1. Apply appropriate features of effective business writing. 2. Prepare documents common in business writing. 3. Produce a report for workplace purposes.
Synopsis of Course Contents	This course is designed to equip students with the necessary writing skills to meet the needs of the workplace. Students will also be taught how to produce clear, accurate and well organised professional business documents. Students will be required to analyse and respond to a variety of situations and to write for identified audiences. The course also explores the ways in which technology helps shape business writing and communication.
Assessment Weightage	Continuous Assessment: 100% Final Examination: 0%

COURSE INFORMATION

Faculty Courses

KIX1001: Matematik Kejuruteraan 1 / *Engineering Mathematics 1*

Kod Kursus *Course Code*	KIX1001
Tajuk Kursus *Course Title*	Matematik Kejuruteraan 1 *Engineering Mathematics 1*
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Rujukan Utama *Main Reference*	1. Glyn James, "Modern Engineering Mathematics", 5th Edition, 2015, Pearson. 2. K.A. Stroud and D.J. Booth, "Engineering Mathematics", 8th Edition, 2020, Red Globe Press. 3. Glyn James, "Advanced Modern Engineering Mathematics", 5th Edition, 2018, Pearson. 4. K.A. Stroud and D.J. Booth, "Advanced Engineering Mathematics", 6th Edition, 2020, Red Globe Press. 5. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition International Student Version, 2011, John Wiley & Sons Ltd.
Strategi Pembelajaran *Learning Strategies*	Kuliah, tutorial, tugasan *Lectures, tutorial, and assignment*
Masa Pembelajaran Pelajar *Student Learning Time*	Bersemuka / *Face to face* : 46 jam/*hours* Tidak Bersemuka / *Non Face to face*: 16 jam/*hour* Masa Persediaan Pelajar / *Student Preparation Time*: 58 jam/*hours*
Kemahiran Boleh Pindah Transferable Skills	Pengaturcaraan MATLAB *MATLAB Programming*
Pensyarah / *Lecturer* Bilik / *Room* Telefon/e-mel *Telephone/e-mail*	Rujuk jadual waktu fakulti *Refer to the faculty's timetable*
Sesi Kuliah / *Lecture Session:* Hari/Masa / *Day/Time* Tempat / *Venue*	Rujuk kepada myum.um.edu.my. *Refer to* myum.um.edu.my.
Sesi Tutorial/Amali: *Tutorial/Practical Session:* Hari/Masa / *Day/Time* Tempat / *Venue*	Rujuk jadual waktu fakulti *Refer to the faculty's timetable*
Perincian Pemberatan Penilaian *Detail of Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment* : 40% Peperiksaan Akhir / Final Examination : 60%

KIX1001: Matematik Kejuruteraan 1 / *Engineering Mathematics 1*

Week	Topic & Activities
1.	Fungsi: Had fungsi, had dan kesinambungan Derivatif: Konsep asas dan definisi, peraturan pembezaan, peraturan rantai, pembezaan parametrik dan tersirat, derivatif yang lebih tinggi. Aplikasi fungsi dan derivatif kejuruteraan: fungsi hampir, kecerunan garis lurus, kecekungan, gerakan dan derivatif kedua, kelengkungan satah lengkung. *Functions: Limit of a function, limits and continuity* *Derivatives: Basic ideas and definitions, rules of differentiations, chain rule, Parametric and implicit differentiation, Higher derivatives.* *Engineering Applications of Functions and Derivatives: Approximating functions, The gradient of a straight line, Concavity, motion and the second derivatives, Curvature of a plane curves.*
2.	Derivatif separa: Konsep asas dan definasi. Fungsi domain, pemboleh ubah bersandar dan pemboleh ubah tidak bersandar, derivatif separa peringkat lebih tinggi, pembezaan fungsi komposit dan fungsi tersirat. Derivatif separa menggunakan Jacobians, operasi pembezaan. Aplikasi kejuruteraan derivatif, satah tangen dan permukaan normal dalam tiga dimensi. *Partial Derivatives: Basic ideas and definitions. Domain of the functions, Dependent and independent variables, Higher order partial derivatives, Differentiation of composite functions and implicit functions.* *Partial Derivatives using Jacobians, Differential operators.* *Engineering Applications of Partial Derivatives, Tangent planes and normal to surface in three dimensions.*
3.	Vektor Algebra 1: Konsep asas, komponen kartesian, vektor dalam ruang, kecerunan, capahan, derivative arah curl. *Vector Algebra I: Basic concepts, Cartesian components, Vectors in space, Gradient, Divergence, Curl Directional derivatives.*
4.	Vektor Algebra II: Hasil darab skalaan dan hasil darab vektor, hasil darab trirangkap. *Vector Algebra II: Scalar Product and Vector Product, Triple Product.*
5.	Aplikasi kejuruteraan vektor algebra, Aplikasi kejuruteraan analisa vector. *Engineering Applications of Vector Algebra, Engineering Applications of Vector Analysis.*
6.	Algebra Matriks untuk Sistem Algebra Lelurus Tidak Homogen: Operasi Matriks Asas; Menyelesaikan Sistem Persamaan Lelurus Tidak Homogen; Penyongsangan Matriks; Kaedah Grafik; Peraturan Cramer; Kaedah Penghapusan; Penghapusan Gauss Naif; Penghapusan Gauss Secara Separa Pangsi; Bentuk Baris Eselon; Pengurangan Bentuk Baris Eselon; Pangkat; Pengantungan Lelurus; Aplikasi Kejuruteraan Sistem Persamaan Lelurus Tidak Homogen. *Matrix Algebra for Non-Homogeneous Linear Algebraic System: Basic Matrices Operations; Solving Non-Homogeneous System of Linear Equations; Matrix Inversion Approach; Graphical Method; Cramer's Rule; Method of Elimination; Naïve Gauss Elimination; Gauss Elimination with Partial Pivoting; Row Echelon Form, Reduced Row Echelon Form, Rank, & Linear Dependency; Engineering Application of Non-Homogeneous System of Linear Equations.*

7.	Algebra Matriks untuk Sistem Algebra Lelurus Homogen: Menyelesaikan Sistem Persamaan Lelurus Homogen; Masalah Nilai Eigen/ Vector Eigen; Aplikasi Kejuruteraan untuk Masalah Nilai Eigen/ Vector Eigen; Pepenjuruan dan Penyambungannya; Teorem Cayley-Hamilton; Aplikasi Kejuruteraan untuk Sistem Algebra Lelurus Homogen. *Matrix Algebra for Homogeneous Linear Algebraic System: Solving Non – Homogeneous System of Linear Equations; Eigenvalue/ Eigenvector Problem; Engineering Application of Eigenvalue/ Eigenvector Problem; Diagonalization & Its Extension; Cayley-Hamilton Theorem; Engineering Application of Solving Homogeneous System of Linear Equations.*
8.	Pengamilan: Konsep asas dan definisi, keedah pengamilan: kaedah penggantian, mengikut bahagian, pecahan separa. Kamiran wajar dan kamiran tidak wajar. *Integration: Basic ideas and definitions, Techniques of Integrations: the substitution method, by parts, by partial fractions.* *Proper and Improper Integrals.*
9.	Aplikasi pengamilan kejuruteraan: Kawasan pada satah, isipadu pepejal bagi keratan rentas yang diketahui, momen dan pusat jisim. *Engineering Applications of Integrals: Areas of regions in the plane, Volumes of solids with known cross sections, Moment and center of mass.*
10.	Pengamilan berganda: pengamilan ganda dua, pengamilan trirangkap. *Multiple Integrals: Double Integrals and triple Integrals.*
11.	Pengamilan berganda: pengamilan ganda dua, pengamilan trirangkap, kamiran isipadu. *Multiple Integrals: Double Integrals and triple Integrals, volume integrals.*
12.	Kamiran garisan dan kerja terlaku. Teorem Green dalam satu satah. *Line integral and work done. Green's theorem in a plane.*
13.	Kamiran permukaan. *Surface Integrals.*
14.	Teorem Stoke. *Stoke's Theorem.*

KIX1002: Matematik Kejuruteraan 2 / *Engineering Mathematics 2*

Kod Kursus *Course Code*	KIX1002
Tajuk Kursus *Course Title*	Matematik Kejuruteraan 2 *Engineering Mathematics 2*
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Rujukan Utama *Main Reference*	1. Glyn James, "Modern Engineering Mathematics", 5th Edition, 2015,Pearson. 2. K.A. Stroud and D.J. Booth, "Engineering Mathematics", 8th Edition, 2020, Red Globe Press. 3. Glyn James, "Advanced Modern Engineering Mathematics", 5th Edition,2018, Pearson. 4. K.A. Stroud and D.J. Booth, "Advanced Engineering Mathematics", 6th Edition, 2020, Red Globe Press. 5. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th EditionInternational Student Version, 2011, John Wiley & Sons Ltd.
Strategi Pembelajaran *Learning Strategies*	Kuliah, Tutorial, dan Perbincangan Kumpulan *Lectures, Tutorial and Group Discussion*
Masa Pembelajaran Pelajar *Student Learning Time*	Bersemuka / *Face to face* : 46 jam/*hours* Tidak Bersemuka / *Non Face to face*: 12 jam/*hour* Masa Persediaan Pelajar / *Student Preparation Time*: 62 jam/*hours*
Kemahiran Boleh Pindah Transferable Skills	-
Pensyarah / *Lecturer* Bilik / *Room* Telefon/e-mel *Telephone/e-mail*	Rujuk jadual waktu fakulti *Refer to the faculty's timetable*
Sesi Kuliah / *Lecture Session:* Hari/Masa / *Day/Time* Tempat / *Venue*	Rujuk kepada myum.um.edu.my. *Refer to* myum.um.edu.my.
Sesi Tutorial/Amali: *Tutorial/Practical Session:* Hari/Masa / *Day/Time* Tempat / *Venue*	Rujuk jadual waktu fakulti *Refer to the faculty's timetable*
Perincian Pemberatan Penilaian *Detail of Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment* : 40% Peperiksaan Akhir / *Final Examination* : 60%

KIX1002: Matematik Kejuruteraan 2 / *Engineering Mathematics 2*

Week	Topic & Activities
1.	Pengenalan: Definasi dan Konsep Asas dalam Persamaan Pembezaan Biasa (ODE). Persamaan Pembezaan Turutan Pertama. *Introduction. Definitions and fundamental concept in ODE First order Differential Equations.*
2.	Teknik untuk Menyelesaikan Persamaan Pembezaan Turutan Pertama. *Strategy to Solve First Order Differential Equations.*
3.	Penyelesaian untuk Persamaan Pembezaan Turutan Kedua Homogen dan Linear. *Solutions to Homogeneous Linear Second Order ODE.*
4.	Penyelesaian untuk Persamaan Pembezaan Turutan Kedua Tidak Homogen dan Linear. *Solutions to Non-homogeneous Linear Second Order ODE.*
5.	Aplikasi Kejuruteraan bagi Persamaan Pembezaan Biasa. *Engineering Applications of ODE.*
6.	Penyelesaian Siri Kuasa untuk Persamaan Pembezaan. *Power Series Solutions for Differential Equations.*
7.	Kaedah Frobenius. *Frobenius Method.*
8.	Jelmaan Laplace. *Laplace Transform.*
9.	Jelmaan Laplace: Penyelesaian untuk Persamaan Pembezaan. *Laplace Transform: Solutions for Differential Equations.*
10.	Siri Fourier. *Fourier Series.*
11.	Siri Fourier: Fungsi-fungsi berkala; Siri Trigonometri; Fungsi-fungsi Genap dan Ganjil, Siri Fourier, Pengembangan Separuh Julat. *Fourier Series: Periodic functions; Trigonometric Series; Odd and even functions, Fourier Series, Half-range Expansion.*
12.	Persamaan Pembezaan Separa: Penyelesaian Umum untuk Persamaan Pembezaan Separa (PDE). *Partial Differential Equations: Solving General Solution of PDE.*
13.	Persamaan Pembezaan Separa: Penyelesaian Tertentu untuk Persamaan Laplace. *Partial Differential Equations: Solving Particular Solution of Laplace Equation.*
14.	Persamaan Pembezaan Separa: Penyelesaian Tertentu untuk Persamaan Haba & Persamaan Gelombang. *Partial Differential Equations: Solving Particular Solution of Heat Equation & Wave Equation.*

KIX2005: Undang-undang, Etika dan Kemampanan untuk Jurutera / *Law, Ethics and Sustainability for Engineers*

Kod Kursus *Course Code*	KIX2005
Tajuk Kursus *Course Title*	Undang-undang, Etika dan Kemampanan untuk Jurutera *Law, Ethics and Sustainability for Engineers*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menghurai implikasi undang-undang, terhadap tingkah laku jurutera. 2. Menggunapakai keperluan praktikal kod-kod etika untuk mengawal selia amalan kejuruteraan. 3. Menilai implikasi kemampanan dalam kerja-kerja kejuruteraan. *At the end of the course, students are able to:* *1. Describe the implication of law for engineers' behaviour.* *2. Apply the practical needs of the codes of ethics to regulate engineering practices.* *3. Assess the implication of sustainability in engineering works.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini merangkumi pengenalan kepada undang-undang dan fungsinya, prinsip asas undang-undang dan kod-kod etika yang berkaitan dengan bidang kejuruteraan. Tanggungjawab dan hak jurutera, implikasi kebajikan awam, dan peranan jurutera kepada pembangunan mampan dan globalisasi juga turut dititik beratkan di dalam kursus ini. *This course covers an introduction to law and functions, basic principles of law and the code of ethics related to the field of engineering. Responsibilities and rights of engineers, public welfare implications, and the role of engineers to sustainable development and globalization has also been emphasized in this course.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%

Rujukan Utama *Main Reference*	1. Martin Peterson, Ethics for Engineers, Oxford University Press, 2020. 2. Mitcham, C. Duval, R.S, Engineering Ethics, Prentice Hall, 2012. 3. Registration of Engineers Act 1967 (REA), 2016. 4. Code of Conduct of Registered Person, Board of Engineers Malaysia (BEM), 2016. 5. Law of torts in Malaysia, 2nd Ed., Norchaya Haji Talib, Petaling Jaya, Selangor, Sweet & Maxwell Asia, 2003. 6. Prinsip-prinsip asas tort, Norchaya Haji Talib, Petaling Jaya, Selangor, Sweet & Maxwell Asia, 2003. 7. Undang-undang kontrak di Malaysia, 2nd Ed., Salleh Buang, Kuala Lumpur, Central Law Book Co., 1995. 8. Robert Brinkmann, Introduction to Sustainability, Wiley, 2nd Edition 2020.

KIX2005: Undang-undang, Etika dan Kemampanan untuk Jurutera / *Law, Ethics and Sustainability for Engineers*

Minggu ***Week***	**Topik** ***Topic***
1	Pengenalan kepada Lembaga Jurutera Malaysia (BEM) dan Institusi Jurutera Malaysia (IEM) *Introduction to the Board of Engineers, Malaysia (BEM) and the Institution of Engineers, Malaysia (IEM)*
2	Akta Pendaftaran Jurutera (REA) 1967 *Registration of Engineers Act 1967 (REA)*
3	Pembatalan, Pengguguran dan Pengembalian Semula *Cancellation, Removal and Reinstatement*
4	Jenis Tort, Liabiliti Tort dan Pembelaan terhadap Tort *Type of Tort, Tort Liability and Defence against Tort*
5	Pengenalan dan Isi Kandungan Kontrak Liabiliti, Pembatalan dan Penyelesaian Kontrak *Introduction and the Content of Contracts Liability, Cancellation and Settlement of Contracts*
6	Jenis-jenis Perkhidmatan Kejuruteraan *Type of Engineering Services*
7	Ujian Pertengahan Semester *Mid-Term Test*
8	Peranan Jurutera Peluang dalam profesion Etika di dalam kajian dan Penyelidikan *Roles of Engineers* *Opportunities in the Profession* *Ethics in Experiment and Research*
9	Profesionalisme, Moral dan Etika *Professionalism, Moral and Ethics*
10	Etika Kejuruteraan, Konflik dan Penyelesaian

	Engineering Ethics, Conflict and Resolution
11	Pengenalan kepada Kelestarian, Rukun Kelestarian, Keselamatan Makanan, Alam Sekitar (udara dan air), Kajian Kes Industri *Introduction to Sustainability, Pillars of Sustainability, Food Security, Environmental (air and water) Security, Industrial Case Studies*
12	Penilaian Kitaran Hayat (LCA) dan Matlamat Pembangunan Mampan (SDG) *Life Cycle Assessment (LCA) and Sustainable Development Goals (SDG)*
13	Kejuruteraan Hijau (proses, bahan, bangunan, dll.) *Green Engineering (processess, materials, buildings, etc.)*
14	Rumusan Kursus *The Course Wrap Up*

KIX2006: Ekonomi Kejuruteraan dan Pengurusan Projek / *Engineering Economics and Project Management*

Kod Kursus *Course Code*	KIX2006
Tajuk Kursus *Course Title*	Ekonomi Kejuruteraan dan Pengurusan Projek *Engineering Economics and Project Management*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menghurai prinsip-prinsip, konsep-konsep asas dan kaedah dalam analisa ekonomi kejuruteraan dan pengurusan projek. 2. Mengaplikasi kaedah-kaedah analisa ekonomi kejuruteraan dalam memilih rekabentuk penyelesaianyang bersaing. 3. Mengaplikasi kaedah-kaedah pengurusan projek dalam melaksanakan dan mencapai matlamat-matlamat strategik organisasi. 4. Menilai kesan keputusan-keputusan ekonomi kejuruteraan dan pengurusan projek ke atas organisasi dan masyarakat. *At the end of the course, students are able to:* *1. Decsribe the principles, basic concepts, and methodology of engineering economy analysis and project management.* *2. Apply engineering economics analysis methods on choosing competing design solutions.* *3. Apply project management methods in implementing and achieving strategic goals of the organization.* *4. Evaluate implications of both engineering economy and project management decisions on organisationand society.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini menawarkan pelajar-pelajar dengan konsep-konsep projek kejuruteraan yang mampu terhasil secara fizikal dan yang berpatutan dari segi ekonomi. Kursus ini membincangkan analisis kos dalam membuat keputusaan kejuruteraan dan juga pengurusan dan pengawalan projek-projek yang kompleks. Topik-topik kejuruteraan ekonomi termasuklah konsep kos, kos kitaran hayat, rekabentuk ekonomik, kiraan setara, kiraan faedah, ukuran nilai pelaburan, analisa gantian dan analisa kos- manfaat. Topik-topik bagi pengurusan projek kejuruteraan pula termasuk kaedah-kaedah perancangan projek, organisasi, pengurusan risiko, anggaran kos dan bajet, penjadualan, laporan, penyeliaan dan perlaksanaan projek projek.

	This course provides students with the concepts of physically realizable and economically affordable engineering project. This course deals with cost analysis in engineering decision making as well as the management and control of complex projects. Engineering economics topics include cost concepts, life- cycle costing, design economics, equivalence calculations, interest considerations, measures of investment worth, replacement analyses and cost- benefit analysis. Engineering project management topics include methods for project planning, organization, risk management, cost estimating and budgeting, scheduling, reporting, monitoring, and implementation of projects.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. William G. Sullivan, Elin M. Wicks and Patrick Koelling, Engineering Economy, 17th Ed., Prentice Hall, 2020 2. Leland Blank and Anthony Tarquin, Engineering Economy, 8th Ed., McGraw-Hill, 2018 3. Erik W Larson and Clifford F Gray, Project Management the Managerial Process, 2018, 7th Edition, McGraw-Hill.

