

PROGRAMME HANDBOOK

SESSION
2023/2024



BACHELOR OF ELECTRICAL ENGINEERING

Department of Electrical Engineering

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UNIVERSITI MALAYA

VISION

A global university impacting the world.

MISSION

Pushing the boundaries of knowledge and nurturing aspiring leaders.

CORE VALUES



TAGLINE

Serving the Nation. Impacting the World.

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.

Faculty of Engineering

VISION

A centre of engineering excellence impacting the world.

MISSION

Pushing the boundaries of knowledge, nurturing aspiring leaders and fostering strategic partnership with industries.



STUDENTS

- Continue to produce highly competent and skilled individuals with leadership qualities and good interpersonal skills
- Contribute to nation-building by producing good citizens who respect universal human values
- Have students of diverse backgrounds who respect and internalize diversity
- Inculcate of social awareness and obligation values
- Develop students to have an international outlook and outreach
- Develop students to become highly competent engineers capable of identifying, formulating, and solving problems in a creative and innovative manner



ACADEMIC PROGRAMME

- Ensure academic programmes are relevant, current, innovative and internationally recognized to meet national and global needs
- Continuously develop academic programmes that inspire and tap students' potential
- Ensure academic programmes are accredited by local and international engineering professional bodies
- Continuously develop programmes that are relevant to industrial requirements

Dean's Message



Dean

Professor Ir. Dr. Kaharudin bin Dimyati

Congratulations and welcome to the Faculty of Engineering, Universiti Malaya, FK@UM.

Thank you for choosing FK@UM to continue your dream. You are a chosen one, as many who wanted to be here did not get the opportunity as the number of applications exceed the intake capacity of the Faculty. We are proud and happy to have you here. You are now in one of the top engineering faculty in the world and definitely the top in Malaysia. Engineering education in UM dated back in 1956 with the establishment of the Engineering Department at Universiti Malaya's Bukit Timah Campus in Singapore. Only a Bachelor Degree Course in Civil Engineering was offered then. The department then was uplifted to a faculty when Universiti Malaya was relocated to its campus in Lembah Pantai in 1958. To date, the Faculty has five departments which are Department of Civil Engineering, Department of Biomedical Engineering, Department of Chemical Engineering, Department of Electrical Engineering and Department of Mechanical Engineering whereby offers 5 programmes; Civil Engineering, Biomedical Engineering, Chemical Engineering, Electrical Engineering and Mechanical Engineering.

Engineering Accreditation Council (EAC) has accredited all the programmes at the Faculty. It simply means that the programmes are planned and delivered with adequate resources and quality. The courses are administered to ensure students attain all the defined attributes upon graduation. The degrees from FK@UM are mutually recognized under Washington Accord signatory countries. You will be getting an internationally recognized degree from the Faculty.

You will be starting your life-changing journey in UM, where you will be acquiring new skills, competencies, knowledge and experiences that will pave the way for your continued success in life and career. Be steadfast and disciplined in optimizing your stay in UM. There will be also lots of opportunities for personal development in the form of student activities, mobility program, training activities and many other. Be proactive in seizing the opportunities. It is often said that University life is the best period of life of many people who have gone through it and many will meet their best friends here.

I am sure upon graduation you will be a better person in many fronts. You will be technically competent as an engineer. The employers will be excited to take you for mutual benefit. Some of you may pursue a different path and may become researchers, entrepreneurs and even politicians. Whatever your ambitions are, the floor is yours to make it happen.