KIX2006: Ekonomi Kejuruteraan dan Pengurusan Projek / *Engineering Economics and Project Management*

Minggu ***Week***	**Topik** ***Topic***
1	Pengenalan kepada Ekonomi Kejuruteraan dan Pengurusan Projek *Introductions to Engineering Economy and Modern Project Management*
2	Konsep-konsep Kos dan Ekonomik Rekabentuk *Cost Concepts and Design Economics*
3	Pentakrifan projek dan Penganggaran Kos *Defining the Project and Cost Estimations*
4	Faktor-faktor: Bagaimana masa dan kadar bunga memberi kesan kepada wang *Factors: How Time and Interest Affect Money*
5	Faktor-faktor bergabung: Kadar Bunga nominal dan Efektif *Combining Factors: Nominal and Effective Interest Rates*
6	Menilai Projek Tunggal *Evaluating a Single Project*
7	Perbandingan dan Pemilihan Antara Projek-Projek *Comparison and Selection Among Alternatives: Financial and non-financial criteria*
8	Analisa Penggantian *Replacement Analysis*
9	Menilai Projek Awam Mengunakan Kaedah Faedah-Kos *Evaluating Public Project Using Benefit-Cost Ratio Method*
10	Membangun Pelan Projek *Developing a Project Plan*
11	Mengurus Risiko *Managing Risk*
12	Pengagihan Sumber dan Penjadualan; Menjejak dan Mengawal Projek *Resource Allocation and Scheduling; Project Tracking and Control*
13	Pengkomputeran Pengurusan Projek dan Perancang Projek Microsoft *Project Management Computing and Microsoft Project Planner*
14	Pembentangan Projek Berkumpulan *Group Project Presentation*

COURSE INFORMATION

Department Courses

KIL1001: Termodinamik Kejuruteraan Kimia I / *Chemical Engineering Thermodynamics I*

Kod Kursus *Course Code*	KIL1001
Tajuk Kursus *Course Title*	Termodinamik Kejuruteraan Kimia I *Chemical Engineering Thermodynamics I*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Mengenali tingkah laku bahan - bahan tulen dan bagaimana untuk mengenalpasti sifat-sifatnya 2. Menerangkan hukum-hukum termodinamik dan bagaimana ia boleh berbeza antara satu sama lain. 3. Mengaplikasi hukum-hukum termodinamik untuk sistem-sistem termodinamik terbuka dan tertutup untuk menyelesaikan masalah berkaitan dengan keseimbangan tenaga. 4. Menilai prestasi kitaran - kitaran termodinamik dan bagaimana untuk mengira ia mengunakan persamaan - persamaan kecekapan. *At the end of the course, students are able to:* *1. Define the behaviour of pure substances and how to identify its properties* *2. Describe laws of thermodynamics and how it can differ from each other.* *3. Apply laws of thermodynamics to open and closed systems to solve problems related to energy balance.* *4. Evaluate performance of thermodynamics cycles and how to quantify it using efficiency equations.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Persamaan keadaan akan digunakan untuk mereka model dan menghitung sifat termodinamik bagi bendalir. Hukum termodinamik akan diajar dengan menitikberatkan aplikasi terhadap proses kimia. Hukum Termodinamik Pertama akan digunakan untuk menghitung kerja, haba dan tenaga bagi sistem tertutup dan terbuka. Hukum Termodinamik Kedua dan entropi akan diperkenalkan. Hukum Termodinamik Kedua juga akan digunakan untuk analisis enjin haba, pendinginan dan pam haba. Akhirnya, kitaran termodinamik (contohnya, kitaran wap, kitaran gas) juga akan diperkenalkan. *In this course, equations of state will be used to model and calculate thermodynamic properties of fluids. The laws of thermodynamics are*

	covered with particular emphasis on application to chemical processes. The First Law of Thermodynamics will be used for determining work, heat and energy of open and closed systems. The Second Law of Thermodynamics and entropy will be introduced. Heat engine, refrigeration and heat pump will be analyzed using the Second Law of Thermodynamics. Finally, thermodynamic cycles (e.g. vapour cycles, gas cycles) will also be introduced.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. . Y.A. Cengel, M.A. Boles & M. Kanoglu. Thermodynamics: An Engineering Approach. 9th Ed. McGraw-Hill Education, 2019 2. J.M. Smith, H. Van Ness M. Abbott & M. Swihart. Introduction to Chemical Engineering Thermodynamics, 9th Ed. McGraw-Hill, 2022.

KIL1002: Prinsip Proses Kimia I / *Chemical Process Principles I*

Kod Kursus *Course Code*	KIL1002
Tajuk Kursus *Course Title*	Prinsip Proses Kimia I *Chemical Process Principles I*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	*Di akhir kursus ini, pelajar dapat:* *1. Mengungkapkan kuantiti dalam angka bererti yang sesuai dengan pelbagai sistem unit.* *2. Mendapatkan sifat fizikal asas, maklumat keseimbangan fizikal dan kimia.* *3. Menyelesaikan masalah imbangan jisim untuk sistem tanpa tindakbalas dan dengan tindakbalas dibantu oleh analisis darjah kebebasan yang asas.* *4. Menyelesaikan masalah imbangan jisim untuk sistem pelbagai unit dengan kitaran dibantu dengan analisis darjah kebebasan.* *At the end of the course, students are able to:* *1. Express quantities in proper significant figures with various systems of units.* *2. Obtain basic physical properties, physical and chemical equilibria data.* *3. Solve material balance problems for non-reacting and reacting systems aided by basic degrees-of-freedom analysis.* *4. Solve mass balance problems for multiple unit systems with loops aided by basic degrees-of-freedom analysis.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini dimulakan dengan mengulangkaji penggunaan dan sebaran angka bererti. Ini diikuti oleh pengenalan kepada sistem unit utama dalam kejuruteraan, termasuk penukaran unit. Ini membawa kepada kuantiti utama yang ditemui, termasuk kaedah untuk menganggar (misalnya ketumpatan gas unggul) atau mendapatinya (misalnya keterlarutan). Penggunaan termodinamik lanjutan untuk anggaran TIDAK diperlukan. Ciri asas unit operasi utama akan dijelaskan untuk membolehkan pelajar mengenalpasti sifat dan bilangan aliran yang berkaitan dengan setiap unit operasi. Fokus kursus kemudian dialihkan kepada penerbitan persamaan am imbangan jisim. Ini diikuti oleh imbangan jisim keadaan mantap ke atas satu unit yang tiada tindakbalas kimia. Penggunaan analisis darjah kebebasan akan diterangkan. Masalah mudah keadaan tidak mantap akan menerangkan penggunaan imbangan jisim secara lebih luas.

	Kerumitan yang melibatkan aliran gas, satu atau lebih tindakbalas kimia, keseimbangan kimia, keseimbangan fizikal, Petua Tuil akan diperkenalkan secara berperingkat. Sistem pelbagai unit operasi akan muncul di antaranya. Keperluan dan kaedah yang betul untuk meyimpulkan keputusan dengan *This course first reviews the use and propagation of significant digits. It is followed by introduction to the key systems of units in engineering, including inter- conversion of units. This leads naturally to the major quantities encountered, including ways to estimate (e.g. ideal gas density) or to obtain them (e.g. solubility). Use of advanced thermodynamics for prediction is NOT required. The basic features of key unit operations will be clarified mainly to enable students to identify the typical nature and number of streams associated with each.* *The focus then shifts to the derivation of the general mass balance equation. This is followed by single unit, non-reactive, steady state mass balance. The use of degrees-of-freedom analysis will be illustrated. Introductory unsteady state problems will illustrate the more general use of mass balance.* *Complications involving gaseous streams, single and multiple chemical reactions, chemical equilibria, physical equilibria, Lever Rule will be introduced in stages. Multiple unit operations will appear in between. The necessity and the proper way to summarize the results with a PFD will be*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Felder R. M. & Rousseau R. W. (2016). Elementary Principles of Chemical Processes. 4th. Ed. John Wiley & Sons. 2. Himmelblau D. M. & Riggs J. B.. (2013). Basic Principles and Calculations in Chemical Engineering, 8th Ed, Pearson. 3. Murphy R. (2022). Introduction to Chemical Processes (Principles, Analysis, Synthesis), 2nd Edition. McGraw-Hill. 4. Reklaitis G. V. (1983). Introduction to Material and Energy Balances, John Wiley & Sons.

KIL1004: Lukisan Kejuruteraan / *Engineering Drawing*

Kod Kursus *Course Code*	KIL1004
Tajuk Kursus *Course Title*	Lukisan Kejuruteraan *Engineering Drawing*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Mentafsirkan geometri, ortografi, isometri, keratan rentas dan pandangan tambahan untuk memahami lukisan kejuruteraan. 2. Menghasilkan lukisan kejuruteraan menggunakan prinsip geometri, ortografi, isometri, keratan rentas dan pandangan tambahan sebagai medium untuk mentakrifkan perincian teknikal pada item kejuruteraan 3. Menghasilkan rajah proses seperti Rajah Aliran Proses dan Rajah Perpaipan & Instrumentasi dan simbol berkaitan sebagai medium untuk memahami proses kimia. *At the end of the course, students are able to:* *1. Interpret geometry, orthographic, isometric, cross-sectional and auxiliary views in understanding engineering drawing.* *2. To produce engineering drawings using principles of geometry, orthographic, isometric, cross-sectional and auxiliary views as the medium to define technical details of engineered items* *3. To produce process diagrams such as Process Flow Diagram (PFD), Process Instrumentation and Diagram (P&ID) and its associated symbols as the medium to understand chemical process*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Memahami asas lukisan kejuruteraan: geometri, ortografi, isometri, keratan rentas, pandangan tambahan. Menggunakan perisian untuk menghasilkan lukisan kejuruteraan dan rajah proses berhubungkait dengan proses kejuruteraan kimia. *Understanding fundamentals of engineering drawing: geometry, orthographic, isometric, cross sectional, auxiliary view. Make use of software to produce engineering drawing and common process diagrams related to chemical engineering process.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*:
Rujukan Utama *Main Reference*	1.Basant Agrawal, Engineering Drawing, Tata McGraw-Hill Education, 2012.

	2.Paul Green, The Engineering Drawing Desk Reference: Creating and Understanding ISO Standard Technical Drawings, Pen Well, 2013. 3..Bill Fane, AutoCAD 2013 For Dummies, 2013.

KIL1005: Kaedah Berangka Kejuruteraan / *Numerical Method For Engineering*

Kod Kursus *Course Code*	KIL1005
Tajuk Kursus *Course Title*	Kaedah Berangka Kejuruteraan *Numerical Method For Engineering*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Mengenalpasti pelbagai kaedah berangka yang digunakan untuk menyelesaikan masalah-masalah kejuruteraan kimia. 2. Menyelesaikan masalah mencari punca, persamaan linear dan tak linear, pengamiran dan pembezaan, dan persamaan pembezaan biasa dan separa menggunakan kaedah berangka yang sesuai. 3. Menggunakan MATLAB atau perisian berangka lain untuk menghitung penyelesaian masalah kejuruteraan kimia dengan menggunakan kaedah berangka yang sesuai. *At the end of the course, students are able to:* *1. Identify the different numerical methods used to solve chemical engineering problems.* *2. Solve roots finding, linear and non-linear equations, integration and differentiation, and ordinary and partial differential equations problems using appropriate numerical methods.* *3. Use MATLAB or other numerical software tools to compute the solutions of chemical engineering problems using the appropriate numerical methods*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Para pelajar akan diperkenalkan kepada komputer dan peranan komputer dalam analisis berangka. Pakej perisian (cth: MATLAB and Excel) dan program asas akan diperkenalkan kepada para pelajar. Pendedahan akan diberikan untuk mencari punca bagi persamaan bukan linear tunggal menggunakan algorithm logik dalam MATLAB atau fungsi binaan dalam Excel. Penyelesaian persamaan linear serentak menggunakan kaedah langsung dan tidak langsung menggunakan gelung bersarang dengan operasi yang lebih rumit akan jalankan. Ini berterusan dengan kaedah Newton Raphson yang menggabungkan algoritma penemuan akar bukan linear dengan sistem linear. Pembezaan berangka dan pengamiran diperkenalkan diikuti penyelesaian biasa dan persamaan pembezaan separa. Ini diikuti oleh masalah pengoptimuman berangka. Melalui pelbagai

	kaedah, akan ada penekanan kepada anggaran ralat dan penggunaan digit bererti yang betul. *Students will be introduced to computers and their roles in numerical analysis. Software packages (ex. MATLAB and Excel) and basics of programming will be introduced to the students. Students are exposed to find the roots of a single non-linear equation using logical algorithm in MATLAB or built-in functions in Excel. Solution of simultaneous linear equations using direct and indirect methods using nested loops with more complicated operations will follow. This paves the way for the Newton-Raphson method, which combines non-linear root finding algorithm with linear systems. Numerical differentiation and integration is introduced together followed by solving ordinary and partial differential equations. This is followed by numerical optimization problems.* *Throughout the various methods, there will be emphasis on error estimates and proper use of significant digits.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 50% Peperiksaan Akhir / *Final Examination*: 50%
Rujukan Utama *Main Reference*	1. S.C. Chapra & R.P. Canale. “Numerical Methods for Engineers”, McGraw-Hill. 8th Edition, 2021. 2. P. Kattan. “MATLAB for Beginners”, LULU Press. 2nd Edition, 2016 3. J. D. Hoffman & S. Frankel. “Numerical Methods for Engineers and Scientists”, CRC, 2018.

KIL1006: Mekanik Bendalir I / *Fluid Mechanics I*

Kod Kursus *Course Code*	KIL1006
Tajuk Kursus *Course Title*	Mekanik Bendalir I *Fluid Mechanics I*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1.Menghuraikan konsep asas berkenaan statik dan dinamik bendalir. 2.Menganggar kejatuhan tekanan untuk aliran tak boleh mampat dan boleh mampat. 3.Menggunakan persamaan Bernoulli untuk rekabentuk asas sistem pengangkutan bendalir untuk aliran tak boleh mampat. 4.Menerangkan prinsip kerja dan ciri-ciri penggerak bendalir. *At the end of the course, students are able to:* *1.Describe the basic concepts related to fluid statics and dynamics.* *2.Estimate standard pressure drop for incompressible and compressible flow.* *3.Apply Bernoulli's equation for the basic design of fluid transfer system for incompressible flow.* *4.Explain working principles and features of fluid movers.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini bermula dengan sifat bendalir, diikuti oleh konsep bendalir melalui ubahbentuk di bawah tegasan. Konsep statik bendalir akan diterangkan. Ini akan disusuli oleh perhitungan tekanan dan kepala hidrostatik di bawah keadaan pegun. Asas dinamik bendalir seperti aliran laminar dan bergelora, konsep kelikatan sebagai punca geseran juga akan diterangkan. Klasifikasi bendalir dan konsep pembentukan dan pemisahan lapisan sempadan akan dibincang. Persamaan Bernoulli tanpa geseran, dengan geseran dan kerja pam untuk aliran tak boleh mampat dan boleh mampat serta kesan kejatuhan tekanan akan diterbitkan daripada persamaan huraian dan masalah kejuruteraan yang berkaitan akan diselesaikan. Analisis dimensi dan nombor tidak berdimensi dalam mekanik bendalir akan diliputi. Penggunaan persamaan Bernoulli untuk mengukur kadar aliran dan kejatuhan tekanan untuk aliran tak boleh mampat dan boleh mampat dengan peranti seperti meter Venturi, meter orifis, rotameter dan tiub Pitot akan diberi perhatian. Pelbagai penyesuai dan aksesori yang terpakai dalam sistem perpaipan termasuk kelengkapan keselamatan seperti injap pelega tekanan, injap keselamatan dan akan

	dibincangkan. Perhitungan kehilangan utama dan kecil, kuasa pam dan sebagainya akan membawa kepada rekabentuk asas sistem pengangkutan bendalir tidak boleh mampat. Komponen dan prinsip kerja pam, kipas, penghembus dan pemampat akan mengakhiri kursus. Langkah-langkah pencegahan *This course begins with the properties of the fluids followed by concepts of fluids through deformation under stress. Fluid statics concepts will be explained. This will be followed by the calculation of pressure and hydrostatic head under static conditions. Basics of fluid dynamics such as laminar and turbulent flow, concept of viscosity as the source of friction will be explained. Classification of fluids and the concepts of boundary layer formation and separation will be discussed. Bernoulli's equation without friction, with friction and pump work for incompressible and compressible flows and the effects on pressure drop will be derived from the governing equations. Engineering problems associated with this equation will be solved.* *Dimensional analysis and the dimensionless numbers in fluid mechanics will be covered. Applications of Bernoulli's equations to measure the flow rate and pressured drop for incompressible and compressible flows using devices such as Venturi meter, orifice meter, rotameter and Pitot tube will be addressed. Various fitting and accessories employed in piping systems including the safety fittings such as pressure relief valves, safety valves and non-return valves, etc will be discussed.* *Calculation of major and minor losses, pumping power etc., leads to the basic design of fluid transfer system for incompressible fluids. The components*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. " Fluid Mechanics 8th Edition in SI unit.", Frank M. White, McGraw Hill; 2016. 2. " Fundamentals of Momentum, Heat and Mass Transfer", 7th Edition, Wiley; 2020. 3. " Fluid Mechanics Fundamentals and Applications", McGraw Hill; 2017.

KIL1009: Makmal Kimia Fizikal dan Analitikal / *Physical and Analytical Chemistry Laboratory*

Kod Kursus *Course Code*	KIL1009
Tajuk Kursus *Course Title*	Makmal Kimia Fizikal dan Analitikal *Physical and Analytical Chemistry Laboratory*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Mengenalpasti prinsip-prinsip kimia fizikal & analitikal untuk melaksanakan ujikaji makmal. 2. Melaksanakan ujikaji makmal berdasarkan prosedur yang diberikan untuk pemungutan data. 3. Menjelaskan perkaitan antara asas ujikaji dengan prinsip teori disebaliknya *At the end of the course, students are able to:* *1. Recognize physical & analytical chemistry principles to perform the laboratory experiment.* *2. Perform experimental laboratory according to procedures given for data collection.* *3. Explain the interconnection between experimental foundations and underlying theoretical principles*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus makmal ini memperkenalkan ujikaji-ujikaji fizikal dan analitikal kimia berkaitan ujian-ujian larutan kimia (konduktiviti dan aplikasi, pekali aktiviti, tindak balas asid- alkali, kebolehlarutan ionik) ,kimia permukaan dan koloid (tegangan permukaan, CMC, isoterma jerapan larutan, pengenapan) dan ujian-ujian analisis alam sekitar (TSS, BOD, COD, nilai klorida). *This laboratory course introduces physical & analytical chemistry experiments involving chemical solution tests (conductance & applications, activity coefficient, acid-base reactions, ionic solubility), surface and colloidal chemistry (surface tension, CMC, liquid adsorption isotherms, sedimentation) and environmental analysis tests (TSS, BOD, COD, chloride value).*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*: -
Rujukan Utama *Main Reference*	1. Manual makmal 2. Laboratory manual

KIL1010: Kimia Fizikal dan Analitikal / *Physical and Analytical Chemistry*

Kod Kursus *Course Code*	KIL1010
Tajuk Kursus *Course Title*	Kimia Fizikal dan Analitikal *Physical and Analytical Chemistry*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1) Menerangkan konsep dan menyelesaikan masalah peralihan fasa, larutan, campuran, kelarutan dan keseimbangan kimia sepert keseimbangan asid-bes dalam larutan berair, termasuk larutan penimbal. 2) Menggunakan konsep asas kalorimetri, konduktimetri, dan spektrofotometri dalam analisis peralihan fizikal dan kimia. 3) Menjelaskan fenomena permukaan seperti kapilari, penjerapan, elmusion dan system koloid Menjelaskan fenomena permukaan seperti tegangan permukaan, kapilari, penjerapan, emulsi dan sistem koloid. 4) Menjelaskan kaedah analitikal dan data analisis yang melibatkan transformasi molekul dan fenomena permukaan. *At the end of the course, students are able to:* *1) Explain concepts and solve problem of phase transition, solutions, mixture, solubility and, chemical equilibrium such as acid-base equilibria in aqueous solutions, including buffer solutions.* *2) Apply basic concepts of calorimetry, conductimetry, and spectrophotometry in physical and chemical transitions analysis* *3) Explain surface phenomena such as surface tension, capillarity,adsorption, emulsion and colloidal system.* *4) Elaborate the methods of analytical techniques and analytical data that involve molecular transform and surface phenomena.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memberi pengenalan kepada elemen-elemen kimia fizikal dan analitikal sebagai pengetahuan asas dalam kejuruteraan kimia. Ia merangkumi konsep asas peralihan fasa dan keseimbangan kimia Pelajar didedahkan dengan teknik analisis kuantitatif seperti kalorimetri dan spektrofotometri. Tindak balas asid-asas, larutan penampan, spesiasi ionik ditekankan. Kursus ini juga mendedahkan pelajar kepada interaksi antara molekul dan asas-asas fenomena permukaan dengan penekanan pada aplikasi kejuruteraan. Ini merangkumi sifat dan ciri permukaan pepejal serta sifat, kegunaan dan masalah, dan

	penghasilan sistem koloid. Kaedah teknik analisis yang melibatkan interaksi antara molekul dan fenomena permukaan, yang merangkumi GC, HPLC, peralatan BET, meter potensi zeta, dan Palung Langmuir akan diperihalkan dan cara mentafsir kaedah tersebut akan dihuraikan dengan terperinci. *This course presents an introduction to the elements of physical and analytical chemistry as a basic knowledge in chemical engineering. It covers basic concepts of phase transition and chemical equilibrium Students are exposed to quantitative analytical techniques such as calorimetry and spectrophotometry. Acid-base reaction, buffer solutions, ionic speciation are emphasized. The course also expose students to the fundamentals of surface phenomena with emphasis on engineering applications. This includes the nature and characterization of solid surfaces as well as the properties, uses and issues, and production of colloidal system. The methods of analytical techniques involving the intermolecular interaction and surface phenomena, which include GC, HPLC, BET equipment, zeta potential meter, and Langmuir Trough will be introduced and the interpretation of analytical data will be elaborated in detail.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	

KIL2001: Prinsip Proses Kimia II / *Chemical Process Principles II*

Kod Kursus *Course Code*	KIL2001
Tajuk Kursus *Course Title*	Prinsip Proses Kimia II *Chemical Process Principles II*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	-
Hasil Pembelajaran Kursus *Course Learning Outcomes*	*Pada akhir kursus, pelajar dapat:* *1. Menerangkan pelbagai bentuk tenaga dan terbitan persamaan am imbangan tenaga. (C3)* *2. Mendapatkan maklumat termo-fizikal yang diperlukan daripada sumber teori atau empirikal untuk digunakan dalam perhitungan imbangan tenaga. (C3)* *3. Melakukan imbangan tenaga tidak bertindakbalas dan bertindakbalas untuk sistem tertutup dan terbukan dengan mengambilkira darjah kebebasan dan imbangan jisim. (C4)* *At the end of the course, students are able to:* *1. Explain the various forms of energy and the derivation of the general energy balance equation. (C3)KIL1002* *2. Extract necessary thermo physical data from theoretical or empirical sources for use in energy balance calculations. (C3)* *3. Perform non-reactive and reactive energy balance for closed and open systems with considerations of the degrees of freedom and mass balance. (C4)*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Pelajar akan diperkenalkan kepada pelbagai bentuk tenaga dan terbitan persamaan am imbangan tenaga untuk sistem tertutup dan terbuka. Kaedah untuk mendapatkan sifat termo-fizikal akan dikupas. Kemudian pelajar menyelesaikan masalah imbangan tenaga untuk sistem tidak bertindakbalas kimia. Penggunaan darjah kebebasan yang dipelajari dalam kursus terdahulu akan diperkembangkan. Ini akan diikuit oleh imbangan tenaga bertindakabalas kimia, dengan menggunakan kedua-dua haba pembentukan dan haba tindakbalas. Kursus ini disudahi dengan masalah lebih rumit yang melibatkan penyelesaian serentak imbangan jisim dan tenaga. *The students are introduced to the forms of energy and the derivation of the general energy balance equation for closed and open systems. Methods to obtain thermo-physical properties will be elaborated. Later students will solve energy balance problems for non-reactive*

	processes. The use of degrees of freedom learnt in an earlier course will be extended. This is followed by reactive energy balance, using both the heats of formation as well as the heat of reaction. This course concludes with the more complex problems that involve simultaneous solutions of mass and energy balances.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Felder R. M. & Rousseau R. W. (2020). Elementary Principles of Chemical Processes. 4th. Edition. John Wiley & Sons. 2. Himmelblau D. M. & Riggs J. B.. (2013). Basic Principles and Calculations in Chemical Engineering, 8th Ed, Pearson. 3. Murphy R. (2007). Introduction to Chemical Processes (Principles, Analysis, Synthesis), McGraw-Hill. 4 Reklaitis G. V. (1983). Introduction to Material and Energy Balances, John Wiley & Sons.

KIL2002: Kimia Organik/ *Organic Chemistry*

Kod Kursus *Course Code*	KIL2002
Tajuk Kursus *Course Title*	Kimia Organik *Organic Chemistry*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Mengenalpasti ikatan kimia, struktur dan nama molekul organik. 2. Menghuraikan laluan dan tindak balas untuk penghasilan bahan-bahan organik yang penting dalam industri. 3. Menerangkan laluan untuk penghasilan pelbagai hasil petrokimia dan oleokimia. *At the end of the course, students are able to:* *1. Identify chemical bonds, structures and names of organic molecules.* *2. Describe routes and reactions for the production of industrially important organic substances.* *3. Explain production routes of different petrochemicals and oleochemicals.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memperkenalkan asas kimia organik dengan memberi tumpuan kepada aplikasi dalam bidang kejuruteraan kimia. Kursus ini memperkenalkan struktur molekul, asal, laluan tindak balas dan aplikasi industri pelbagai bahan kimia organik. Teras kursus ini memberi tumpuan kepada pemahaman mendalam mengenai kimia organik dalam pemprosesan petroleum, gas asli, petrokimia dan oleokimia. Kursus ini juga akan merangkumi beberapa aspek penting proses pempolimeran. *The course introduces fundamentals of organic chemistry with emphasis on the application in chemical engineering. The course exposes students to molecular structures, origin, reaction paths and industrial applications of various organic chemicals. The core of the subject focuses on an in-depth understanding of organic chemistry in petroleum, natural gas, petrochemicals and oleochemicals processes. The subject will also cover the essentials of polymerisation.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*: 0%

Rujukan Utama *Main Reference*	1. Organic Chemistry, T.W.Graham Solomons, Craig B.Fryhle. 12th Edition, John Willey & Sons, 2016. 2. Organic Chemistry, Global Edition, 8th Edition, Paula Yurkanis Bruice, Pearson, 2017. 3. Chemistry of Petrochemical Processes, Sami Matar & Lewis F.Hatch, Elsevier, 2001. 4. Fatty Acids - Chemistry, Synthesis, and Applications, 1st Edition, Moghis Ahmad, Academic Press and AOCS Press, 2017. 5. The Future of Glycerol: New Uses of a Versatile Raw Material, Mario Pagliaro & Michele Rossi, RSc Punlishing, 2008. 6. Oleochemical Manufacture and Applications, F.D. Gunstone and Richard John Hamilton, CRC Press, 2001.

KIL2004: Makmal dan Komunikasi I / *Laboratory and Communications I*

Kod Kursus *Course Code*	KIL2004
Tajuk Kursus *Course Title*	Makmal dan Komunikasi I *Laboratory and Communications I*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	*Di akhir kursus ini, pelajar dapat:* *1. Menjelaskan teori-teori yang menyokong eksperimen yang dikendalikan.* *2. Menjalan eksperimen yang berkaitan asas kejuruteraan kimia. Menganalisa data eksperimen.* *3. Mempersembahkan keputusan eksperimen dalam laporan teknikal dan pembentangan lisan* *At the end of the course, students are able to:* *1. Explain theories underpinning the experiments conducted.* *2. Perform experiments related to chemical engineering fundamentals.* *3. Analyse experimental data.* *4. Present experimental results in technical reports and oral presentation.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memberi satu latihan asas kepada pelajar dalam menjalani ujikaji berkenaan subjek kejuruteraan kimia (mekanik bendalir, termodinamik, pengangkutan momentum dan jisim, kimia fizikal) menganalisa data ujikaji, menulis laporan teknikal, dan membentang secara lisan. Kefahaman pelajar tentang teori ujikaji juga diperkuatkan melalui sesi lisan dengan pensyarah sebelum sesi makmal. Pelajar dikehendaki mengkaji aspek keselamatan ujikaji semasa sesi lisan. *The course provides a basic training to students in conducting experiments related to fundamental chemical engineering subjects (fluid mechanics, thermodynamics, momentum and mass transport, physical chemistry), analyzing experimental data obtained, writing technical reports, and delivering oral presentation. Students' understandings on theories of experiments are also enhanced via lab oral session with lecturers prior to laboratory sessions. Students are to assess the safety aspect of the experiment during the lab oral session.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*: 0%

Rujukan Utama *Main Reference*	1. Manual makmal, panduan makmal Lab manual and guidelines 2. Pelbagai rujukan berkenaan dengan ujikaji Various references related to experiments

KIL2005: Termodinamik Kejuruteraan Kimia II / *Chemical Engineering Thermodynamics II*

Kod Kursus *Course Code*	KIL2005
Tajuk Kursus *Course Title*	Termodinamik Kejuruteraan Kimia II *Chemical Engineering Thermodynamics II*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1) Menganggar pertukaran sifat dan fasa bagi bahan tulen dan campuran dengan menggunakan persamaan keadaan. 2) Menggunakan aturan rantai dan hubungan Maxwell untuk penjelmaan terbitan termodinamik 3) Mengira sifat termodinamik keseimbangan fasa kompleks dengan menggunakan model-model termodinamik berasaskan pekali aktiviti. 4) Menentukan kebolehlaksanaan termodinamik tindak balas untuk proses-proses kimia. *At the end of the course, students are able to:* *1) Estimate property change and phase behavior of pure solutions and mixtures using equations of state.* *2) Apply the chain rule and Maxwell relations to transform one thermodynamic derivative into another.* *3) Calculate the thermodynamic properties of complex phase equilibria using activity coefficient-based thermodynamic models.* *4) Determine the thermodynamic feasibility of reactions for chemical processes*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	*. Kursus ini menumpu pada prinsip-prinsip termodinamik dan aplikasi prinsip-prinsip tersebut pada keseimbangan bagi sistem yang mengandungi komponen-komponen tulen, bercampur atau bertindak balas. Kursus dimulakan dengan penggunaan termodinamik klasik dan generalisasi kepada sebarang wap dan cecair. Ini diikuti dengan teorem keadaan berpadanan dan persamaan-persamaan keadaan (EOS). Seterusnya, keseimbangan antara fasa atau dengan keadaan bertindak balas kimia akan dikaji untuk sistem tertutup. Pengiraan ciri-ciri spesis di dalam sistem berkomponen tulen, bercampur atau bertindak balas bergantung kepada aplikasi dan hubungan asas tenaga Gibbs; dengan itu hanya mampu memberikan maklumat tentang arah daya penggerak untuk satu sistem tetapi tidak dapat menggambarkan kadar satu sistem mencapai keseimbangan. Model-*

	model termodinamik lain seperti NRTl dan UNIQUAC juga akan digunakan untuk menganggarkan ciri-ciri termodinamik bagi keseimbangan fasa kompleks. Kesan tindak balas kimia terhadap keseimbangan kimia dan penukaran juga akan dikaji di dalam kursus ini. Pelajar juga akan didedahkan kepada pakej simulasi seperti HYSYS/ASPEN. *This course focuses primarily on the underlying principles of thermodynamics and the application of these principles to problems related to pure components, mixtures and reacting systems at equilibria. The use of the thermodynamic web and its generalization to any fluids will begin the course. This is followed by the theorem of corresponding state and other major equations of state (EOS).* *Subsequently, equilibria between coexisting phases or in the presence of chemical reactions will be examined for a closed system. The calculations for the properties of a species in a pure, mixed or reacting system are based upon the application of various fundamental property relations to Gibbs energy; thereby restricted to only providing information on the direction of the driving force for a given system but not on the rate with which a system reaches equilibrium. Other thermodynamic models such as NRTL and UNIQUAC would also be used to estimate the thermodynamic properties of complex phase equilibria. The effects of reaction conditions on chemical equilibrium and conversion will also be addressed in this course. Students would also be introduced to the various thermodynamic packages available in HYSYS/ASPEN.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1 Joseph Mauk Smith, Hendrick C. Van Ness, Michael M. Abbott, M. T. Swihart, Introduction to Chemical Engineering Thermodynamics, 8th Edition, McGraw-Hill, 2017 2. JR Elliot, CT Lira. Introductory Chemical Engineering Thermodynamics, 2nd edition, Prentice Hall, 2012 3. Jürgen Gmehling, Michael Kleiber, Bärbel Kolbe, Jürgen Rarey, Chemical Thermodynamics for Process Simulation, 2nd Edition, John Wiley and Sons, 2019 4. Arthur D. Pelton, Phase Diagrams and Thermodynamic Modeling of Solutions, Academic Press, 2018

KIL2006: Pemindahan Haba / *Heat Transfer*

Kod Kursus *Course Code*	KIL2006
Tajuk Kursus *Course Title*	Pemindahan Haba *Heat Transfer*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1) Menyelesaikan masalah konduksi, konveksi dan radiasi haba dalam geometri mudah. 2) Menentukan koefisien pemindahan haba secara semulajadi dan perolakan haba paksa. 3) Menganalisis prestasi penukar haba menggunakan perbezaan log min suhu dan/ atau menggunakan kaedah keberkesanan NTU *At the end of the course, students are able to:* *1) Solve conduction, convection and heat radiation problem in easy geometry.* *2) Determine the natural heat transfer coefficient and forced heat convection.* *3Analyze heat exchanger performance using temperature difference log and / or using NTU effectiveness method*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini membolehkan pelajar untuk menerangkan hukum asas pemindahan haba. Pada masa yang sama, mereka akan belajar untuk menyelesaikan masalah konduksi dan radiasi haba dalam geometri mudah. Kemudian, pelajar akan didedahkan kepada cara pengiraan bagi menentukan koefisien pemindahan haba secara semulajadi dan perolakan haba paksa. Di akhir semester, mereka akan dilatih untuk menganalisis prestasi penukar haba menggunakan perbezaan log min suhu dan/ atau menggunakan kaedah keberkesanan NTU. *This course allows students to explain the basic law of heat transfer. At the same time, they will learn to solve conduction problems and heat radiation in simple geometry. Then, the student will be exposed to the calculation method to determine the coefficient of heat transfer naturally and the convection of forced heat. At the end of the semester, they will be trained to analyze the performance of the heat exchanger using differences in temperature logs and / or using the NTU effectiveness method.*
Pemberatan Penilaian	Penilaian Berterusan / *Continuous Assessment*: 40%

Assessment Weightage	Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Y. A. Cengel, A. J. Ghajar , “Heat and Mass Transfer: Fundamentals & Applications in SI Units”, 6th Ed., McGraw-Hill (2020) 2. T. L. Bergman, A. S. Lavine, F. P. Incropera, D. P. DeWitt, “Incropera's Principles of Heat and Mass Transfer”, John Wiley & Sons (2017)

KIL2007: Pemindahan Jisim / *Mass Transfer*

Kod Kursus *Course Code*	KIL2007
Tajuk Kursus *Course Title*	Pemindahan Jisim *Mass Transfer*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menerangkan konsep – konsep pemindahan jisim (fluks, resapan, pekali resapan dan pekali pemindahan jisim olakan) dan kesinambungannya dalam kejuruteraan kimia. 2. Menggunakan persamaan pemindahan jisim untuk menyelesaikan secara analitikal masalah mudah yang melibatkan resapan, olakan dan / atau tindakbalas. 3. Menilai masalah – masalah kompleks berkaitan dengan pemindahan jisim dengan menggunapakai pekali pemindahan jisim yang sesuai, termasuk yang melalui analogi. 4. Mencadangkan kajian ujikaji ke atas pemindahan jisim bagi mencari pekali resapan dan pekali pemindahan jisim olakan. *At the end of the course, students are able to:* *1. Explain the concepts of mass transfer (flux, diffusion, diffusivity, and convective mass transfer coefficient) and its significance in chemical engineering.* *2. Apply mass transfer equation to solve analytically simple problems involving diffusion, convection and / or reaction.* *3. Evaluate complex problems related to mass transfer by applying appropriate mass transfer coefficients, including those via analogies.* *4. Propose experimental investigations on mass transfer to find diffusivity and convective mass transfer coefficient.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memperkenalkan resapan jisim dan fluks, seterusnya Hukum Fick dan pekali resapan. Persamaan konstitutif Fick akan dimasukkan dalam imbangan jisim untuk menghasilkan persamaan am pemindahan jisim. Pelbagai keadaan penting yang boleh diselesaikan secara analitikal seperti resapan pada lapisan pegun gas, resapan sama molar, resapan serentak dengan tindakbalas akan dikaji. Dengan pendedahan ini, kaedah ujikaji asas untuk menilai pekali resapan akan diliputi. Untuk keadaan yang lebih rumit termasuk lapisan sempadan dan aliran pelbagai fasa, konsep dan pemakaian pekali pemindahan jisim olakan akan diperkenalkan. Ini akan diikuti lagi oleh perbincangan

	ke atas kaedah ujikaji untuk menentukan pekali pemindahan jisim. Untuk kes tanpa data empirikal, kegunaan dan salah-guna analogi akan dikaji. *This course first introduces mass diffusion and flux, leading to Fick's Law and the diffusivity. The Fickian constitutive equation will then be incorporated into the material balance to arrive at the general mass transport equation. Various important scenarios amenable to analytical solution such as diffusion in a stagnant gas film, equimolar diffusion, diffusion with reaction will be examined. With these established, basic experimental methods of evaluating the diffusivity will be covered. For more complex situations including boundary layers and multiphase flows, the concept and application of convective mass transfer coefficient are introduced. This is again followed by discussions on experimental techniques to determine the mass transfer coefficient. For cases with no empirical data, use and misuse of analogies are examined.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1 Fundamentals of Momentum, Heat, and Mass Transfer, James Welty, Gregory L. Rorrer, David G. Foster, 7th. Ed., John Wiley & Sons, 2019. 2. Transport Processes and Unit Operations, Christie John Geankoplis, Allen Hersel, Daniel H. Lepek, 2nd Ed., Prentice Hall, 2018. 3 Diffusion and Mass Transfer, James S. Vrentas, Christine M. Vrentas, 1st Ed., CRC Press, 2013.

KIL2008: Proses Pemisahan I / *Separation Processes I*

Kod Kursus *Course Code*	KIL2008
Tajuk Kursus *Course Title*	Proses Pemisahan I *Separation Processes I*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	*Termodinamik Kejuruteraan Kimia II, Prinsip Proses Kimia I*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	*Di akhir kursus ini, pelajar dapat:* *1. Membincangkan jenis unit operasi yang melibatkan pemindahan jisim antara fasa.* *2. Membuat pengiraan asas (contoh: keseimbangan bahan, bilangan tahap) bagi penyulingan perduaan dan pelbagai komponen, penyerapan gas dan pengekstrakan cecair.* *3. Mencadangkan rekabentuk permulaan bagi penyulingan, penyerapan gas dan pengekstrakan lajur.* *At the end of the course, students are able to:* *1. Discuss the types of unit operations which involve inter-phase mass transfer.* *2. Perform basic calculations (e.g. material balance, number of stages) for binary and multicomponent distillation, gas absorption and liquid-liquid.* *extraction.* *3. Propose preliminary design for distillation, gas absorption and extraction columns.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memberi pendedahan kepada pelajar mengenai konsep pemindahan jisim antara fasa yang terlibat dalam unit operasi dan perbezaan di antara jenis unit operasi. Penggunaan persamaan berkaitan bagi pengiraan VLE dan LLE untuk pemodelan unit operasi yang terlibat dalam proses pemisahan akan diperkenalkan. Akhir sekali, pengetahuan ini akan digunakan untuk memilih kaedah yang sesuai bagi mereka bentuk turus penyulingan, penyerapan dan penyarian. *This course exposes the students to the concept of interphase mass transfer in unit operations and the different types of unit operations. The use of the relevant equations e.g. vapour-liquid equilibria (VLE) and liquid-liquid equilibria (LLE) to perform basic calculations in separation processes will be introduced. Lastly, this knowledge will be used to arrive at preliminary designs of distillation, gas absorption and extraction columns.*

Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Geankoplis C J, 2018, 'Transport Process and Unit Operations', Prentice-Hall. 5th Edition. 2. Mc.Cabe W L, Smith J C, 2005, 'Unit Operations of Chemical Engineering', McGraw-Hill. 7th Edition. 3. Seader& Henley, 2012, 'Separation Process Principles', John Wiley & Son. 3rd Edition. 4. Coulson J M, Richardson J F, 2002, 'Chemical Engineering Vol 2, Butterworth-Heinemann. 5. Smith B D, 1980, Design of Equilibrium Stage Processes, McGraw Hill. 6. Treybal R E, 1981, Mass Transfer Operations, McGraw-Hill.

KIL2009: Kejuruteraan Tindakbalas Kimia I / *Chemical Reaction Engineering I*

Kod Kursus *Course Code*	KIL2009
Tajuk Kursus *Course Title*	Kejuruteraan Tindakbalas Kimia I *Chemical Reaction Engineering I*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	*KIL1002*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	*Di akhir kursus ini, pelajar dapat:* 1. Membuat pengiraan asas untuk pelbagai reaktor (seperti reaktor kelompok, CSTR dan PFR) untuk sistem yang berisipadu tetap dan berubah; berasaskan kepada persamaan reka bentuk yang diterbitkan. (C3) 2. Menganalisis kadar tindakbalas kimia dan menggunakan data ujikaji untuk menentukan parameter kinetik. (C4) 3. Menyelesaikan masalah berkaitan dengan reaktor isotermal dan adiabatik, termasuk fenomena keadaan mantap berbilang. (C4) *At the end of the course, students are able to:* 1. *Perform calculations for different types of reactors (e.g. batch, CSTR and PFR) for constant and variable volume systems; based on derived design equations.* 2. *Analyse rate of chemical reaction and use experimental data to determine kinetic parameters. (C4)* 3. *Solve problems involving non-isothermal and adiabatic reactors, including multiple steady state phenomenon. (C4)*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memperkenalkan konsep kejuruteraan tindak balas kimia seperti persamaan kadar tindak balas, penukaran dan lain-lain. Konsep tersebut boleh digunakan untuk menerbit persamaan kadar tindak balas daripada andaian keadaan mantap pseudo dan andaian langkah had kadar. Persamaan kadar pula boleh menerbit persamaan rekabentuk untuk reaktor berbilang (kelompok, CSTR, PFR, PBR) serta skim tindak balas (isipadu malar dan berubah). Berdasarkan daripada pengetahuan pelbagai jenis reaktor, data ujikaji untuk menentukan kinetik parameter dapat dianalisiskan. Kursus ini juga meliputi imbangan jisim dan tenaga supaya fenomena keadaan mantap berbilang untuk reaktor tidak sesuhu dan adiabatik boleh dikenalpastikan.