The Management



Professor Ir. Dr. Kaharudin
Dimiyati

Dean



Assoc. Prof. Ir. Dr. Norazura
Muhamad Bunnori

Deputy Dean
(Undergraduate)



Prof. Ir. Dr. Ngoh
Gek Cheng

Deputy Dean
(Postgraduate)



Dr. Mohd Usman
Mohd Junaidi

Deputy Dean
(Student Affairs)



Assoc. Prof. Ir. Dr. Tan
Chou Yong

Deputy Dean
(Value Creation & Enterprise)



Assoc. Prof. Ir. Ts. Dr. Lai
Khin Wee

Deputy Dean
(Research)



Noraien Abu Samah

Manager (Administration)



Ir. Dr. Nasrul Anuar
Abd. Razak

Head of Biomedical
Department



Dr. Mahar Diana
Hamid

Head of Chemical
Department



Assoc. Prof. Dr. Zainah
Ibrahim

Head of Civil
Department



Prof. Ir. Dr. Sulaiman
Wadi Harun

Head of Electrical
Department



Assoc. Prof. Ir. Dr. Nik Nazri
Nik Ghazali

Head of Mechanical
Department

The Officers



Noraien Abu Samah

Manager (Administration)



Lee Kok Yuen

Science Officer



Nurfadila Shafina
Mohd Redha

Senior Finance Officer



Junainah Jamaluddin

Senior Assistant Registrar
(Postgraduate)



Nor Sabrina Nordin

Engineer (Infrastructure
Development)



Hasnatul Farhana
Hassan

Senior Assistant Registrar
(Undergraduate)



Muhammad Zuhairi
Mohd Aliashak

Engineer
(Laboratory and Safety)



Muhammad Hazim
Hamidon

Science Officer
(Laboratory and Safety)



Fatinurshaira Mohd
Yunus

Assistant Registrar
(Research)



Nurul Atiqah
Mohd Azman

Assistant Registrar
(Student Affairs)



Shafinaz Daud

Assistant Registrar (Value
Creation & Enterprise)

Deputy Dean (Undergraduate) Organization



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Muhamad Bunnori
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Assistant Registrar
(Undergraduate)



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Noor Arhanani
Hasan
Senior Administrative
Asst.



Aishatul Fiza
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Asst.



Nurhani Muhamad
Zainalid
Asst. Administrative
Officer



Hasnita
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Asst.



Norfadziatul
Fadhar
Administrative Assistant

Programme Coordinators



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Kim Hung

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Ir. Dr. Khairunnisa
Hasikin

Biomedical Engineering



Dr. Mohd Faiz
Mohd Salleh

Electrical Engineering



Dr. Goh Yingxin

Mechanical Engineering



Dr. Muhamad Fazly
Abdul Patah

Chemical Engineering

Academic Calendar

ACADEMIC CALENDAR 2023/2024 ACADEMIC SESSION (BACHELOR DEGREE LEVEL)					
SEMESTER I					
Orientation (<i>Week of Welcome</i>) - WOW	1	week	01.10.2023	-	08.10.2023
Lectures	7	weeks*	09.10.2023	-	26.11.2023
Mid Semester I Break	1	week	27.11.2023	-	03.12.2023
Lectures	7	weeks*	04.12.2023	-	21.01.2024
Revision Week	1	week*	22.01.2024	-	28.01.2024
Semester I Final Examination	2	weeks*	29.01.2024	-	11.02.2024
Semester Break	3	weeks	12.02.2024	-	03.03.2024
	22	weeks			
SEMESTER II					
Lectures	5	weeks*	04.03.2024	-	07.04.2024
Mid Semester II Break	1	week	08.04.2024	-	14.04.2024
Lectures	9	weeks*	15.04.2024	-	16.06.2024
Revision Week	1	week*	17.06.2024	-	23.06.2024
Semester II Final Examination	2	weeks*	24.06.2024	-	07.07.2024
	18	weeks			
SEMESTER BREAK					
Break	9	weeks*	08.07.2024	-	08.09.2024
SPECIAL SEMESTER					
Lectures	7	weeks*	08.07.2024	-	25.08.2024
Special Semester Final Examination	1	week*	26.08.2024	-	01.09.2024
Break	1	week	02.09.2024		08.09.2024
	9	weeks			

Note:

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

Maulidur Rasul	28 September 2023	Eidul Fitri	10 & 11 April 2024
Deepavali	12 November 2023	Labour Day	01 May 2024
Christmas Day	25 December 2023	Wesak Day	22 May 2024
New Year	01 January 2024	His Majesty the King's Birthday	03 June 2024
Thaipusam	25 January 2024	Eidul Adha	17 June 2024
Federal Territory Day	01 February 2024	Awal Muharam	07 July 2024
Chinese New Year	10 & 11 February 2024	National Day	31 August 2024
Nuzul Al-Quran	28 March 2024	Malaysia Day	16 September 2024

Academic Dishonesty

Extracted from Universiti Malaya (Bachelor's Degree) Regulations 2019

- (1) Academic dishonesty may occur in various forms including but not limited to:
- a. plagiarism - the act of someone using someone else's ideas without citing the source;
 - b. false excerpt - quoting sources which never have been used or linking the work produced with reference materials which were never referred to or the source obtained;
 - c. falsifying information - fabricating or changing the data in order to create confusion, for example, changing data to obtain a better experimental result;
 - d. conspire or abet - copying the work of another student, asking someone else to write a person's assignment, or allowing another student to borrow his work;
 - e. cheating in exams - bringing or having access to books or any material in any form or format illegally during an examination or assessment or in any assignment which would be used by the lecturer/tutor/examiner as the basis of assessment, and
 - f. contract cheating and disguising - the work of a student was completed by another person, usually including a payment to the third party but would be submitted as his own work.
- (2) Any student who is found committing an act which amounts to academic dishonesty can be subject to disciplinary action by the University.

(Senate approval 25.02.2021)

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Quick Links

Academic Administration and Services Department (AASD)	https://aasd.um.edu.my
Student Affairs Division	https://hep.um.edu.my
Academic Portal: MAYA	https://maya.um.edu.my
UMSItS Guide	https://umsitsguide.um.edu.my
MyUM	https://myum.um.edu.my

Bachelor of Electrical Engineering

Introduction

Bachelor of Engineering (Electrical) has been offered by the Faculty of Engineering since 1959. In 1974, Department of Electrical Engineering was established and since then, the Electrical Engineering Programme is managed by the department. This course has obtained its accreditation from Department of Public Service (Jabatan Perkhidmatan Awam) and Board of Engineers Malaysia (Lembaga Jurutera Malaysia). Due to the rapid evolving of telecommunications technology in the mid-1990s, the Bachelor of Engineering (Telecommunications) was established and parked under this department in 1996 and is persistently running until 2015. Since then, both programmes are merged and now known as the Bachelor of Electrical Engineering.

In meeting the Universiti Malaya's Mission and Vision, the Department of Electrical Engineering strives hard to provide quality education in preparing students for professional employment in the industry, commercial and academic sectors. The comprehensive curriculum content, with the innovative and state-of-the-art teaching and delivery techniques, is designed and planned to enrich the students' knowledge and experience which will effectively enhance their range of intellectual and practical skills. Since the past few years, around 30% of the students under this programme graduated with First Class and over 80% of them found employment within 6 months after graduation. In 2023, this programme is ranked 61st by the QS World University Ranking in the Electrical and Electronic Engineering subject category. Apart from the Bachelor of Electrical Engineering, the Department also offers one Master's degree by coursework, Master's degree by research, and Doctor of Philosophy (Ph.D). This provides an ample opportunity for students to pursue postgraduate studies.

The Department is also furnished with various high technology facilities designed for research and teaching. Among the facilities are the laboratories that come with reliable, up-to-date and advance equipment, computer laboratories and the Engineering Library. The main university computer facilities as well as common facilities provided by the Faculty such as workshop, high performance computer (HPC) and CAD/CAM systems, can be utilized by the students from the department as well. The department also receives support from the industries such as from Huawei, Motorola, Intel, DiGi, MEASAT, TNB, Telekom Malaysia, CREST, and many more. Furthermore, with the collaboration of Huawei, Pestech and Motorola, three industrial laboratories has been established at the department. Together with the industrial partners, the professional bodies namely BEM, IEEE and IEM, have been providing input and suggestions to the department in enhancing the curriculum as well as the quality of the research (Final Year Project) and design (Integrated Design Project) projects that will be offered to the students throughout their studies.