	This course introduces the concept of chemical reaction engineering such as rate expressions, conversion etc. These concepts are used to derive rate equation for reaction, based on pseudo steady state assumption, rate limiting step assumptions. The rate equations can be used to derive design equation for different types of reactors (batch, semi-batch, CSTR, PFR) and reaction schemes (constant and variable volume). Based on the knowledge of types of reactors, the experimental data for determination of kinetic parameters can be analysed. The course also covers mass and energy balances to examine the effects on the product yield and multiple steady state phenomenon for non-isothermal and adiabatic reactors.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. S.H. Fogler, Element of Chemical Reaction Eng. Prentice Hall, 2021 2. O. Levenspiel, Chemical Reaction Engineering, John Wiley,1999 3. J. M. Smith Chemical Engineering Kinetics. McGRAW-HILL, 1981 4. L.D. Schmidt,The Engineering of Chemical Reaction. 2nd Ed. Oxford University press, 2005 5. G.W. Roberts, Chemical Reactions and Chemical Reactors, John Wiley, 2009 6. W.L. Luyben, Chemical Reactor Design and Control, John Wiley, 2007

KIL2010: Biokimia / *Biochemistry*

Kod Kursus *Course Code*	KIL2010
Tajuk Kursus *Course Title*	Biokimia *Biochemistry*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Membezakan jenis mikroorganisma dan biomolekul yang berlainan dan aplikasi mereka dalam industri. 2. Bezakan tindakbalas enzim tak-terencat dan terencat dan kebezaan kinetik mereka. 3. Jelaskan jalan metabolisma utama seperti glikolisis dan kitaran asid sitrik dan aplikasi industri. 4. Tentukan kinetik pertumbuhan sel dalam kultur berkelompok dan berterusan. *At the end of the course, students are able to:* *1. Distinguish different types of microorganisms and biomolecules and their applications in industry.* *2. Differentiate enzymatic reactions without and with inhibition and how they differ in kinetics.* *3. Describe major metabolic pathways such as glycolysis and citric acid cycle and its industrial applications.* *4. Determine cell growth kinetics in batch and continuous culture.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini mendedah pelajar kepada asas biokimia dengan menitikberatkan aplikasi dalam pelbagai bioproses. Pertama, struktur dan fungsi mikroroganisma dan biomolekul diperkenalkan. Kemudian, mekanisma, kinetik dan perencatan tindakbalas enzim dibincang, disusuli dengan corak pertumbuhan sel, pelbagai faktor pengaruhi pertumbuhan sel dan fungsi jalan metabolik dalam sel. Akhirnya, model Monod diguna untuk huraikan kinetik pertunbuhan sel dalam kultur berkelompok dan berterusan. *This course aims to expose students to the basics of biochemistry with emphasis on applications in various bioprocesses. Firstly, the structures and functions of microorganisms and biomolecules are introduced. Then, the mechanisms, kinetics and inhibitions of enzymatic reactions are discussed, followed by typical cell growth pattern, various factors affecting the cell growth and the functions of important metabolic pathways in cells. Lastly, Monod model is applied to determine the kinetics of cell growth in batch and continuous cultures.*

Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%

Rujukan Utama *Main Reference*	1. M. Madigan, J. Marticko, D. Stahl, and D. Clark (2015). Brock Biology of Microorganisms. Pearson, 14th edition. 2. C. W. Pratt, and K. Cornely (2017). Essential Biochemistry. Wiley, 4th edition. 3. M. Shuler, F. Kargi, and M. DeLisa (2017). Bioprocess Engineering: Basic Concepts. Prentice Hall, 3rd edition.

KIL2011: Statistik Gunaan untuk Kejuruteraan / Applied Statistics for Engineering

Kod Kursus *Course Code*	KIL2011
Tajuk Kursus *Course Title*	Statistik Gunaan untuk Kejuruteraan *Applied Statistics for Engineering*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menentukan statistik deskriptif dan graf yang sesuai bagi data univariasi dan multivariasi. 2. Melaksanakan penilaian hipotesis dan analisa selang keyakinan bagi min populasi dan varians 3. Mencadangkan rekabentuk eksperimen yang sesuai untuk data atau masalah yang diberi *At the end of the course, students are able to:* *1. Determine the descriptive statistics and suitable graphs of univariate and multivariate data.* *2. Perform hypothesis testing and confidence intervals analysis for the population mean and variance* *3. Propose appropriate experimental designs for a given data or problem*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini mengajar para pelajar tentang penggunaan inferens statistik dalam penentuan dan penganggaran ciri- ciri populasi. Para pelajar akan diajar tentang proses- proses dan keperluan menghasilkan rekabentuk eksperimen yang bagus berdasarkan rekabentuk faktoran penuh dan faktoran pecahan. Penganalisaan menggunakan ANOVA melengkapi kursus ini. Pelajar akan diberi pendedahan kepada perisian yang sesuai. *This course teaches students the use of statistical inference in determining and estimating the characteristics. Students will be taught the processes and requirements to produce a good experimental design based on full factorial and fractional factorial designs. Analysis using ANOVA will complete the course. Students will be introduced to relevant softwares.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Montgomery, Douglas C. “Design and Analysis of Experiments”, 10th Edition, Wiley, June 2019

	2. Douglas C. Montgomery, George C. Runger. 'Applied Statistics and Probability for Engineers', 7th Edition, Wiley August 2019 3. Yuri A.W. Shardt, "Statistics for Chemical and Process Engineers : A Modern Approach",Springer International Publishing,2015.

KIL2012: Pengkomputeran Kejuruteraan Kimia / *Chemical Engineering Computing*

Kod Kursus *Course Code*	KIL2012
Tajuk Kursus *Course Title*	Pengkomputeran Kejuruteraan Kimia *Chemical Engineering Computing*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1) Menggambarkan blok binaan asas program Python. 2) Membangunkanalgoritma dengan Python untul menyelesaikan masalah matematik. 3) Mengembang program Python untuk menyelesaikan masalah berkaitan dengan kejuruteraan kimia. *At the end of the course, students are able to:* *1) Describe the basic building blocks of Python programmes.* *2) Construct algorithm using Python to solve mathematical problems* *3) Develop Python programmes to solve problems related to chemical engineering*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memperkenalkan program Python kepada pelajar. Pelajar akan mempelajari program asis Python, termasuk operasi aritmetik, gelung, fungsi dan pengendalian fail. Di samping itu, subjek juga akan memperkenalkan cara menggunakan Python untuk menyelesaikan masalah yang berkaitan dengan kejuruteraan kimia. *This course introductes Python programming to students. Students will learn the basic programming of Python, including arithmetic operations, loops, functions and file handling. In addition, the subject will also introduce how to use Python to solve problems related to chemical engineering.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*:
Rujukan Utama *Main Reference*	1. John V. Guttag, Introduction to Computation and Programming Using Python, The MIT Press, 2021 2. Mark J. Johnson, A Concise Introduction to Programming in Python (Second Edition), Chapman and Hall/CRC, 2018. 3. Kenneth A. Lambert, The Fundamentals of Python: First Programs (2nd Edition), Cengage Learning, 2017.

KIL3002: Mekanik Bendalir II / *Fluid Mechanics II*

Kod Kursus *Course Code*	KIL3002
Tajuk Kursus *Course Title*	Mekanik Bendalir II *Fluid Mechanics II*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Mekanik Bendalir I
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menyelesaikan masalah menggunakan imbangan momentum lelurus makroskopik. 2. Menerangkan penerbitan persamaan pergerakan pertama Cauchy dan penurunannya kepada persamaan Navier-Stokes atau bentuk sepadan untuk bendalir bukan Newtonian. 3. Menunjukkan penyelesaian analitikal untuk persamaan Navier-Stokes bagi masalah aliran mudah. 4. Menganalisis penyelesaian masalah aliran yang kompleks menggunakan perisian CFD komersial. *At the end of the course, students are able to:* *1. Solve problems using macroscopic linear momentum balance.* *2. Explain the derivation of the Cauchy's First Equation of Motion and its reduction to the Navier- Stokes equation or the corresponding non- Newtonian versions* *3. Demonstrate the analytical solutions of Navier- Stokes equation for simple flow problems.* *4. Analyse solutions of complex flow problems using commercial CFD software packages*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus bermula dengam konsep imbangan momentum lelurus dan applikasi. Ini diikuti oleh ungkapan ketegasan berpunca daripada pergerakan bendalir, seterusnya membawa kepada tensor ketegasan likat untuk pemaparan padat. Teorem Kecapahan terkembang atau imbangan momentum mikroskopik membolehkan penukaran kepada bentuk pembezaan, iaitu Persamaan Pergerakan Pertama Cauchy. Penggunaan persamaan konstitutif membawa kepada persamaan Navier-Stokes. Perbincangan kondisi sempadan untuk penyelesaian analitikal akan menyusul. Contoh masalah untuk penyelesaian analitikal akan diliputi untuk pelbagai masalah aliran mudah. Akhir sekali, asas CFD dan pakej perisian untuk penyelesaian berangka akan diperkenalkan untuk menangani masalah yang lebih rumit. *The course will begin with the integral linear momentum balance concepts and applications. This is followed by stresses due to fluid*

	motion and the stress tensor for compact representation. The extended Divergence Theorem or the differential linear momentum balance enables conversion into the differential form, i.e. Cauchy's First Equation of Motion. Application of constitutive equations leads to the Navier-Stokes equations. Discussions on boundary conditions for analytical solutions of Navier-Stokes equation will follow. Sample problems for analytical solutions will be covered for various simple flow problems. Finally, fundamental of CFD and software packages for numerical solution will be introduced to handle more complex problems.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. " Fluid Mechanics 8th Edition in SI unit.", Frank M. White, McGraw Hill; 2016. 2. " Fundamentals of Momentum, Heat and Mass Transfer", 7th Edition, Wiley; 2020. 3. " Fluid Mechanics Fundamentals and Applications", McGraw Hill; 2017. 4. "An Introduction to Computational Fluid Dynamics : The Finite Volume Method", Pearson; 2018.

KIL3003: Pemodelan Proses Kimia / *Chemical Process Modelling*

Kod Kursus *Course Code*	KIL3003
Tajuk Kursus *Course Title*	Pemodelan Proses Kimia *Chemical Process Modelling*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Kaedah Berangka Kejuruteraan *Numerical Methods for Engineering*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Mengaplikasikan prinsip model dinamik pertama bagi proses-proses kimia. 2. Menyelesaikan model dinamik untuk mendapat penyelesaian model proses. 3. Melaksanakan simulasi proses-proses kimia dengan menggunakan MATLAB dan Simulink. *At the end of the course, students are able to:* *1. Apply first principles dynamic modelling for chemical processes.* *2. Solve dynamic models to obtain the solution of process models.* *3. Simulate chemical processes using MATLAB and Simulink*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini menunjukkan langkah-langkah utama dalam menjalankan permodelan proses-proses kimia, menyelesaikan pelbagai jenis model dan pelelurusan model tak lelurus. Para pelajar akan menggunakan sistem lelurus dan tak lelurus. Sistem bukan linear diluruskan melalui pengembangan siri Taylor. Para pelajar akan didedahkan dengan penggunaan MATLAB dan Simulink untuk proses pemodelan. *This course shows the key steps in carrying out process modelling of a chemical process, solving different types of models and linearization of nonlinear models. Students will deal with both linear and nonlinear systems. Nonlinear systems are linearized through Taylor series expansion. Students will also be exposed to the usage of MATLAB and Simulink for modelling processes.*

Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Seborg, D. E., Edgar, T. F., Mellichamp, D. A., and Doyle III, F. J., Process Dynamics and Control (fourth edition), John Wiley (2016). 2. Bequette, B. W., Process Dynamics: Modelling, Analysis, and Simulation, Prentice Hall (1998). 3. Ferrareso Lona, Liliane Maria: A Step by Step Approach to the Modeling of Chemical Engineering Processes, Springer (2018). 4. Yeong Koo Yeo. Chemical Engineering Computation with MATLAB. CRC Press (2018).

KIE3005: Kawalan Proses / *Process Control*

Kod Kursus *Course Code*	KIL3004
Tajuk Kursus *Course Title*	Kawalan Proses *Process Control*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Permodelan Proses Kimia *Chemical Process Modelling*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menganalisa sambutan sistem gelung terbuka berbagai tertib. 2. Mereka bentuk pengawal untuk sistem gelung tertutup dengan menggunakan kaedah-kaedah lazim. 3. Menganalisa prestasi system terkawal dalam berbagai keadaan. *At the end of the course, students are able to:* *1. Analyse responses of systems with different orders.* *2. Design controllers for closed loop systems using conventional approaches.* *3. Analyse the performance of controlled systems under various conditions.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus bermula dengan sambutan dinamik proses menggunakan kaedah rangkap pindah. Ini diikuti dengan rumusan gambar rajah kawalan gelung tertutup dan kajian sambutan dan kestabilan sistem gelung tertutup mengguna pengawal konvensional. Reka bentuk sistem kawalan dengan teknik berasas frekuensi akan diajar bersama dengan kaedah kestabilan kriteria Bode termasuk penalaan pengawal. Reka bentuk sistem kawalan mengguna teknik lata akan juga diajar pada akhir kursus. *The course will initially cover the dynamic responses of processes of various orders using transfer function approach. It is followed by the formulation of the closed loop control block diagram and study of the responses and stability of these closed loop systems using conventional controllers. Design and tuning of control systems through frequency based techniques and the Bode stability criteria will follow. The design of cascade control systems will end the course.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Coughanowr & Steven E. LeBlanc, Process Systems, analysis and Control, McGraw-Hill , 2009.

	2. Seborg, D. E., Edgar, T. F., Mellichamp, D. A., and Doyle III, F. J., Process Dynamics and Control (fourth edition), John Wiley (2016). 3. Jose A. Romagnoli, Ahmet Palazoglu. Introduction to Process Control. CRC Press (2020) 4. Lawrence Daley. Handbook of Process Control and Instrumentation (Chemical Engineering). Clanrye International (2018).

KIL3005: Teknologi Zarah / *Particles Technology*

Kod Kursus *Course Code*	KIL3005
Tajuk Kursus *Course Title*	Teknologi Zarah *Particles Technology*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	*Tiada* *None*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	*Di akhir kursus ini, pelajar dapat:* *1. Mencirikan pepejal zarah dalam sesuatu sistem.* *2. Menggunakan persamaan yang sesuai bagi sistem zarah yang berbeza.* *3. Merekabentuk unit operasi yang berkaitan dengan sistem zarah.* *At the end of the course, students are able to:* *1. Characterise particulate solids in a system.* *2. Apply suitable equations for different particulate systems.* *3. Design unit operations involving particulate systems..*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memperkenalkan konsep dan teknologi yang melibatkan zarah. Kuliah bermula dengan memberi definisi dan ciri-ciri zarah pepejal. Kemudian, para pelajar diberi pengetahuan mengenai mekanisma lapisan terpadat dan terbendalir. Berikutan itu, pelbagai aplikasi mekanisma tersebut seperti penurasan, penyimpanan dan pengaliran dan laluan pneumatik diperkenalkan. Pada sesi-sesi akhir kursus, pelajar akan terlibat dalam reka bentuk unit operasi yang berkaitan dengan zarahan khususnya siklon dan corong. Kursus berakhir dengan perbincangan mengenai risiko kesihatan, kebakaran dan letupan oleh zarah halus. *This course covers concept and technologies involving particulate solids. The course begins with particulate solid definition and characterization. Then students are exposed to packed bed and fluidization mechanism. Following that, popular applications in the field such as filtration, storage and flow and pneumatic conveying are taught. Towards the end, students will be involved in equipment design of unit operations related to particulate systems, focusing on cyclone and hopper design. The course concludes with health, fire and explosion hazard of fine powders.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1 Introduction to Particle Technology, Martin Rhodes (2008).

	2. An Engineer's Guide to Particles and Powders: Fundamentals and Computational Approaches, Jonathan P.K. Seville Chuan-Yu Wu, Butterworth-Heinemann (2016

KIL3006: Sintesis dan Simulasi Proses / *Process Synthesis and Simulation*

Kod Kursus *Course Code*	KIL3006
Tajuk Kursus *Course Title*	Sintesis dan Simulasi Proses *Process Synthesis and Simulation*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Proses Pemisahan I dan Kejuruteraan Tindakbalas I *Separation Process I and Reaction Engineering I*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	*Di akhir kursus ini, pelajar dapat:* *1. Melaksanakan Konsep Kerangka Rekabentuk Produk (CPD) untuk menghasilkan rekabentuk-rekabentuk yang lebih baik.* *2. Mengaplikasikan konsep-konsep heuristik kepada pemilihan yang lebih baik untuk laluan proses dan unit operasi.* *3. Menghasilkan jujukan pemisahan bagi penggunaan tenaga yang optimum.* *4. Melaksanakan simulasi operasi-operasi unit utama seperti turus penyulingan, reaktor, penukar haba dan sebagainya untuk menghasilkan carta aliran imbangan jisim dan tenaga yang lengkap* *At the end of the course, students are able to:* *1. Implement Conceptual Product Design Framework (CPD) to develop improved designs.* *2. Apply heuristics concepts to improve selection of process pathways and unit operations.* *3. Develop separation trains for optimum energy use.* *4. Perform simulation of major unit operations such as distillation columns, reactors, heat exchangers, etc to produce complete mass and energy balance flowsheet*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini membolehkan pelajar untuk belajar langkah- langkah utama dalam membangunkan aliran lembaran proses untuk pengeluaran bahan kimia. Pelajar didedahkan kepada prinsip-prinsip asas penjujukan pemisahan. Kursus ini juga memperkenalkan penggunaan perisian proses Aspen Hysis bagi memudahkan penyelesaian masalah kejuruteraan yang kompleks yang berkaitan dengan reka bentuk loji proses kimia. Selain itu, pelajar dilatih tentang bagaimana untuk menjalankan analisis sensitiviti dan pengoptimuman berdasarkan kriteria tertentu seperti ketulenan produk dan kos.

	This course enables students to learn the key steps in developing the process flow sheet for the production of chemicals. Students are exposed to basic principles of sequencing of separation columns. This course also introduces the use process simulator Aspen Hysis to facilitate solving of complex engineering problems associated with the design of chemical process plants. Additionally, students are trained on how to conduct sensitivity analysis and optimization based on certain criteria such as product purity and cost.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Warren D. Seider, Daniel R. Lewin, J. D. Seader, Soemantri Widagdo, Rafiqul Gani, Ka Ming Ng. Product and Process Design Principles: Synthesis, Analysis and Evaluation, 4th Edition, Wiley (2016). 2. El-Halwagi, M., Sustainable Design Through Process Integration, 2nd Edition. Elsevier (2017). 3. Henley, Ernest J., Seader J. D., Roper D. Keith, Separation Process Principles, International Student Version, 3rd Edition, John Wiley & Sons (2011). 4. Uhlemann J, Costa R, Charpentier JC: Product experiments design and engineering in chemical engineering: past, present state and future. Chemical Engineering Technology (2019), 42(11):2258-2274 5. Zhang L, Babi DK, Gani R: New vistas in chemical product and process design. Annu Rev Chem Biomol (2016), 7:557-582.

KIL3007: Proses Pemisahan II / *Separation Processes II*

Kod Kursus *Course Code*	KIL3007
Tajuk Kursus *Course Title*	Proses Pemisahan II *Separation Processes II*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Prinsip Proses Kimia II *Chemical Process Principles II*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Pada akhir kursus, pelajar dapat: 1. *Menjelaskan prinsip asas bagi proses yang berkaitan dengan pelembapan/penyah lembapan, pengeringan, pengewapan, penghabluran dan sistem membran.* 2. *Membuat pengiraan (contoh keseimbangan jisim dan tenaga) bagi proses pemisahan berkaitan dengan pelembapan/ penyahlembapan, pengeringan, pengewapan, penghabluran dan sistem membran.* 3. *Memilih peralatan pemisahan yang sesuai untuk pelembapan/ penyahlembapan, pengeringan, pengewapan, penghabluran dan sistem membran* *At the end of the course, students are able to:* 1. *Explain the fundamental principles of humidification/dehumidification, drying, evaporation, crystallisation and membrane separation processes.* 2. *Perform calculations (eg. mass and energy balances) of separation processes related to humidification/ dehumidification, drying, evaporation, crystallization and membrane systems.* 3. *Propose appropriate separation equipment for humidification/ dehumidification, drying, evaporation and crystallisation and membrane separation processes.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memberi pengenalan terhadap prinsip-prinsip beberapa proses pemisahan (contoh: pelembapan/penyah lembapan, pengeringan, pengewapan, penghabluran dan system membrane). Pengiraaan rekabentuk yang berkaitan seperti imbangan jisim dan haba, pertaburan saiz dan lain-lain akan diperkenalkan. Ini akan diikuti dengan huraian mendalam berkenaan jenis-jenis peralatan yang sedia ada. Seterusnya kursus ini akan dilengkapi dengan perbincangan mengenai pemilihan peralatan bersesuaian untuk sesuatu aplikasi yang spesifik. *This course introduces the principles of various separation processes (e.g. humidification / dehumidification, drying, evaporation, crystallization, membrane separation). The relevant design*

	calculations such as mass and energy balances, size distribution etc. will be introduced. This will be followed by more detailed descriptions of the different types of equipment available. Finally the course will conclude with discussions on the appropriate selection of separation equipment(s) for a specific application.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Geankoplis, C.J., 'Transport Process and Unit Operations, 5th edn, 2018, Prentice-Hall. 2. Treybal, R.E., 'Mass Transfer Operations", 3rd edn, 1980, McGraw Hill 3. Seader, J.D. and Henley, E.J., 'Separation Process Principles: Chemical and Biochemical Operations', 2013, John Wiley & Sons. 4. McCabe, W., Smith, J. and Harriot, P., "Unit Operations of Chemical Engineering', 2005, McGraw Hill's.

KIL3008: Keselamatan Proses dan Pencegahan Susutan / *Process Safety and Loss Prevention*

Kod Kursus *Course Code*	KIL3008
Tajuk Kursus *Course Title*	Keselamatan Proses dan Pencegahan Susutan *Process Safety and Loss Prevention*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	*Di akhir kursus ini, pelajar dapat:* *1. 1.Mengenalpasti hazad di tempat kerja dan unit-unit proses yang boleh menyebabkan berlakunya kemalangan. (C2, P2, A1)* *2. Menilai pendedahan pekerja terhadap hazad di dalam persekitaran tempat kerja yang boleh memudaratkan keselamatan dan kesihatan pekerja. (C4, P3, A3)* *3. Mencadangkan ukuran kawalan bagi mengurangkan impak hasil dari kegagalan proses dan sistem (C6, P4, A3)* *4. Melakukan penyiasatan kemalangan dalam mengenalpasti kelemahan- kelemahan di dalam Sistem Pengurusan Keselamatan Proses (C4, P2, A3)* *At the end of the course, students are able to:* *1. Identify hazards at workplace and processing units that may cause the occurrence of accidents. (C2, P2, A1)* *2. Appraise worker exposure to hazards in the workplace environment which may harm the workers' safety and health. (C4, P3, A3)* *3. Propose control measures to reduce impacts as a result of system and process failures. (C6, P4, A3)* *4. Conduct accident investigation by identifying deficiencies in the Process Safety Management System. (C4, P2, A3*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kaedah dalam mengenalpasti bahaya di tempat kerja melalui Bancian Pemeriksaan Senarai Semak, Tinjauan Keselamatan, Analisa Keselamatan Kerja dan HIRAC,HAZOP dan Analisa 'Fault Tree' akan dijelaskan. Kaedah analitikal untuk menganggarkan keboleharapan peralatan ada dijelaskan. Impak dari BLEVE dan Letupan Awan Wap (VCE) akan juga dipelajari. Model Sumberdan Penyerakkan untuk melihat pelbagai scenario ke arah pelepasan toksik akan juga dipelajari. Kaedah-kaedah Kawalan akan dibincangkan untuk melihat beberapa ukuran kawalan yang boleh diaplikasikan untuk menyahkan hazad yang berpotensi menyebabkan kehilangan jiwa, kerosakkan harta benda dan juga impak ke atas alam sekitar.

	Pencegahan yang berkesan dari sebarang kebakaran dan letupan di loji kima memerlukan penggabungan pelbagai teknik rekabentuk seperti pengalihudaraan,system pemercik, bentangan peralatan keselamatan, symbol-simbol keselamatan, laluan kecemasan, dll. Kursus ini juga akan merangkumi kaedah penyiasatan kemalangan dan mengkaji kelemahan- kelemahan di dalam Sistem Pengurusan Keselamatan Proses dan kaedah kawalan lain. *Methods to identify hazardsin workplace by application of Survey Checklist Inspection, Safety Review, Job Safety Analysis and HIRAC, Hazard and Operability (HAZOP) study and Fault Tree Analysis (FTA) will be explained. Analytical methods to estimate reliability of equipment are described. Impact from BLEVE and Vapor Cloud Explosion (VCE) will also be looked at. Source Dispersion Models to look on various scenarios leading to toxic release will also be included. Control Techniques will be discussed to look on possible control measures that can be applied to eliminate the hazards that may lead to loss of personnel, damage to property and environment. The successful prevention of fires and explosions in chemical plants requires a combination of many design techniques and these are also included such as ventilation, sprinkler system, safety equipment layout, safety signs, escape routes, etc. This course also includes method for accident investigation and to look for deficiencies in the Process Safety Management System and other control measures.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Daniel, Crowl and Joseph: Chemical Process Safety: Fundamentals with Applications, Prentice-Hall, 2019. 2. 514 Acts: Occupational Health and Safety Act. 3. Benintendi, R. Process Safety Calculations. Elsevier, 2018.

KIL3009: Makmal dan Komunikasi II / Laboratory and Communication II

Kod Kursus *Course Code*	KIL3009
Tajuk Kursus *Course Title*	Makmal dan Komunikasi II *Laboratory and Communication II*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Makmal dan Komunikasi I *Laboratory and Communication I*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	*Di akhir kursus ini, pelajar dapat:* *1. Menyatakan prinsip-prinsip asas kejuruteraan kimia dan bagaimana ia berkait dengan ujikaji makmal.* *2. Mereka ujikaji berdasarkan pernyataan masalah yang berkaitan dengan proses kejuruteraan kimia.* *3. Melaksanakan ujikaji-ujikaji makmal berkaitan dengan perkakas kejuruteraan kimia mengikut prosedur - prosedur yang telah dirancang.* *4. Membentangkan hasil analisa dan dapatan ujikaji dalam laporan teknikal dan pembentangan lisan.* *At the end of the course, students are able to:* *a. Describe chemical engineering fundamental principles and how it relates to the laboratory experiment.* *b. Design an experiment based on a given problem statement related to chemical engineering processes.* *c. Perform laboratory experiments related to chemical engineering equipment according to planned procedures.* *d. Present analysis result and finding of the experiment in technical report and oral presentation*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini mengandungi dua jenis ujikaji yang berbeza, iaitu ujikaji tetap dan ujikaji “Pembelajaran Berasaskan Masalah” (PBL). Untuk ujikaji - ujikaji tetap, pelajar menjalankan kerja makmal dengan mengikuti prosedur yang diberikan. Untuk ujikaji PBL, pelajar dikehendaki mereka satu ujikaji berasaskan pernyataan masalah yang dibagikan. Dengan kursus ini, pelajar didedahkan kepada ujikaji berkaitan dengan pelbagai jenis unit operasi, termasuk penukar haba, turus penyulingan, reaktor, pencampur, penyejat, dan sistem kawalan proses. Pelajar diperlukan bekerja dalam kumpulan, menganalisa hasil makmal, dan menyediakan laporan teknikal. Sesi lisan dengan pensyarah dan pembentangan dijalankan sepanjang masa kursus ini. *This course consists of two different types of experiments, i.e., regular experiments and problem based learning (PBL) experiments. In regular*

	experiments, students conduct laboratory works according to the given procedures. In the PBL experiment, students are required to design an experiment based on the given problem statement. Throughout this course, students are exposed to experiments related to various unit operations, which include the heat exchanger, distillation column, reactor, mixer, evaporator, and process control system. The students are required to work in team, analysing the experiment results, and prepare technical reports. Face-to-face oral sessions with lecturers and presentations are also conducted throughout the whole session of the course.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1 Manual makmal dan garis panduan Lab manual and guidelines 2 Rujukan berkaitan dengan topik ujikaji References relevant to the experimental subjects.

KIL3010: Latihan Industri/ *Industrial Training*

Kod Kursus *Course Code*	KIL3010
Tajuk Kursus *Course Title*	Latihan Industri *Industrial Training*
Kredit *Credit*	5
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	*Tiada* *None*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Mengamalkan etika dan amalan professional kejuruteraan dalam persekitaran kerja. 2. Menyiasati isu-isu kejuruteraan dalam bidang yang berkaitan ke arah pembelajaran sepanjang hayat. 3. Mengenal pasti isu-isu kesihatan dan keselamatan awam dalam persekitaran kerja kejuruteraan yang berkaitan. 4. Memaparkan semangat kerja berpasukan dalam persekitaran kerja. 5. Menunjukkan kemahiran komunikasi dan penyampaian berkaitan dengan industri. 6. Merumuskan penyelesaian yang praktikal untuk masalah berkaitan dengan industri. 7. Menilai kesan penyelesaian kejuruteraan terhadap alam sekitar yang mampan. *At the end of the course, students are able to:* *1. Adopt ethics and professional engineering practice in working environment.* *2. Investigate engineering issues in related field towards lifelong learning.* *3. Identify public health and safety issues in relevant engineering working environment.* *4. Display team working spirit in working environment.* *5. Demonstrate industrial related communication and presentation skills.* *6. Formulate practical solutions for industrial related problems.* *7. Examine the impact of engineering solution towards sustainable environment.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memberi pelajar peluang untuk mengaplikasikan dan mempraktikkan pengetahuan yang dipelajari dalam teori untuk membangunkan kemahiran mereka untuk bekerja secara berdikari. Dalam tempoh latihan pelajar dapat mempelajari pengkhususan bidang alternatif. Latihan meningkatkan pengetahuan pelajar, melatih mereka untuk tugas-tugas profesional dan melengkapi pembelajaran.

	This course gives the student a possibility to apply and practice the knowledge learnt and theory to develop their skills in working independently. During the training period the student gets familiar with a specific area of the specialisation alternatives of the degree programme. The training deepends student's knowledge, trains them for the professional tasks and complements the studies.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*:
Rujukan Utama *Main Reference*	*1. Riordan, D. (2013). Technical report writing today. USA: Cengage Learning.* *2. Manuele, F. A. (2013). On the practice of safety. USA: John Wiley & Sons.* *3. Goetsch, David L. (2011). Occupational Safety and Health for Technologists, Engineers, and Managers, 7th eds. N.J.: Pearson Prentice Hall*

KIL3011: Kejuruteraan Tindakbalas Kimia II / *Reaction Engineering II*

Kod Kursus *Course Code*	KIL3011
Tajuk Kursus *Course Title*	Kejuruteraan Tindakbalas Kimia II *Reaction Engineering II*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Kejuruteraan Tindakbalas Kimia I *Reaction Engineering I*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Pada akhir kursus, pelajar dapat: 1. Huraikan jenis pemangkin, tindak balas bermangkin dan kaedah mencirikan pemangkin berliang berdasarkan penjerapan. 2. Menentukan persamaan kadar tindak balas heterogen berdasarkan kawalan tindak balas, kawalan penjerapan 3. dan kawalan resapan untuk pemangkin dari pelbagai geometri. 4. Menilai kesan pemindahan jisim (luaran dan dalaman) pada kepekatan dan kecerunan suhu antara fasa pukal, permukaan pemangkin dan di dalam pelet pemangkin. 5. Lakukan rekabentuk awal reaktor heterogen (seperti. Rektor buburan dan rektor lapisan terpadat) *At the end of the course, students are able to:* *1. Describe types of catalyst, catalytic reactions and methods of characterising porous catalysts based on adsorption.* *2. Determine the heterogeneous reaction rate equation based on reaction control, adsorption control and diffusion control for catalysts of different geometries.* *3. Appraise the effects of mass transfer (external and internal) on concentration and temperature gradients between the bulk phase, the catalyst surface and inside the catalyst pellet.* *4. Perform preliminary design of heterogeneous (e.g. slurry, packed bed) reactors*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini pertamanya memperkenalkan sifat, ciri dan kaedah untuk menghasilkan pemangkin berliang, diikuti dengan tindakbals bermangkin dan kriterianya. Semua mekanisme yang terlibat dalam tindakbalas bermangkin resapan pukal, penjerapan, reaksi permukaan dan resapan dalaman akan dibincangkan. Ini diikuti dengan liputan terperinci mengenai faktor keberkesanan dan Modulus Thiele. Pengenalpastian langkah mengawal kadar tindakbalas(mis. Kriteria

	Weisz-Prater) akan dibincangkan. Kursus ini diakhiri dengan rekabentuk reaktor heterogen *This course first introduces the properties, characterization and methods to manufacture porous catalysts, to be followed by the catalytic reactions and their criteria. All possible mechanisms for the catalytic reactions, i.e. bulk diffusion, adsorption, surface reaction and internal diffusion will be covered. This is followed by detailed coverage of the effectiveness factor and the Thiele Modulus. Identification of the rate limiting step (e.g. Weisz-Prater criterion) will be discussed. This course concludes with the preliminary designs of heterogeneous reactors.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. S.H. Fogler, Element of Chemical Reaction Eng. Prentic Hall, 2021. 2. O. Levenspiel, Chemical Reaction Engineering, John Wiley, 3rd Ed. 1999. 3. J. M. Smith, Chemical Engineering Kinetics. McGRAW-HILL,1981. 4. L.D. Schmidt,The Engineering of Chemical Reaction. 2nd Ed. Oxford University press, 2005. 5. G.W. Roberts, Chemical Reactions and Chemical Reactors, John Wiley, 2009. 6. W.L. Luyben, Chemical Reactor Design and Control, John Wiley, 2007

KIL 3013: Latihan Rekabentuk Berintegrasi / *Integrated Design Exercise*

Kod Kursus *Course Code*	KIL 3013
Tajuk Kursus *Course Title*	Latihan Rekabentuk Berintegrasi *Integrated Design Exercise*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Melengkapkan 50 jam kredit *Completed 50 credit hours*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus, pelajar dapat: 1. Menilai pelbagai proses yang boleh menghasilkan produk akhir yang disasarkan berdasarkan maklumat yang dikumpul daripada kajian literatur. 2. Menghasilkan Gambarajah Aliran Proses untuk proses yang terpilih berdasarkan piawaian kejuruteraan 3. Menyelesaikan pengiraan keseimbangan material dan tenaga bagi semua aliran utama dan sampingan dalam proses; dan merumuskan nilai-nilai yang diperoleh dalam 'Helaian Aliran Proses'. *At the end of the course, students are able to:* *1. Evaluate various possible process routes that could lead to the targeted final product/goal based on information gathered from the literature studies.* *2. Create a Process Flow Diagram (PFD) of the selected process route according to the engineering standards* *3. Solve the material and energy balances calculation for all major and minor streams in the process and summarize the values in a Process Flow Sheet*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Latihan rekabentuk berintegrasi ialah satu kursus yang memerlukan pelajar menggunakan pengetahuan kejuruteraan yang telah dipelajari untuk melengkapkan projek yang ditugaskan. Secara berkumpulan, pelajar dikehendaki mengambilkira semua kebarangkalian proses yang dapat menghasilkan produk akhir yang disasarkan; dan membuat penilaian penyelesaian yang paling praktikal dan mampan untuk projek. Seterusnya pelajar perlu merekabentuk Gambarajah Aliran Proses yang sesuai dan menjalankan pengiraan keseimbangan material dan tenaga untuk proses yang dipilih. Kesemua dapatan dalam kursus ini perlu dilaporkan mengikut piawaian kejuruteraan. *The integrated design exercise is a courses that require students to use the engineering knowledge they have learnt to complete the assigned*

	project. In groups, students are required to take into account all possible process routes that could lead to the targeted final product/goal; and evaluate the most practical and sustainable solution for the project. Subsequently, students are also required to design a suitable Process Flow Diagram (PFD) and solve the material and energy balances calculations for the selected route. All findings and outputs obtained from this course are required to be presented according to the engineering standards.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*: 0%
Rujukan Utama *Main Reference*	1. Sinnott, R. K. &Towler, G. "Chemical Engineering Design", 6th ed., Butterworth-Heinemann, 2019. 2. Green, D.W. & Southard, M.Z., "Perry's Chemical Engineers' Handbook", 9th ed., McGraw-Hill, 2018. 3. Smith, R. M., "Chemical Process: Design and Integration", 2nd ed., Wiley, 2016. 4. Turton, R., Bailie, R. C., Whiting, W. B. & Shaeiwitz, J. A., "Analysis, Synthesis, and Design of Chemical Processes", 4th ed., Prentice-Hall, 2012. 5. Seider, W. D., Seader, J. D. & Lewin, D. R., "Product and Process Design Principles: Synthesis, Analysis, and Evaluation", 2nd ed., Wiley, 2004. 6. Peters, M. S., Timmerhaus, K. D., West, R. E. & Peters, M., "Plant Design and Economics for Chemical Engineers", 5th ed., McGraw-Hill, 2002. 7. Towler, G. & Sinnott, R. K., "Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design", 2nd ed. Butterworth-Heinemann, 2013

KIL3014: Rekabentuk berintegrasi / *Integrated design*

Kod Kursus *Course Code*	KIL3014
Tajuk Kursus *Course Title*	Rekabentuk berintegrasi *Integrated design*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Memilih ukuran paip nominal (NPS) dan nombor jadual untuk saluran paip berdasarkan kod dan piawai paip. 2. Menilai langkah-langkah kawalan kesihatan, keselamatan dan persekitaran yang sesuai untuk satu unit operasi. 3. Membina gambarajah paip dan instrumentasi untuk satu unit operasi. *At the end of the course, students are able to:* *1. Select the nominal pipe size (NPS) and schedule number for a pipeline based on piping codes and standards.* *2. Evaluate suitable health, safety and environmental control measures for a unit operation.* *3. Construct a piping and instrumentation diagram for a unit operation.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memberi pendedahan kepada kod dan piawaian perpaipan, ukuran dan nombor jadual paip serta pengiraan yang diperlukan untuk operasi unit. Pendedahan terhadap pencampuran dan pengadukan cecair dalam tangki dan penggabungan pemindahan haba dalam kapal berjaket yang bergolak juga disediakan. Kursus ini membantu mengintegrasikan langkah-langkah kawalan kesihatan, keselamatan dan persekitaran yang memuncak pada pembinaan gambarajah paip dan instrumen. Konsep sistem pelepasan tekanan untuk operasi unit juga digabungkan *This course provides the exposure to piping codes and standards, nominal pipe size and schedule number and the subsequent calculations required for a unit operation. Exposures to mixing and agitation for liquids in tanks and heat transfer calculations in agitated jacketed vessels are also provided. This course helps to integrate health, safety and environmental control measures that culminates in the construction of a piping and instrumentation diagram. Concepts of pressure relief systems for a unit operation are also incorporated.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*:

Rujukan Utama *Main Reference*	1. Green, D.W. & Southard, M.Z. Perry's Chemical Engineer's Handbook. McGraw Hill Professional, 2018. 2. ASME Boiler & Pressure Veseel Code Section VIII. Rules for Construction of Pressure Vessels Division 1. American Society of Mechanical Engineers, 2019. 3. Chhabra, R.P. & Shankar, V. Coulson and Richardson's Chemical Engineering: Volume 1A: Fluid Flow: Fundamentals and Applications. Butterworth-Heinemann, 2017. 4. Sinnott, R. Chemical Engineering Design: Chemical Engineering Volume 6. Elsevier, 2005. 5. Towler, G. & Sinnott, R. Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design. Elsevier, 2013. 6. Crowl, D.A. & Louvar, D.A. Chemical Process Safety Fundamentals with Applications. Prentice Hall, 2011. 7. Turton, R., Bailie, R.C., Whiting, W.B., Shaeiwitz, J.A. Analysis, Synthesis and Design of Chemical Processes. Pearson Education, 2008. 8. Douglas, J.M. Conceptual design of chemical processes. McGraw Hill, 1988.