Programme Synopsis

The Bachelor of Electrical Engineering exposes the students to the theory and applications of electricity, electronics, information and signal processing. During the four years (eight semesters) of study, this programme also offers a comprehensive view into the basic applications and principles in the field of electrical engineering. There is a variety of teaching-learning (delivery) modes of lectures, project work, design tasks, research, experiments, seminars, fieldwork and practical training, that encourages innovation and creativity among students. To strengthen and enhance students design skills and hands-on experience, integrated design and research project are introduced in the program. The curriculum structure requires a minimum of 137 credits to graduate, with an average of 5 or 6 courses in a semester. The programme also requires an industrial training attachment of 10 weeks. The objective of this attachment is to enable students to gain first-hand experience in 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.

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 Educational Objectives (PEOs)

Programme educational objectives (PEOs) describe the career and professional accomplishments that a programme would prepare the graduates to achieve in 3 - 5 years after their graduation. Three PEOs have been formulated for the Bachelor of Electrical Engineering programme in line with the University's and the Faculty's vision and mission.

01

Professionalism

Graduates establish themselves as practicing professionals in Electrical Engineering or related fields.

02

Continuous Personal Development

Graduates engage in lifelong pursuit of knowledge and interdisciplinary learning appropriate for industrial and academic careers.

03

Societal Engagement

Graduates contribute to sustainable development and the well-being of society.

Programme Outcomes (POs)

All signatories in the Washington Accord (WA) must demonstrate that their engineering programmes prepare graduates to exhibit 12 graduate attributes at the time of graduation. The Engineering Accreditation Council (EAC) under the Board of Engineers Malaysia (BEM) has adopted all the 12 WA graduate attributes. With this in mind, the Bachelor of Electrical Engineering programme has the following 12 Programme Outcomes (POs):

PO1 Engineering Knowledge	Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialisation as specified in WK1 to WK4 respectively to the solution of complex engineering problems.
PO2 Problem Analysis	Identify, formulate, conduct research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (WK1-WK4).
PO3 Design/Development of Solutions	Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations (WK5).
PO4 Investigation	Conduct investigation of complex engineering problems using research-based knowledge (WK8) and research methods, including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
PO5 Modern Tool Usage	Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations (WK6).
PO6 The Engineer and Society	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems (WK7).
PO7 Environment and Sustainability	Understand and evaluate the sustainability and impact of professional engineering work in the solutions of complex engineering problems in societal and environmental contexts.
PO8 Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PO9 Individual and Team Work	Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

PO10 Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11 Project Management and Finance	Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.
PO12 Life Long Learning	Recognise the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

The knowledge profile (WK) is summarised in the table below:

WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline.
WK2	Conceptually-based mathematics , numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline.
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge that supports engineering design in a practice area.
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
WK7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability.
WK8	Engagement with selected knowledge in the research literature of the discipline.

The POs are directly mapped to relevant courses and explicitly mapped to the course outcomes (COs) of the related courses. The POs attainment of individual students will be continuously measured throughout the period of study based on the performance in each course. Course Outcomes (COs) are the expected outcomes of each course and it is what student should be able to do upon the completion of a specific course.

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Programme Structure

Bachelor of Electrical Engineering

Courses	Content	Credit Hours
University Courses	GIG1012: Philosophy and Current Issues* / GLT1017: Basic Malay Language**	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	91
	Department Elective Courses	14
Sub-total Credit Hours		105
Total Credit Hours		137