KIL3015: Rekabentuk Kelengkapan Proses/ *Design of Process Equipment*

Kod Kursus *Course Code*	KIL3015
Tajuk Kursus *Course Title*	*Rekabentuk Kelengkapan Proses* *Design of Process Equipment*
Kredit *Credit*	3
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	*KIL2008 Proses Pemisahan I*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Mencadangkan rekabentuk asas perpaipan, bekas proses dan sokongan berdasarkan piawaian, kod dan peraturan. 2. Menentukan pakej peralatan yang sesuai (rekabentuk terpelihara) (seperti pemacu, utiliti, peralatan bergerak) untuk tugas tertentu. 3. Menganggarkan kos peralatan proses individu. *At the end of the course, students are able to:* *1. Propose basic design of piping, process vessels and their supports according to standards, codes and regulations.* *2. Determine suitable packaged (proprietary) equipment (such as drives, utilities moving equipment) for a particular duty.* *3. Estimate the cost of individual process equipment.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memberi pendedahan kepada pelajar kepada kod, piawaian, kriteria dan amalan yang digunakan dalam rekabentuk dan pemasangan peralatan dan sistem-sistem kejuruteraan kimia. Pengetahuan ini akan membimbing para pelajar untuk menyediakan rekabentuk asas atau memilih peralatan yang bersesuaian untuk proses yang diberikan. Kursus ini juga memberi pendedahan kepada penganggaran kos peralatan individu dan sistem berpakej. *This course first exposes the students to the codes, standards, criteria, and practices used in the design and installation of chemical engineering equipment and systems. This knowledge would then guide students to provide the basic design or arrive at suitable selections of the right equipment for a given process. This course then touches on the estimation of cost of individual equipment and packaged systems.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%

Rujukan Utama *Main Reference*	*1. Ray Sinnott and Gavin Towler (2020) Chemical Engineering Design. SI Edition (Sixth edition). Butterworth-Heinemann.* *2. Richard Turton, Joseph A. Shaeiwitz, Debangsu Bhattacharyya, and Wallace B. Whiting. Analysis, Synthesis, and Design of Chemical Processes (2018) 5th Edition. Pearson.* *3. Green, D.W. & Southard, M.Z., "Perry's Chemical Engineers' Handbook", 9th ed., (2018), McGraw-Hill.* *4. Subhabrata Ray and Gargi Das (2020) Process Equipment and Plant Design : Principles and Practices. Elsevier Science Publishing Co Inc*

KIL4002: Projek Rekabentuk / *Design Project*

Kod Kursus *Course Code*	KIL4002
Tajuk Kursus *Course Title*	Projek Rekabentuk *Design Project*
Kredit *Credit*	6
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	KIL2008 Proses Pemisahan 1 KIL3011 Kejuruteraan Tindak Balas Kimia 2 KIL3008 Keselamatan Proses dan Pencegahan Susutan KIL3004 Kawalan Proses
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Melakukan kajian kebolehlaksanaan teknikal dan ekonomi untuk proses kimia. 2. Mensintesiskan proses kimia dan gambarajah aliran proses dengan mengambil kira aspek keselamatan, kesihatan dan persekitaran (SHE), dan kos untuk loji kimia. 3. Merekabentuk peralatan atau sistem utama (seperti reaktor, sistem pemisahan, sistem perpaipan), lengkap dengan P&ID, reka bentuk kejuruteraan mekanikal dan pertimbangan SHE untuk sesuatu proses kimia. 4. Menerapkan prinsip etika, standard dan kod etika kejuruteraan profesional dalam kekangan reka bentuk proses kimia. 5. Berkomunikasi secara berkesan mengenai aktiviti kejuruteraan yang kompleks. 6. Berfungsi dengan berkesan sebagai individu dan sebagai ahli pasukan dalam projek kumpulan. 7. Mengatur masa, tenaga dan sumber yang bersesuaian untuk menyelesaikan projek. *At the end of the course, students are able to* 1. *Conduct technical and economic feasibility studies for a chemical process.* 2. *Synthesize a chemical process and a process flow diagram by taking into consideration safety, health and environmental (SHE), and costing aspects for a chemical plant.* 3. *Design a major equipment or system (e.g. reactor, separation system, piping system), complete with P&ID, mechanical engineering design and SHE considerations for a chemical process.* 4. *Apply ethical principles, standards and professional engineering code of ethics within the constraint of a chemical process design* 5. *Communicate effectively on complex engineering activities.* 6. *Function effectively as an individual and as a team member in a group project.*

	7. *Organize appropriate time, manpower and resources to complete the project.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Pelajar bekerja dalam kumpulan berempat atau berlima ditugaskan masalah rekabentuk terbuka contohnya, pengeluaran bahan kimia. Dalam semester pertama, setiap kumpulan perlu mencadangkan carta aliran yang boleh dilaksanakan berdasarkan pertimbangan teknikal, ekonomi, keselamatan, kesihatan dan alam sekitar (SHE). Ini termasuk imbangan jisim dan tenaga. Dalam semester kedua, setiap pelajar perlu merekabentuk peralatan atau sistem utama loji yang dicadangkan (contohnya reaktor kimia, turus penyulingan, rangkaian pertukaran haba) lengkap dengan lukisan kejuruteraan, ciri-ciri keselamatan, sistem kawalan dan anggaran harga. *Students work in groups of four or five on an assigned open-ended design problem e.g. production of chemicals. In the first semester, each group has to propose feasible flow sheets based on technical, economic, safety, health and environmental (SHE) considerations. These will include mass and energy balances. In the second semester, each student has to design a major equipment or system of the proposed plant (e.g. chemical reactor, distillation column, heat exchange network) complete with the engineering drawings, safety features, control systems and costing.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*:
Rujukan Utama *Main Reference*	1. Sinnott, R. K. &Towler, G. “Chemical Engineering Design”, 6th ed., Butterworth-Heinemann, 2019. 2. Green, D.W. & Southard, M.Z., “Perry’s Chemical Engineers’ Handbook”, 9th ed., McGraw-Hill, 2018. 3. Smith, R. M., “Chemical Process: Design and Integration”, 2nd ed., Wiley, 2016. 4. Kirk, R. E., Othmer, D. F., “Kirk-Othmer Encyclopedia of Chemical Technology”, Vols. 1 to 26, 5th ed., Wiley-Interscience, 2007 5. Turton, R., Bailie, R. C., Whiting, W. B. & Shaeiwitz, J. A., “Analysis, Synthesis, and Design of Chemical Processes”, 4th ed., Prentice-Hall, 2012. 6. Seider, W. D., Seader, J. D. & Lewin, D. R., “Product and Process Design Principles: Synthesis, Analysis, and Evaluation”, 2nd ed., Wiley, 2004. 7. Peters, M. S., Timmerhaus, K. D., West, R. E. & Peters, M., “Plant Design and Economics for Chemical Engineers”, 5th ed., McGraw-Hill, 2002. 8. Towler, G. & Sinnott, R. K., “Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design”, 2nd ed. Butterworth-Heinemann, 2013. 9. Manual perisian ASPEN HYSYS.

KIL4003: Projek Penyelidikan / *Research Project*

Kod Kursus *Course Code*	KIL4003
Tajuk Kursus *Course Title*	*Projek Penyelidikan* *Research Project*
Kredit *Credit*	6
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	*Laboratori dan Komunikasi II*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Mengenal pasti masalah/jurang, skop dan objektif penyelidikan melalui kajian literatur yang sistematik. 2. Membentuk sebuah cadangan penyelidikan dengan latar belakang yang jelas, masalah/jurang penyelidikan, objektif, kaedah yang sesuai dan pelan yang praktikal. 3. Menjalankan kajian penyelidikan/ eksperimen menggunakan pelbagai teknik, sumber dan alat kejuruteraan dan IT yang sesuai. 4. Menilai data penyelidikan secara kajian dan analisa yang sistematik serta tafsiran saintifik untuk mencapai kesimpulan yang tepat 5. Membentang projek penyelidikan secara lisan, poster dan laporan bertulis. 6. Menunjukkan ciri-ciri individu yang efektif dalam menjalankan projek penyelidikan *At the end of the course, students are able to:* *1. Identify research problems/gaps, scope, objectives via systematic literature review.* *2. Construct a research proposal with clear background, research problems/gaps, objectives, sound methodology and practical plans.* *3. Conduct research study/experiment using appropriate techniques, resources, and modern engineering and IT tools.* *4. Evaluate research data via systematic review and analysis, and scientific interpretation to reach sound conclusions.* *5. Present the research project via oral communication, poster, and written reports.* *6. Demonstrate effectiveness as individual in executing the research project.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini membolehkan pelajar untuk mempelajari langkah-langkah utama dalam menjalankan projek penyelidikan. Pelajar akan dilatih untuk menulis kertas cadangan penyelidikan serta melakukan eksperimen/ujikaji secara simulasi yang berkaitan dengan kertas cadangan penyelidikan. Mereka kemudian didedahkan kepada cara

	menganalisis secara saintifik data ujikaji atau simulasi. Selain itu, pelajar dilatih untuk membentangkan hasil penyelidikan melalui laporan bertulis, pembentangan lisan dan poster. *This course allows students to learn the key steps in carrying out a research project. Students are trained in writing a research proposal as well as in conducting research experiment/simulation study related to their research proposal. They are then exposed to how to analyze experimental data or simulated data in a scientific manner. In addition, students are trained to present research findings through written reports, oral and poster presentations.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*:
Rujukan Utama *Main Reference*	1. Jurnal penyelidikan, paten, maklumat di internet dan buku rujukan 2. Research journals, patents, information on the internet and reference books

KIL4004: Asas Pencemaran Udara / *Air Pollution Fundamental*

Kod Kursus *Course Code*	KIL4004
Tajuk Kursus *Course Title*	Asas Pencemaran Udara *Air Pollution Fundamental*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat*:* 1. Membincangkan isu –isu berkaitan dengan pencemaran udara dan jenis, sumber dan kesan pencemar udara. 2. Mengenalpasti teknik pemantauan dan peralatan untuk pencemar udara yang penting. 3. Melakukan perhitungan untuk penyerakan pencemar udara. 4. Mencadangkan strategi kawalan yang sesuai untuk pencemar udara zarahan dan bergas *At the end of the course, students are able to:* *1. Discuss the issues related to air pollution and the types, sources and effects of air pollutants.* *2. Identify monitoring techniques and equipment for important air pollutants.* *3. Perform calculations for dispersion of air pollutants.* *4. Propose appropriate control strategies for particulate and gaseous air pollutants.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Sifat interaktif sistem alam sekitar global diterapkan terlebih dahulu. Kajian pencemaran udara bermula dengan kronologi sejarah peristiwa pencemaran udara yang signifikan. Jenis, sumber dan kesan/impak pencemar udara dibincang secara terperinci serta dikaitkan dengan sumbangan pencemar udara kepada fenomena pertukaran iklim. Kuantifikasi pencemaran udara diperkenalkan melalui pemantauan dan pengukuran pencemar udara terpenting. Penyerakan pencemar udara dibincang bermula dengan aspek meteorologi udara diikuti dengan ungkapan matematik menggunakan persamaan Gaussian mudah. Pendekatan terhadap pengurusan pencemaran udara diperincikan melalui beberapa strategi. Teknologi kawalan untuk mencegah pencemaran udara dibincang untuk komponen zarahan dan gas. *The interactive nature of the global environment system is first established. The air pollution proper starts with the historical chronology of major air pollution events. The types, sources and effects/impacts of air pollutants are elaborated with emphasis on health*

	impacts and contribution of air pollutants to climate change. Quantification of air pollution is introduced through monitoring and measurement of major air pollutants. The dispersion of air pollutants is discussed through meteorological beginnings followed by mathematical expressions using simple Gaussian dispersion equations. The approach towards management of air pollution is then elaborated using several strategies. Possible control technology to mitigate air pollution is discussed based on particulates and gaseous components.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	

KIL4005: Integrasi Proses / *Process Integration*

Kod Kursus *Course Code*	KIL4005
Tajuk Kursus *Course Title*	Integrasi Proses *Process Integration*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Mengira suhu jepit dan keperluan sasaran utiliti minima dengan menggunakan analisis jadual masalah dan lengkung komposit. 2. *Mengoptimumkan rangkaian penukar haba bagi pemulihan maksima tenaga (MER) termasuklah arus pecahan.* 3. *Mengurangkan bilangan unit penukar haba dengan menggunakan santaian tenaga dan santaian laluan* 4. *Menggunakan perisian Aspen Energy Analyser (AEA) untuk mereka-bentuk rangkaian penukar haba (MER) bagi logi pemprosesan kimia.* *At the end of the course, students are able to:* 1. *Calculate pinch temperature and target minimum utilities using problem table analysis and composite curve.* 2. *Optimize the heat exchanger networks for maximum energy recovery (MER) including stream splitting.* 3. *Reduce the number of heat-exchanger unit using energy and path relaxation.* 4. *Use Aspen Energy Analyser (AEA) software tools to design heat exchanger network (MER) for chemical process plant.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Pelajar akan diperkenalkan dengan integrasi proses bagi loji pemprosesan dengan menggunakan gambarajah bawang bermula dari reaktor, diikuti dengan pemisah, kemudian penukar haba dan akhirnya utiliti. Fokus akan lebih tertumpu kepada pemulihan maksima tenaga (MER) dari aliran proses dengan menggunapakai kaedah jepit bagi tujuan mengurangkan penggunaan utiliti (stim dan air pendinginan). Pembangunan lengkung komposit akan disusuli. Rekabentuk rangkaian penukar haba berdasarkan MER dan kaedah (contohnya pecahan arus, rantaian tenaga) untuk memperolehi jumlah penukar haba minima akan mengakhiri kursus ini. Di samping itu pelajar di dedahkan dengan penggunan perisian bagi mendapatkan rangkaian penukar haba untuk logi pemprosesan.

	The students will be introduced to the process integration of the process plant using onion diagram which begins with reactors, followed by separators, then heat exchangers and finally the utilities. Focus will be more on the maximum energy recovery (MER) from the process streams by applying pinch techniques with the aim of using minimum utilities (steam and cooling water). The construction of the Grand Composite Curve will follow. Design of heat exchanger network based on MER and techniques (e.g., stream splitting, energy relaxation) to obtain the minimum number of heat exchangers required will conclude this course. In addition, the students will be exposed to the software which will be used to obtain the heat-exchanger network for the process plant.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / Continuous Assessment: 40% Peperiksaan Akhir / Final Examination: 60%
Rujukan Utama *Main Reference*	

KIL4006: Kawalan Proses Termaju / *Advanced Process Control*

Kod Kursus *Course Code*	KIL4006
Tajuk Kursus *Course Title*	Kawalan Proses Termaju *Advanced Process Control*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Kawalan Proses *Process Control*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	*Di akhir kursus ini, pelajar dapat:* 1. Rekabentuk teknik kawalan proses lanjutan yang sesuai untuk pelbagai jenis proses kimia dan operasi unit. 2. Mengguna teknik pembuatan kepintaran (artificial intelligence) untuk sistem proses kimia. 3. Mengkaji pelaksanaan berbagai pengawal termaju dalam sistem-sistem proses kimia. *At the end of the course, students are able to:* *1. Design appropriate advanced process control techniques for different types of chemical processes and unit operations.* *2. Apply artificial intelligence techniques for chemical process systems.* *3. Evaluate the performance of various advanced controllers in chemical process systems*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini merangkumi teori dan kegunaan berbagai strategi kawalan termaju seperti kawalan penyesuaian, kawalan tidak lelurus, kaedah jejaring neural dan kawalan logik untuk sistem-sistem proses kimia *The course will cover the theory and applications of various advanced control strategies such as adaptive control, nonlinear control, neural networks methods and fuzzy logic control for various chemical process systems.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	

KIL4007: Pengurusan Sisa Pepejal / *Solid Waste Management*

Kod Kursus *Course Code*	KIL4007
Tajuk Kursus *Course Title*	Pengurusan Sisa Pepejal *Solid Waste Management*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menganggarkan kuantiti penghasilan dan ciri-ciri terma, kimia, fizikal dan biologi sisa munisipal tercampur. 2. Mengenal pasti kaedah yang paling sesuai bagi pemuliharaan sumber, penyimpanan, pengangkutan, dan rawatan bagi sisa pepejal. 3. Menganalisa isu-isu semasa dan peluang perniagaan berasaskan sisa pepejal. *At the end of the course, students are able to:* *1. Estimate the quantity of generation and thermal, chemical, physical and biological characteristics of a mixed municipal waste.* *2. Identify the most appropriate resource recovery, storage, transportations and treatment methods for a given solid waste* *3. Analyse current issues and business opportunities based on solid waste..*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Pelajar akan diajar untuk mengenalpasti ciri-ciri therma, kimia, biologi dan fizikal sisa pepejal. Pelajar juga akan mempelajari pelbagai komponen pengurusan sisa termasuk pengumpulan, penyimpanan, pengangkutan, perawatan, pemulihan sumber dan penanaman sisa secara sistematik. Selain daripada itu, pelajar juga akan didedahkan kepada isu semasa dan peluang perniagaan yang berkaitan dengan sisa pepejal. *In this subject the student will be taught to characterize waste for their thermal, chemical, biological and physical properties. Subsequently, the students will be systematically introduced to various waste management components, which include collection, storage, transportation, treatment, resource recovery and finally landfilling. Through the course student will be also exposed to current issues and business opportunities available based on solid waste.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	

KIL4008: Rawatan Air Sisa / *Wastewater Treatment*

Kod Kursus *Course Code*	KIL4008
Tajuk Kursus *Course Title*	Rawatan Air Sisa *Wastewater Treatment*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	*Di akhir kursus ini, pelajar dapat:* *1. Bezakan pelbagai ciri air sisa dan impaknya ke atas alam sekitar.* *2. Menerangkan prinsip rawatan fizikal, kimia dan biologi serta aplikasinya.* *3. Melakukan pemodelan asas bagi proses enapcemar teraktif.* *4. Cadangkan sistem rawatan yang sesuai bagi air sisa dengan ciri-ciri tertentu.* *At the end of the course, students are able to:* *1. Distinguish various wastewater characteristics and their impacts on environment.* *2. Explain principles of physical, chemical and biological wastewater treatment and their applications.* *3. Perform basic modelling on suspended activated sludge process.* *4. Propose appropriate treatment system for wastewater with certain characteristics.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini mendedah pelajar kepada asas rawatan air sisa. Pertama, pelbagai ciri air sisa diperkenal dan impak ke atas alam sekitar dibincang. Kemudian, prinsip rawatan fizikal, kimia dan biologi dibincang, disusuli dengan pemodelan asas proses enapcemar teraktif. Penekanan diberi kepada aplikasi proses rawatan yand sesuai bagi air sisa dengan ciri-ciri berlainan. *This course aims to expose students to the fundamentals of wastewater treatment processes. Firstly, different wastewater characteristics are introduced and their impacts on environment discussed. Then, the principles of physical, chemical and biological wastewater treatment are discussed, followed by basic modelling of suspended growth treatment process. Emphasis is given to application of appropriate treatment process for wastewater with different characteristics.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%

Rujukan Utama *Main Reference*	

KIL4009: Penjerapan Dalam Pepejal Berliang / *Adsorption in Porous Solid*

Kod Kursus *Course Code*	KIL4009
Tajuk Kursus *Course Title*	Penjerapan Dalam Pepejal Berliang *Adsorption in Porous Solid*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menerangkan jenis liang mikro, meso dan makro. 2. Mentaksirkan bentuk garisan sesuhu serta mekanisma terlibat. 3. Menilai tebal dinding, jejari, isipadu, luas permukaan dan taburan saiz untuk liang mikro dan liang meso berdasarkan beberapa persamaan. *At the end of the course, students are able to:* *1. Describe various concepts related to micro, meso and macropores.* *2. Interpret the shape of the isotherms and the mechanisms involved.* *3. Evaluate the wall thickness, radius, volume, surface area and size distribution of micropores and mesopores using relevant equations*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memberi pengenalan kepada penjerapan dan pelbagai jenis liang, lengkung garisan sesuhu serta mekanisma terlibat. Ia juga meliputi termodinamik penjerapan, mekanisma penjerapan dan nyaherapan serta klasifikasi liang. Kursus ini akan diikuti oleh pengiraan isipadau liang mikro, meso dan taburan isipadu liang meso. *This course give introduction to adsorption and different types of pores, different types of isotherm curves and the mechanisms involved. It covers the thermodynamics of adsorption, adsorption and desorption mechanisms and pore classification. This will be followed by the determination of micropore volume, mesopore volume and mesopore volume distribution.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	

KIL4011: Keselamatan Proses Lanjutan dan Pencegahan Susutan / *Advanced Process Safety and Loss Prevention*

Kod Kursus *Course Code*	KIL4011
Tajuk Kursus *Course Title*	Keselamatan Proses Lanjutan dan Pencegahan Susutan *Advanced Process Safety and Loss Prevention*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Keselamatan Proses *Process Safety*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Melakarkan sistem pengurusan keselamatan yang baik di tempat kerja untuk meningkatkan kualiti keselamatan. 2. Melaksanakan penilaian risiko dan permodelan kemalangan menggunakan kaedah-kaedah dan perisian komputer terkini. 3. Menyediakan laporan ”Control of Industrial Major Accident Hazards” (CIMAH) bagi sesebuah binaan loji yang dapat meminimakan impak terhadap manusia, harta benda dan persekitaran akibat kemungkinan berlakunya kegagalan. *At the end of the course, students are able to:* *1. Describe better safety management system at workplace for a safety quality improvement.* *2. Perform risk assessment and accident modelling using advanced methods and computer software tools.* *3. Prepare Control of Industrial Major Accident Hazards (CIMAH) report for a plant to be built that will minimize impact to people, property and environment due to any failures.* .
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini akan mendedahkan pelajar kepada garis panduan berkenaan dengan sistem pengurusan keselamatan dan kesihatan pekerjaan dengan berlandaskan piawaian keselamatan kod dan amalan terbaik. Pelajar kemudiannya akan didedahkan kepada teknik audit keselamatan dan pemeriksaan aktiviti kerja menggunakan HIRARC. Penyediaan laporan CIMAH untuk sesebuah organisasi akan diliputi. Pelajar juga akan diperkenalkan kepada peralatan keselamatan (e.g. INOVA/PHAST) di dalam permodelan risiko dalam sesebuah loji. Mereka kemudiannya dikehendaki mencadangkan penunjuk prestasi keselamatan yang lebih baik bagi sesebuah organisasi berdasarkan Model Proses bagi industri tertentu. *This course will expose students to guidelines on occupational safety and health management system with the adherence of safety*

	standards, codes and best practice. Students will then be exposed to safety audit technique and analysing work activities using HIRARC. Preparation of a CIMAH report for an organization will be covered. Students will also be introduced to safety tools (e.g. INOVA/PHAST) in modelling risk in a plant. Later, they are required to suggest better safety performance indicators for an organisation based on the Process Model for a specific industry.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	

KIL4013: Teknologi Membran dan Proses / *Membrane Technology and Processes*

Kod Kursus *Course Code*	KIL4013
Tajuk Kursus *Course Title*	Teknologi Membran dan Proses *Membrane Technology and Processes*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Pada akhir kursus ini, pelajar dapat: 1. Menghuraikan prinsip-prinsip proses pemisahan membran, penyediaan membran dan teknik-teknik pencirian. 2. Menentukan sifat pengangkutan jisim dalam proses membran seperti osmosis songsang dan peresapan gas. 3. Menyelesaikan masalah yang melibatkan rekabentuk membran dan modul membran. *At the end of the course, students are able to:* *1. Describe the principles of membrane separation processes, membrane preparation and characterization techniques.* *2. Determine mass transport properties in membrane processes such as reverse osmosis and gas permeation.* *3. Solve problems involving design of membranes and membrane modules.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Mendedahkan pelajar kepada kepentingan membran dan proses pemisahan membran dalam aplikasi industri. Sifat, prinsip dan sifat pengangkutan setiap proses membran ditunjukkan dengan penekanan diberikan pada kuasa- kuasa memandu, mekanisme dan model pengangkutan melalui membran berliang dan tidak berliang. Bahan kursus adalah inovatif dan memberikan pelajar pengetahuan lanjutan tentang teknologi membran sebagai alat pemisahan dan tindakbalas dalam bidang kejuruteraan kimia. *Expose students to the importance of membranes and membrane separation processes in industrial applications. The nature, principles and transport properties of each membrane processes are demonstrated with the emphasis given on the driving forces, mechanism and transport model through porous and non-porous membranes. The course material is innovative and gives the students an advanced knowledge of membrane technology as a separation and reaction tools in the field of chemical engineering.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%

Rujukan Utama *Main Reference*	

KIL4016: Kejuruteraan Tindakbalas untuk Bioreaktor/ *Reaction Engineering for Bioreactors*

Kod Kursus *Course Code*	KIL4016
Tajuk Kursus *Course Title*	Kejuruteraan Tindakbalas untuk Bioreaktor *Reaction Engineering for Bioreactors*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menjalankan pengiraan bagi tindakbalas enzim dalam sistem biokimia dan bioproses. 2. Menganalisasikan pelbagai kinetik pertumbuhan. 3. Menilai kepentingan pemindahan jisim dan tindakbalas heteroneneous dalam bioproses . 4. Menentu rekabentuk utama serta aspek pengendalian bioreaktor *At the end of the course, students are able to:* *1. Perform calculations on enzymatic reactions in biochemical systems and bioprocesses.* *2. Analyze various kinetics of growth.* *3. Evaluate the importance of mass transfer in heterogeneous reactions in bioprocessing.* *4. Specify key design and operational aspects of a bioreactor.*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memperkenalkan tindakbalas dan proses biologi. Kursus ini meliputi pelbagai model bagi kinetik pertumbuhan dan proses pemindahan jisim yang mengaruhi kadar pencapaian keseluruhan, perkesanan kepekatan substratum, campuran dan suhu. Kursus ini juga meliputi pelbagai jenis bioreaktor di mana transformasi kimia dan biokimia berlaku. Aspek rekabentuk bioreaktor seperti tatarajah reaktor, saiz, keadaan pemprosesan dan ragam pengendalian akan dibincangkan. *This course introduces the biological reactions and the bioprocesses. It covers various growth kinetic models and the mass transfer processes that have considerable influence on the overall conversion rate, the effects of substrate concentration, mixing and temperature. The course also covers types of bioreactor where chemical and biochemical transformations take place. The aspects of the bioreactor design such as reactor configuration, saiz, processing conditions and mode of operation will be discussed too.*

Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Sustainable Engineering Products and Manufacturing Technologies: Kaushik Kumar, Divya Zindani, J. Paulo Davim., (2019) 2. Engineering for Sustainability: A Practical Guide for Sustainable Design, Jonker, G. & Harmsen J., (2012), Elsevier. 3. Environmental Engineering: Fundamental, Sustainability, Design. Mihelcic, JR. Zimmerman JB. (2013) Wiley 4. Sustainability Principles and Practice. Robertson, M. (2014). Routledge, UK. 5. Sustainability Economics: An Introduction, Bartelmus, P., (2013), Routledge 6. Corporate Social Responsibility: The Role of Business in Sustainable Development, Williams, O., (2013), Routledge. 7. The International Law of Environmental Impact Assessment: Process, Substance and Integration, Craik, N., (2010), Cambridge University Press.

KIL4018: Pembangunan Mampan dalam Kejuruteraan / *Sustainable Development In Engineering*

Kod Kursus *Course Code*	KIL4018
Tajuk Kursus *Course Title*	Pembangunan Mampan dalam Kejuruteraan *Sustainable Development In Engineering*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus, pelajar dapat 1. Mengaitkan impak pembangunan industri terhadap ekosistem. 2. Mencadangkan kerangka penilaian kelestarian untuk projek kejuruteraan. 3. Memberikan tindakan pencegahan untuk peningkatan indeks kelestarian projek kejuruteraan. *At the end of the course, students are able to:* *1. Relate the impacts of industrial development to ecosystems.* *2. Propose sustainability assessment frameworks for engineering projects.* *3. Provide mitigation measures to improve sustainability indices of engineering projects*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus bermula dengan imbasan semula peranan jurutera untuk melaksanakan konsep pembangunan lestari. Bagi mengaitkan sfera biotik dengan bukan biotik, struktur dan fungsi ekosistem, aliran jirim dan tenaga akan diliputi. Kemudian, kesan dan sumbangan aktiviti industri terhadap udara, air dan media tanah dibincang bersama dengan impak penggunaan tenaga dan pelucutan sumber. Pengenalpastian dan kuantifikasi kesemua impak ini melalui EIA seperti yang diamalkan sekarang akan menyusul. Ini akan membawa kepada konsep yang lebih mendalam berkaitan dengan kejuruteraan hijau / rekabentuk hijau berserta dengan kerangka penilaian dan penunjuk yang terhasil. Isu mencabar untuk mengimbangi ekonomi dan alam sekitar kemudiannya dikupas. Perspektif akan diperluaskan untuk mencakupi dimensi sosial kelestarian, terutamanya peranan dan penglibatan warga korporat. Dalam dunia global yang salingkait, kesemua tindakan tekno-sosio-ekonomik ini diselaraskan di bawah perundangan berkaitan dan perjanjian antarabangsa atau blok perdagangan. Seorang jurutera perlu tahu bagaimana untuk berusaha mencapai pembangunan lestari dalam kerangka perundangan tersebut. Bagi mencapai hasil

	pembelajaran dengan lebih berkesan, pelajar didedahkan dengan pelbagai aktiviti pembangunan kelestarian didalam dan juga luar kampus Universiti Malaya disamping mengambil bahagian dalam program kelestarian. *The course begins with a re-capitulation of the role of engineers to operationalise the sustainable development concept. To connect the biotic and abiotic spheres, the ecosystem structure, function, material and energy flows will be covered. Next the impact and contribution from industrial activities to air, water and soil media is discussed together with impacts due to energy utilization and resource depletion. Identification and quantification of these impacts via EIA as currently practiced will follow. This leads to more advanced concepts associated with green engineering/ green design together with the resulting assessment frameworks and indicators. The tricky issue of balancing economics against the environment is then addressed. The perspective widens further to encompass the social dimensions of sustainability, in particular the roles and involvement of corporate citizens. In this globally interconnected world, all these techno-socio- economic measures come under the umbrella of the relevant statutes and international treaties or trade blocks. The engineer must also know how to strive for sustainable development within these regulatory frameworks. To achieve learning outcomes more effectively, students are exposed to various sustainability development activities inside and outside the University of Malaya campus as well as participate in sustainability program*.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Sustainable Engineering Products and Manufacturing Technologies: Kaushik Kumar, Divya Zindani, J. Paulo Davim., (2019) 2. Engineering for Sustainability: A Practical Guide for Sustainable Design, Jonker, G. & Harmsen J., (2012), Elsevier. 3. Environmental Engineering: Fundamental, Sustainability, Design. Mihelcic, JR. Zimmerman JB. (2013) Wiley 4. Sustainability Principles and Practice. Robertson, M. (2014). Routledge, UK. 5. Sustainability Economics: An Introduction, Bartelmus, P., (2013), Routledge 6. Corporate Social Responsibility: The Role of Business in Sustainable Development, Williams, O., (2013), Routledge. 7. The International Law of Environmental Impact Assessment: Process, Substance and Integration, Craik, N., (2010), Cambridge University Press.

KIL4019: Kejuruteraan Lapisan Terbendalir Lanjutan / *Advanced Fluidization Engineering*

Kod Kursus *Course Code*	KIL4019
Tajuk Kursus *Course Title*	Kejuruteraan Lapisan Terbendalir Lanjutan *Advanced Fluidization Engineering*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	KIL3005 Teknologi Zarah KIL3011 Kejuruteraan Tindak Balas Kimia 2
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Mengklasifikasikan sifat zarah-zarah Geldart dan lapisan bendalir mengikut model aliran yang berbeza; 2. Mereka bentuk konfigurasi dan juga pelbagai komponen-komponen berkenaan di dalam reaktor lapisan terbendalir; dan 3. Mereka bentuk reaktor lapisan bendalir sebagai gas- pepejal reaktor pemangkin dan yang bukan-pemangkin *At the end of the course, students are able to:* *1. Classify the properties of Geldart particles and fluidized bed according to different flow models;* *2. Design the different configurations and components of fluidized bed reactor; and* *3. Design fluidized beds as catalytic and non-catalytic gas-solid reactors*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini bermula dengan ciri-ciri aliran zarah dan klasifikasi Geldart. Ini diikuti dengan pengenalpastian pelbagai jenis ciri-ciri fluidisasi, termasuk fenomena percampuran, pembalikan dan pengubahan, yang wujud tertakluk kepada keadaan operasi. Implikasi langsung dari pemindahan haba dan jisim di dalam lapisan terbendalir juga akan dibincangkan. Ini memungkinkan kejuruteraan lanjut untuk reka bentuk reaktor lapisan terbendalir dan komponen-komponen terlibat. Terakhirnya, kursus ini akan merangkumi kejuruteraan reaktor lapisan terbendalir yang melibat dan tidak melibatkan pemangkin untuk aplikasi industri penting termasuk yang digunakan untuk penukaran haba bahan api pepejal. *The course begins with the characteristics of particles flowability and Geldart classifications. This is followed by the identification of the different type of fluidization behaviors, their mixing, inversion and entrainment under different operating conditions. The direct implications of the heat and mass transfer within the fluidized bed will also discussed. This allows for further engineering design of the fluidized bed reactor and their components. Lastly, the course will cover*

	the design of non-catalytic and catalytic fluidized bed reactors for important industrial applications including those used for thermal conversion of solid fuels.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Wen C.Y., "Handbook of fluidization and fluid particle system" CRC Press, 2003. 2. Grace, J.R., Bi, X., Ellis, N., "Essentials of fluidization technology" Wiley-VCH, 2020 3. John G, Y, and Lettieri P., "Fluidized-bed reactors: Processes and Operating Conditions, 2016

KIL4020: Bahan Berfungsi Termaju / *Advanced Functional Materials*

Kod Kursus *Course Code*	KIL4020
Tajuk Kursus *Course Title*	Bahan Berfungsi Termaju *Advanced Functional Materials*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	KIL3001
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menentukan konsep bahan dan sistem berfungsi termaju, dan teknik sintesis bahan fungsian termaju (C2) 2. Pilih bahan berfungsi termaju untuk aplikasi kejuruteraan tertentu (C6) 3. Menilai aplikasi bahan berfungsi termaju berkenaan dengan kemungkinan pembuatan dan pelaksanaannya, dan aspek ekonomi (C6) 4. Menggunakan pengetahuan di atas untuk aplikasi terpilih, terutamanya elektronik, penyimpanan data, penderiaan dan bioperubatan.(C3) *At the end of the course, students are able to:* *1. Identify the concepts of advanced functional material and system, and the techniques for the synthesis of advanced functional (C2)* *2. Select advanced functional advanced materials for specific engineering applications (C6)* *3. Judge the appropriate application of advanced functional materials with respect to the feasibility of their fabrication and implementation, and to the economic aspects.(C6)* *4. Apply the above knowledge to selected applications, particularly electronics, data storage, sensing and biomedical. (C3)*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Bahan-bahan aktif baru yang berstruktur nano telah dibangunkan disebabkan oleh kemajuan teknologi fabrikasi dan pemahaman keadaan kerap tidak seimbang semasa sintesisnya. Kini pada abad ke-21, mereka adalah asas kepada banyak penyelesaian kejuruteraan berkaitan dengan kawalan alam sekitar, pengurusan tenaga, bioteknologi, elektronik berintegrasi, aeroangkasa dan lain-lain lagi. Kursus ini akan menyediakan pelajar kepada pengetahuan terbaru dalam bahan berfungsi dan composit system, dan juga teknik untuk menfungsikan bahan-bahan biasa. Penekanan akan diberikan kepada penggunaan bahan-bahan tersebut dalam industri. Contoh

	penggunaan praktikal termaju termasuk sensor pintar, penggerak pintar, alat penukaran tenaga, bahan termaju untuk elektronik dan data penyimpanan, dan lain lain. *New nanostructured active materials are being developed thanks to the advances in the fabrication technologies and to the understanding of frequently non-equilibrium conditions during their synthesis. They are now basis of numerous 21st century engineering solutions related to the control of environment, for energy management, for biotechnology, for integrated electronics, for aerospace, and for many others. This course will provide the students with the state-of-the-art knowledge on advanced functional materials and composite systems, as well as the techniques used to functionalize common materials. Particular emphasis will be placed on the application of these materials in the industry. Examples of advanced practical applications will include smart sensors, smart actuators, energy conversion devices, advanced materials for electronics and data storage, etc*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Leclerc, Mario / Gauvin, Robert, Functional Materials for Energy, Sustainable Development and Biomedical Sciences, DeGruyte, 2014. 2. S. Banerjee; A.K. Tyagi, Functional Materials: Preparation, Processing and Applications, Elsevier, 2011 3. Ewa Klodzinska, Functional Materials Properties, Performance and Evaluation, Apple Academic Press, 2015 4. Toshio NaitoFunctional MaterialsAdvances and Applications in Energy Storage and Conversion, Taylor & Francis Group, 2019 5. William F. Smith, Javad Hashemi, Foundations of Materials Science and Engineering, Mc Graw Hill Education, 2010. 6. Mel Schwartz, Smart Materials, CRC Press, Boca Raton, 2009

KIL4021: Proses Penguraian Kimia / *Chemical Decomposition Processes*

Kod Kursus *Course Code*	KIL4021
Tajuk Kursus *Course Title*	Proses Penguraian Kimia *Chemical Decomposition Processes*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	KIL2009
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menghuraikan pelbagai teknik/proses penguraian kimia dan kesesuaiannya berdasarkan maklumat yang diberikan. (C3) 2. Merekabentuk reaktor penguraian berdasarkan keperluan-keperluan operasi tertentu. (C5) 3. Menilai isu-isu berkaitan reaktor/relau penguraian kimia. (C6) *At the end of the course, students are able to:* *1. Elaborate the various methods/processes that lead to chemical decomposition and their suitability based on given set of requirements. (C3)* *2. Design decomposition reactors according to specific operational requirements. (C5)* *3. Evaluate issues related to chemical decomposition reactor/furnace. (C6)*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memperkenalkan konsep penting bagi kaedah- kaedah dan proses yang digunapakai bagi tujuan penguraian kimia. Kaedah-kaedah penguraian yang diperkenalkan dalam kursus ini adalah kaedah penguraian termal (pembakaran, pembakaran sembur, gasifikasi, pirolisis, torrefaksi, liquefaksi); penguraian biologi, penguraian secara elektrolisis dan penguraian akibat cahaya matahari. Manakala konsep yang diketengahkan bagi setiap kaedah pula merangkumi aspek-aspek seperti faktor-faktor yang mempengaruhi prestasi tindakbalas dan taburan produk, pertimbangan dan cabaran dalam rekabentuk reaktor/relau, mekanisma tindakbalas, binaan dan pemilihan bahan reaktor/relau serta perbincangan berkaitan persamaan, perbezaan, amalan dan teknologi penguraian sedia ada. Di akhir kursus ini, pelajar dijangka akan dapat mengenali proses-proses penguraian kimia yang berlaku dalam kehidupan seharian dan kaedah yang biasa digunapakai dalam industri. *This course introduces important concepts, approaches, and processes used for chemical decomposition application. The main*

	decomposition approaches thought in this course includes thermal decomposition (combustion, spray combustion, gasification, pyrolysis, torrefaction, and liquefaction), biological decomposition as well as decomposition via electrolysis and sunlight. The concepts highlighted in each of the decomposition approaches includes engineering aspects such as the factors affecting reaction performance and product distribution, reactor design considerations and challenges, reaction mechanisms, reactor construction, material selection and discussions on the similarity, differences and existing decomposition practices and technologies currently available. At the end of this course, students are expected to be familiar with the common chemical decomposition processes occurring in the daily life as well as popular decomposition approaches used in the industries.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. S.H. Fogler, Element of Chemical Reaction Engineering. Prentice Hall, 2021 2. K.V. Geem, Thermochemical Process Engineering, 2016. 3. R. Chamy, Biodegradation: Life of Science, 2013 4. M. Crocker, Thermochemical Conversion of Biomass to Liquid Fuels and Chemicals, 2010

KIL4022: Nanoteknologi untuk penukaran dan penyimpanan tenaga / *Nanotechnology for energy conversion and storage*

Kod Kursus *Course Code*	KIL4022
Tajuk Kursus *Course Title*	Nanoteknologi untuk penukaran dan penyimpanan tenaga *Nanotechnology for energy conversion and storage*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	KIL3001 Sains bahan untuk kejuruteraan kimia
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar akan dapat: 1. mengenal pasti masalah tenaga dan harapan Nanoteknologi dalam menyediakan penyelesaian jangka panjang 2. menerapkan Nanoteknologi dalam mereka bentuk sistem penukaran tenaga 3. menerapkan Nanoteknologi dalam mereka bentuk sistem penyimpanan tenaga *At the end of the course, students are able to:* *1. Identify the urgency of Energy solutions and the expectations of Nanotechnology in providing long term solutions to these problems* *2. Apply Nanotechnology in the designing of energy conversion systems* *3. Apply Nanotechnology and nanomaterials in the designing of energy storage systems*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini bertujuan untuk mendidik pelajar mengenai konsep asas dan teknologi tenaga dari persegian Nanoteknologi. Dengan merangkumi bidang teknologi yang berkenaan: produksi bahan bakar “ultraclean”, sel bahan api, janakuasa suria, penyimpanan hidrogen dan tenaga elektrik, kursus ini memberikan ilmu asas teknologi tenaga dan mempersiapkan pelajar-pelajar untuk menghadapi revolusi teknologi ini. Pengetahuan yang dibina menerusi kursus ini akan melengkapkan pelajar-pelajar dengan ilmu keseluruhan mengenai cara- cara penyelesaian tenaga, dan berpotensi menolong mereka dalam pengurusan teknologi berkenaan. *The course aims to educate students on the basic concepts of energy technologies in the aspect of Nanotechnology. By covering the different areas of emerging technologies from ultraclean fuel production and utilisation, fuel cell conversion, solar photovoltaic conversion, to hydrogen and energy storage, the course prepares students for these revolutionary technologies. Understanding the fundamental concepts of these technologies allow students to be creative towards the development in these areas. Such knowledge shall equip students with*

	holistic views on various energy solutions, with implications of assisting them in managing these technologies in their future professions.
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. . Wilson, M., Kannangara, K., Raguse, B., Simmon, M. (2002) Nanotechnology: Basic Science and Emerging Technologies, Chapman and Hall/CRC 2. 2. Garcia-Martinez, J. (2010) Nanotechnology for the Energy Challenge, Wiley-VCH 3. 3. Teoh, W.Y., Urakawa, A., Ng, Y.H., Sit, P. (2021) Heterogeneous Catalysts, Wiley-VCH 4. 4. Skoog, D.A., West, D.M., Holler, F.J., Crouch, S.R. (2013) Fundamentals of Analytical Chemistry, 9th Ed., Brooks/Cole CENGAGE learning 5. 5. Niemantverdriet, J.W. (2007) Spectroscopy in Catalysis: An Introduction, 3rd Ed., Wiley-VCH 6. 6. Larminie, J., Dicks, A. (2003) Fuel Cell Systems Explained, John Wiley & Sons Ltd 7. 7. Rahn, C.D., Wang, C.-Y. (2013) Battery Systems Engineering, John Wiley & Sons Ltd

KIL4023: Teknologi, globalisasi dan pembangunan mampan / *Technology, globalization and sustainable development*

Kod Kursus *Course Code*	KIL4023
Tajuk Kursus *Course Title*	Teknologi, globalisasi dan pembangunan mampan *Technology, globalization and sustainable development*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	KIL4018
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Mengaitkan elemen kemampanan bermultidimensi dalam konteks pembangunan. 2. Menilai kesan inovasi teknologi dan globalisasi terhadap pertumbuhan ekonomi dan kemampanan. 3. Menilai kesan strategi sesuatu institusi untuk mencapai kemampanan. *At the end of the course, students are able to:* *1. Relate the multidimensional elements of sustainability in the context of development.* *2. Evaluate the effects of technological innovations and globalization on economic growth and sustainability.* *3. Evaluate the effects of an institutional strategy for achieving sustainability*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini meneroka pelbagai aspek pembangunan mampan dengan mengaitkan kemampanan dan konsep-konsep globalisasi dan pembangunan dengan inovasi teknologi. Mediasi kerajaan dan perdagangan sebagai pemacu transformasi industri diterokai. Usaha pengawalseliaan untuk memajukan kesihatan, keselamatan dan alam sekitar serta pembiayaan inovasi juga dibincang. *This course explores the multi-faceted aspects of sustainable development by relating sustainability and concepts of globalization and development with technological innovations. Governmental interventions and trade as drivers for industrial transformations are explored. Regulatory efforts to advance health, safety and the environment as well as financing innovations are also discussed.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*:
Rujukan Utama *Main Reference*	1. Ashford, N.A. & Hall, R. P. Technology, Globalization and Sustainable Development: Transforming the Industrial State. Routledge. 2018.