* 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 2023/2024

YEAR 1						
CODE	COURSE	S1	S2	SS	TOTAL CREDIT	PRE-REQUISITE
UNIVERSITY COURSES						
GIG1012 / GLT1017	Philosophy And Current Issues* / Basic Malay Language**	2				
GLTXXXX	English Communication Programme I	2				
GIG1013	Appreciation of Ethics and Civilisations		2			
Sub-total Credit Hours		4	2		6	
UNIVERSITY ELECTIVE COURSES (STUDENT HOLISTIC EMPOWERMENT)						
Cluster 1	Thinking Matters: Mind and Intellect		2			
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						
KIE1003	Digital System	3				
KIE1004	Programming I	3				
KIE1005	Circuit Analysis I	3				
KIE1001	Lab 1		1			
KIE1006	Electronic Physics		3			
KIE1007	Electronic Circuits I		3			
KIE2006	Signals and Systems		3			
Sub-total Credit Hours		9	10		19	
TOTAL CREDIT HOURS		16	17	0	33	

* Compulsory for local students.

** Compulsory for international students.

YEAR 2						
CODE	COURSE	S1	S2	SS	TOTAL CREDIT	PRE-REQUISITE
UNIVERSITY COURSES						
GLTXXXX	English Communication Programme II	2				
GIG1003	Basic Entrepreneurship Enculturation		2			
	Co-Curriculum		2			
Sub-total Credit Hours		2	4		6	
UNIVERSITY ELECTIVE COURSES (STUDENT HOLISTIC EMPOWERMENT)						
Cluster 2	Emotional, Physical and Spiritual Intelligence: Heart, Body & Soul	2				
Cluster 3	Technology/Artificial Intelligence and Data Analytics: i-Techie		2			
Sub-total Credit Hours		2	2		4	
FACULTY COURSES						
KIX2006	Engineering Economics and Project Management		3			
Sub-total Credit Hours			3		3	
DEPARTMENT CORE COURSES						
KIE1002	Lab 2	1				
KIE1008	Programming II	3				
KIE2004	Electronic Circuit II	3				
KIE2007	Basic Electromagnetics	3				
KIE2010	Microprocessors and Microcontrollers	3				
KIE2001	Lab 3		1			
KIE2008	Communication Systems		3			
KIE2009	Machines and Drives		3			
KIE2011	Digital Design		3			
Sub-total Credit Hours		13	10		23	
TOTAL CREDIT HOURS		17	19		36	

YEAR 3						
CODE	COURSE	S1	S2	SS	TOTAL CREDIT	PRE-REQUISITE
UNIVERSITY ELECTIVE COURSES (STUDENT HOLISTIC EMPOWERMENT)						
Cluster 4	Global Issues and Community Sustainability: Making the World a Better Place		2			
Sub-total Credit Hours			2		2	
FACULTY COURSES						
KIX2005	Law, Ethics and Sustainability for Engineers	3				
Sub-total Credit Hours		3			3	
DEPARTMENT CORE COURSES						
KIE2002	Lab 4	1				
KIE3004	Applied Electromagnetics	3				KIE2007
KIE3005	Numerical Analysis	3				
KIE3006	Control System	3				KIE2006
KIE3007	Digital Signal Processing	3				
KIE3012	Integrated Design Project	3	3			KIE1003, KIE1004, KIE1005, KIE1007, KIE2001
KIE3001	Lab 5		1			
KIE3008	Power Electronics		3			
KIE3009	Energy Conversion and High Voltage Transmission		3			
KIE3010	Instrumentation		3			
KIE3011	Digital Communications		3			KIE2008
KIE3003	Industrial Training			5		
Sub-total Credit Hours		16	16	5	37	
TOTAL CREDIT HOURS		19	18	5	42	

YEAR 4						
CODE	COURSE	S1	S2	SS	TOTAL CREDIT	PRE-REQUISITE
DEPARTMENT CORE COURSES						
KIE4002	Final Year Project	3	3			KIE1008, KIE2004, KIE2006, KIE2007
KIE4004	Power System	3				
KIE4028	Electrical Energy Utilization	3				
Sub-total Credit Hours		9	3		12	
DEPARTMENT ELECTIVE COURSES						
	Elective Course I	2				
	Elective Course II	2				
	Elective Course III	2				
	Elective Course IV		2			
	Elective Course V		2			
	Elective Course VI		2			
	Elective Course VII		2			
Sub-total Credit Hours		6	8		14	
TOTAL CREDIT HOURS		15	11		26	

Department Elective Courses

CODE	COURSE	CREDIT HOURS	PRE-REQUISITE
Sustainable Energy Technologies			
KIE4010	Electrical Energy Conversion Technologies	2	
KIE4011	Renewable Energy Technologies	2	
KIE4012	Nanotechnology for Sustainable Energy	2	
KIE4013	High Voltage Engineering	2	
KIE4029	Electrical Power Quality	2	
KIE4030	Power System Economics	2	
Information Communication Technologies			
KIE4014	Wireless Communication	2	
KIE4015	Optical Communication	2	
KIE4016	Antenna and Propagation	2	
KIE4017	Optical Waveguides	2	
KIE4026	Data Communication Networks	2	
Integrated Micro/Nano Electronics			
KIE4018	VLSI Design	2	
KIE4019	Analog VLSI Circuit Design	2	
KIE4020	Microwave Electronics and Systems	2	
KIE4021	Analog Electronics Design	2	
Cyberphysical Systems			
KIE4022	Embedded Systems	2	
KIE4023	Digital Control System	2	KIE3006
KIE4024	Optimization Methods	2	
KIE4031	Machine Learning	2	
KIE4032	Human-Computer Interaction	2	
KIE4033	Data Analytics	2	

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

Student Holistic Empowerment Courses

The Student Holistic Empowerment (SHE) courses are categorized into four (4) clusters:

CLUSTER	COURSE
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

Note:

ALL STUDENTS ARE REQUIRED TO REGISTER ONE (1) COURSE FROM EACH CLUSTER

The list of Co-Curricular and SHE courses offered for each semester could be found through the following link:

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

Path for English Communication Programme

ENGLISH COMMUNICATION PROGRAMME (UNIVERSITY COURSE) (KURSUS BAHASA INGGERIS KOMUNIKASI- KURSUS UNIVERSITI) LIST OF COURSES TO BE COMPLETED BY ALL STUDENTS (NEW COHORT)			
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
<u>COMPULSORY</u>	<u>COMPULSORY</u>	<u>COMPULSORY</u>	<u>CHOOSE TWO:</u>
GLT1018 – Proficiency in English I	GLT1021 – Proficiency in English II	GLT1024 – Proficiency in English III	• GLT1027 – Advanced Oral Communication* • GLT1028 – Advanced Business Writing* • Alternative courses - Foreign Language
** <u>CHOOSE ONE:</u> • GLT1019 – Let's Speak • GLT1020 – Fundamental Writing	** <u>CHOOSE ONE:</u> • GLT1022 – Speak Up • GLT1023 – Effective Workplace Writing	** <u>CHOOSE ONE:</u> • GLT1025 – Effective Oral Communication • GLT1026 – Writing at the Workplace	*Students can only register for one course per semester

** 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.

ALTERNATIVE COURSES FOR PATH 4

List of Foreign Language University Courses

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

Grading Scheme

Marks	Grade	Grade Points	Meaning
90.00 - 100.00	A+	4.00	High Distinction
80.00 - 89.99	A	4.00	Distinction
75.00 - 79.99	A-	3.70	Distinction
70.00 - 74.99	B+	3.30	Good
65.00 - 69.99	B	3.00	Good
60.00 - 64.99	B-	2.70	Good
55.00 - 59.99	C+	2.30	Pass
50.00 - 54.99	C	2.00	Pass
45.00 - 49.99	C-	1.70	Fail
40.00 - 44.99	D+	1.30	Fail
35.00 - 39.99	D	1.00	Fail
00.00 - 34.99	F	0.00	Fail

(Senate approval 22.07.2021)