	2. Beverelli, C., Kurtz, J. & Raess, D. International Trade, Investment, and the Sustainable Development Goals: World Trade Forum. Cambridge University Press. 2020. 3. Milward, B. International Trade and Sustainable Development: Economic, Historical and Moral Arguments for Asymmetric Global Trade. Routledge. 2019. 4. Hansen, A. & Wethal, U. Emerging Economies and Challenges to Sustainability: Theories, strategies, local realities. Routledge. 2014.

KIL4024: Kawalan optimum / *Optimal control*

Kod Kursus *Course Code*	KIL4024
Tajuk Kursus *Course Title*	Kawalan optimum *Optimal control*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Kawalan Proses
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menganalisa model proses berbilang pembolehubah dalam perwakilan keadaan-ruang. 2. Mereka bentuk sistem kawalan optimum bagi proses-proses kimia. 3. Menilai prestasi system kawalan optimum dalam berbagai keadaan. *At the end of the course, students are able to:* *1. Analyse multivariable process model in state- space representations.* *2. Design optimal control systems for chemical processes.* *3. Evaluate the performance of optimal control systems under various conditions*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini merangkumi teori dan aplikasi untuk pelbagai strategi kawalan optimum. Kursus ini memperkenalkan pendekatan permodelan berbilang pembolehubah dalam bentuk ruang keadaan. Pelbagai strategi kawalan optimal akan diajar. Reka bentuk penganggar keadaan untuk menganggar pembolehubah keadaan dan parameter yang tidak diketahui akan diperkenalkan untuk melengkapkan strategi pengawal optimal. *The course will cover the theory and applications of various optimal control strategies. The course introduces multivariable modelling approach using state-space representations. Various optimal control strategies will be covered. Design of state estimators to estimate unknown states and parameters will be introduced to complement the optimal control strategies.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1 Sigurd Skogestad and S. Ian Postlethwaite. Multivariable Feedback Control: Analysis and Design (Vol. 2). New York: Wiley, 2007. 2. Jose A. Romagnoli, Ahmet Palazoglu. Introduction to Process Control. CRC Press (2020)

	3. D.Seborg et.al., Process Dynamics and Control (4th ed.). Wiley, 2016. 4.Simon, Dan. Optimal state estimation: Kalman, H infinity, and nonlinear approaches. John Wiley & Sons, 2006.

KIL4025: Teknologi Semasa dalam Industri Kimia Oleo/ *Current Technologies in Oleochemicals Industry*

Kod Kursus *Course Code*	KIL4025
Tajuk Kursus *Course Title*	Teknologi Semasa dalam Industri Kimia Oleo *Current Technologies in Oleochemicals Industry*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	KIL2008
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Terangkan asas minyak/lemak dan kimia oleo, asas teknik analisis biologi dan kimia, kaedah deria, ketoksikan dan keselamatan, jaminan kualiti / kawalan kualiti dan sifat fizikokimia produk kimia oleo terpilih. 2. Huraikan proses tipikal dan kemajuan proses di hulu dan hilir industri bahan kimia oleo yang boleh dimakan dan tidak boleh dimakan (Cth., Pengekstrakan dan penapisan, Teknik rawatan, transesterifikasi produk / produk sampingan kelas rendah menggunakan pelarut mesra alam, penyahairan, digum dan diasidifikasi dll.) 3. Menilai isu lanjutan yang berkaitan dengan pengekstrakan dan pemprosesan modifikasi lemak dan minyak melalui kaedah kimia, fizikal dan enzim (Cth., Hidrogenasi pecahan, interesterifikasi, peneutralan, hidrolisis dan esterifikasi, lipase dalam pengubahsuaian lipid dll.) *At the end of the course, students are able to:* *1. Explain basic oils/fats and oleo chemistry, fundamentals of biological and chemical analytical techniques, sensory methods, toxicity and safety, quality assurance/ quality control and products physicochemical properties of selected oleo chemicals.* *2. Elaborate typical and advanced processes in upstream and downstream of edible and non-edible for oleo chemicals industry (e.g., extraction and refining, treatment techniques, transesterification of low-grade products/by-products using green solvents, dewaxing, degumming and deacidification etc.).* *3. Evaluate advanced issues related to extraction and processing modification of fats and oils via chemical, physical and enzymatic methods (e.g., hydrogenation fractionation, interesterification, neutralization, hydrolysis and esterification, lipases in lipid modification etc.).* .

Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memperkenalkan konsep aplikasi minyak dan lemak untuk pengeluaran oleokimia. Garis panduan kursus menerangkan peralatan pemprosesan hulu ke hilir. Teknik analisis, sifat fizikokimia dan kawalan kualiti produk minyak / lemak serta penekanan tentang produk yang membentuk industri kimia oleo dengan asas oleo-kimia. Kursus ini akan membincangkan kesan persekitaran dan pengurusan sisa minyak & lemak untuk aplikasi yang boleh dimakan dan tidak boleh dimakan. Kursus ini akan mengetengahkan kelestarian dan arah masa depan industri oleo-kimia. Penerapan bioteknologi dalam memproses bahan kimia oleo akan membincangkan teknologi canggih terbaharu dalam pemprosesan Minyak / Lemak serta teknologi hijau dalam industri oleokimia. *This course introduces the concept of oils and fats application for production of oleochemicals. The course outlines described upstream to downstream processing equipment. Analytical techniques, physicochemical properties and quality control of oils/fats and their products as well as products form oleo chemicals industry will be covered with fundamentals of oleo-chemistry. The course will discuss the environmental impact and waste management of oils & fats for edible and non-edible applications. The course will highlight the sustainability and future direction of the oleo- chemicals industry. Application of biotechnology in processing of oleo chemicals and it will discuss the recent advanced technologies in Oils/Fats processing as well as green technologies in the oleochemicals industry.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1- Green Vegetable Oil Processing, Revised First Edition, Edited by Walter E. Farr and Andrew Proctor, ISBN 978-0-988-85653-8. AOCS Press 2013. 2- Fereidoon Shahidi, BAILEY'S INDUSTRIAL OIL AND FAT PRODUCTS, John Wiley & Sons, 2005. 3- S. Z. Erhan and J.M Perez, eds., Biobased Industrial Fluids and Lubricants, AOCS Press, Champaign, Illinois, 2002. 4- G. Cevc and F. Paltauf, eds., Phospholipids: Characterization, Metabolism, and Novel, Biological Applications. AOCS Press, Champaign Illinois, 2003. 5- Lipids and Edible Oils, Properties, Processing and Applications 1st Edition, Editor: Charis Galanakis, Academic Press, 2019. 6- Industrial Oleochemicals from Used Cooking Oils (UCOs): Sustainability Benefits and Challenges, ByAlvaro Orjuela, Edition1st Edition, CRC Press, 2021..

KIL4026: Pencirian Bahan / *Materials Characterization*

Kod Kursus *Course Code*	KIL4026
Tajuk Kursus *Course Title*	Pencirian Bahan *Materials Characterization*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Menerangkan prinsip asas teknik pencirian bahan (tahap taksonomi 2) 2. Mentafsir data yang diperoleh daripada teknik-teknik pencirian (tahap taksonomi 4) 3. Mengesahkan teknik-teknik pencirian yang sesuai untuk aplikasi tertentu (tahap taksonomi 5) *At the end of the course, students are able to:* *1. Explain basic principle of materials characterization techniques (taxonomy level 2)* *2. Interpret data obtained from characterization techniques (taxonomy level 4)* *3. Justify appropriate characterization techniques for specific applications (taxonomy level 5)*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Kursus ini memperkenalkan rangka kerja teori asas untuk pencirian mikrostruktur, haba dan komposisi dan analisis bahan kejuruteraan. Teknik pencirian yang dilindungi termasuk analisis haba menggunakan DSC, DTA dan TGA, analisis mikrostruktur seperti perkecilan X-ray dan mikroskopi elektron (optik, SEM dan TEM). Keupayaan, batasan dan penyediaan sampel setiap teknik pencirian yang berkaitan dengan aplikasi akan dibincangkan. Kursus ini juga mendedahkan pelajar untuk menyerahkan eksperimen daripada persediaan ke analisis keputusan *This course introduces the fundamental theoretical framework for microstructural, thermal and compositional characterization and analysis of engineering materials. The characterization techniques covered include thermal analysis using DSC, DTA and TGA, microstructural analysis such as X-ray diffraction and electron microscopy (optical, SEM and TEM). The capabilities, limitations and sample preparation of each characterization technique related to the application will be discussed. This course also expose student to hand on experiment from preparation to result analysis*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 100% Peperiksaan Akhir / *Final Examination*:
Rujukan Utama *Main Reference*	1. Chi Ming Chan; Hiroshi Ikeda Materials Characterization, Scitus Academics LLC, 2019. 2. Valcarcel Cases, M. Et.al., Foundation of Analytical Chemistry, Springer, 2018.

	3. David B. Williams, C. Barry Carter, Transmission Electron Microscopy: A Textbook for Materials Science, Springer, 2009.

KIL4027: Kejuruteraan Gas Asli / *Natural Gas Engineering*

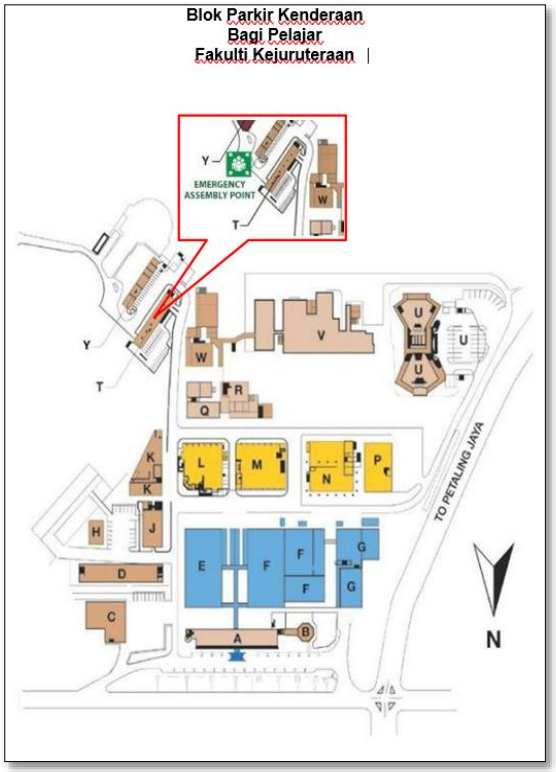
Kod Kursus *Course Code*	KIL4027
Tajuk Kursus *Course Title*	Kejuruteraan Gas Asli *Natural Gas Engineering*
Kredit *Credit*	2
Bahasa Pengantar *Medium of Instruction*	Bahasa Inggeris *English*
Prasyarat/Keperluan Minimum Kursus *Course Pre-requisite(s)/ Minimum Requirement(s)*	Tiada *No*
Hasil Pembelajaran Kursus *Course Learning Outcomes*	Di akhir kursus ini, pelajar dapat: 1. Memperihalkan asal usul, komposisi, sifat dan kepentingan gas asli 2. Mengelaskan jenis gas asli dan takungan gas asli 3. Menerangkan aspek asas pengeluaran gas asli daripada takungan serta proses merawat gas asli *At the end of the course, students are able to:* *1. Describe the origin, composition, properties and the importance of natural gas* *2. Classify the types of natural gas and natural gas reservoirs* *3. Explain the fundamental aspects of natural gas production from the reservoirs and process in treating natural gas*
Sinopsis Kandungan Kursus *Synopsis of Course Contents*	Pengenalan kepada industri gas asli, asas gas asli dan sifat-sifatnya. Kursus ini juga meliputi aspek teknikal penghasilan, sumber bukan konvensional, pemprosesan, rawatan dan penghantaran gas asli. *Introduction to natural gas industry, natural gas fundamentals and properties. The course also covers the technical aspect of natural gas production and recovery, unconventional resources, processing, treatment and transmission.*
Pemberatan Penilaian *Assessment Weightage*	Penilaian Berterusan / *Continuous Assessment*: 40% Peperiksaan Akhir / *Final Examination*: 60%
Rujukan Utama *Main Reference*	1. Saeid Mokhatab, William A. Poe and John Y. Mak, Handbook of Natural Gas Transmission and Processing-Principles and Practices, Gulf Professional Publishing, 2018. 2. Arthur J. Kidnay; William R. Parrish; Daniel G. McCartney Fundamentals of Natural Gas Processing, Second Edition CRC Press, 2011

FACILITIES

Vehicle Parking for Students

Students are only allowed to park in designated student parking areas which is at parking Block T. If you park outside the designated areas, you may be fine and clamp. For any inquiries, please e-mail/contact:

Deputy Dean (Development) Office
Email: fk_tdp@um.edu.my
Tel: +603 7967 7621



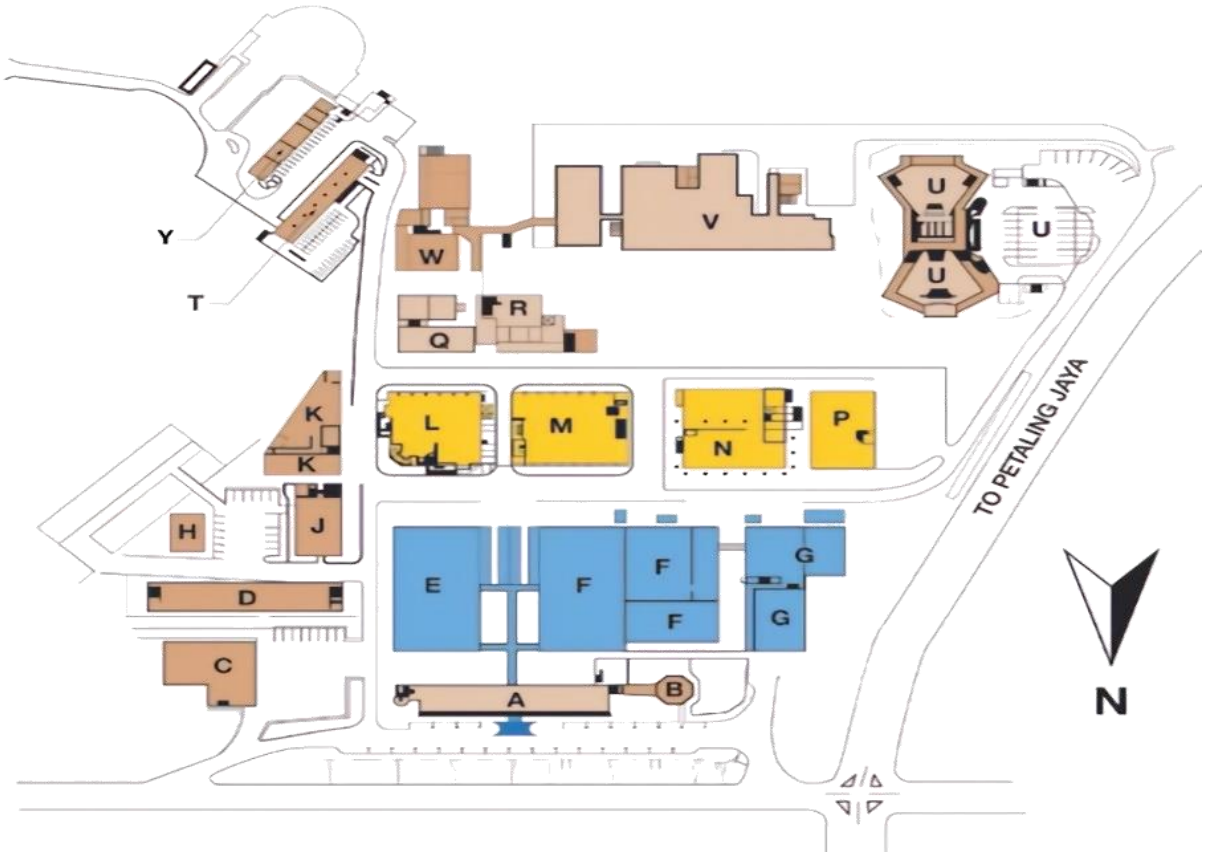
BLOK T	
Gambar	Aras
	3(B) (Pelajar)
	Masuk dari Blok Y
	3(A) (Pelajar)
	4(B) (Pelajar)
	4(A) (Pelajar)

BLOK T	
Gambar	Aras
	5(B) (Pelajar)
	5(A) (Pelajar)

CAMPUS MAP


UNIVERSITY OF MALAYA
CAMPUS MAP
JALAN ELMU GATE
Tadika UM
Economics & Administration
Education
Business & Accountancy
Arts & Social Sciences
Centre for Civilisational Dialogue
UM Specialist Centre
Museum of Asian Art
Main Library
Geology
UNIVERSITY ROAD
PJ GATE
PERSIARAN AKAL
LINGKUNGAN BUDI
PERSIARAN ELMU
LENGKOK CENDEKIA
PERSIARAN BERNAS
SEC 16 GATE
9th College
3rd College
4th College
7th College
Languages & Linguistics
Science
ICT Services (PTM)
Engineering
Kompleks Perdanasiswa/ ISC
UM LAKE
Museum of Zoology
Malay Studies
8th College
10th College
LINGKARAN WAWASAN
Computer Science & Information Technology
Bulit Environment
2nd College
PERSIARAN GAGASAN
Dewan Tunku Canselor (DTC)
High Impact Research (HIR)
Dentistry
Medical
6th College
Examination Building
Security Office/ Cultural Centre
RIMBA ILMU (Botanical Garden)
Chancellery
1st College
UM Press
ROTU Training Site
UM Sports Ground
Centre for Foundation Science (PASUM)
Islamic Studies
Law
Rimba Ilmu
UM Medical Centre
Ambang Asuhan Jepun
Kong-Zi
Graduate Studies
5th College
Sports Centre
UM Arena
Swimming Pool
Research Management & Innovation Complex
Asia-Europe
12th College
11th College
Reserve Office Training Unit (ROTU)
Department of Development and Asset Maintenance (JPPHB)
SUSUR DAMANSARA
KL GATE
DAMANSARA GATE
PANTAI BARU ROAD
SPRINT HIGHWAY
CHANCELLERY ZONE
RIMBA ILMU ZONE
LIBRARY ZONE
FACULTY/ INSTITUTE/ CENTRE
RESIDENTIAL COLLEGES
FACILITIES/ ADMINISTRATION

FACULTY MAP



A	Department of Biomedical Engineering	M	Engineering Tower (Research Wing)
B	Lecturer Hall 1 (DK1)	N	Hydraulic Lab (Mechanical)
C	Industry and Research Labs	P	Public Health Engineering Lab (Civil)
D	Lecture Rooms and IR Cube	Q	Metallurgy Lab (Mechanical)
E	Research Labs	R	Mechanical and Electrical Engineering Labs
F	Civil Engineering Labs	T	Multiple Storey Parking Block
G	Advanced Structured Labs (Civil)	U	Lecture Halls
J	Department of Mechanical Engineering	V	Department of Chemical Engineering
K	Department of Mechanical Engineering	W	Department of Chemical Engineering
L	Engineering Tower (Administration Wing)	Y	Department of Electrical Engineering

CONTACT US

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