Grade	Remarks
I	Grade I, may be given when: (A) A student did not take the final examination due to medical/ compassionate reasons; and/or (B) A student has not fulfilled a part of the course requirement in a semester due to medical/compassionate reasons or a situation beyond the student's control that is accepted by the Committee of Examiners concerned.
K	Grade K, is given for courses that are approved for transfer of credit without grade.
CT(APEL)	Grade CT(APEL), is given for courses for which the transfer of credit without grade through APEL(C) were approved.
K1	Grade K1, is given for courses that are approved for course exemption.
P	Grade P, is given in every semester of registration for progressive courses which are conducted consecutively until the total credit for the course is completed.
R	Grade R, is given for courses audited and fulfils the minimum of 80% attendance requirement. Credits are not given for this grade.
UR	Grade UR, is given for courses audited and does not fulfil the minimum of 80% attendance requirement. Credits are not given for this grade.
W	Grade W, is given for a course where a student has withdrawn officially from one or more courses in a semester.
W1	Grade W1, is given for all courses where a student has withdrawn officially from a semester.
W2	Grade W2, is given for all courses where a student has withdrawn officially from the University.

Maklumat Kursus

Course Information

UNIVERSITY COURSES

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

Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Melayu <i>Malay</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	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. <i>At the end of the course, students are able to:</i> 1. <i>Explain current issues based on philosophy, the Philosophy of National Education and the Rukunegara.</i> 2. <i>Explain current issues based on the main of thoughts from the various streams of philosophy.</i> 3. <i>Explain current issues through a comparative perspective of philosophy as a basis for establishing inter-cultural dialogue.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	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. <i>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.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 70% Peperiksaan Akhir / <i>Final Examination</i>: 30%

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

Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Melayu (pelajar warganegara) / Bahasa Inggeris (pelajar bukan warganegara) <i>Malay (local students) and English (international students)</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada No
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	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. <i>At the end of the course, students are able to:</i> 1. <i>Explain the ethical concepts of different civilizations.</i> 2. <i>Compare systems, levels of development, social progress and culture across nations.</i> 3. <i>Discuss contemporary issues related to economic, political, social, cultural and environmental from the perspective of ethics and civilization.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	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 menghubungkan etika dan kewarganegaraan berminda sivil. <i>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.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 70% Peperiksaan Akhir / <i>Final Examination</i> : 30%

**GIG1003: Asas Pembudayaan Keusahawanan /
Basic Entrepreneurship Enculturation**

Kredit Credit	2
Bahasa Pengantar Medium of Instruction	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menerangkan konsep asas keusahawanan. 2. Menghasilkan idea keusahawanan yang kreatif dan inovatif. 3. Membangunkan kerangka rancangan perniagaan. <i>At the end of the course, students are able to:</i> 1. <i>Explain the basic concepts of entrepreneurship.</i> 2. <i>Producing creative and innovative entrepreneurial ideas.</i> 3. <i>Develop a business plan framework.</i>
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 sasaran 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. <i>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.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 100% Peperiksaan Akhir / <i>Final Examination</i> : 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%

Maklumat Kursus

Course Information

FACULTY COURSES

KIX1001: Matematik Kejuruteraan 1 / *Engineering Mathematics 1*

Kod Kursus <i>Course Code</i>	KIX1001
Tajuk Kursus <i>Course Title</i>	Matematik Kejuruteraan 1 <i>Engineering Mathematics 1</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menjelaskan prinsip matematik seperti derivatif, derivatif separa, teknik pengamilan, algebra matriks atau algebra vektor yang digunakan dalam bidang kejuruteraan. 2. Menggunakan prinsip matematik seperti derivatif, derivatif separa, teknik pengamilan, algebra matriks atau algebra vektor dalam menganalisis masalah kejuruteraan. 3. Menyelesaikan masalah kejuruteraan kompleks dan mencapai kesimpulan sah dengan menggunakan prinsip matematik. <i>At the end of the course, students are able to:</i> 1. <i>Explain mathematical principles such as derivatives, partial derivative, integration techniques, matrix or vector algebra used in engineering field.</i> 2. <i>Use mathematical principles such as derivatives, partial derivative, integration techniques, matrix or vector algebra in analyzing engineering problem.</i> 3. <i>Solve complex engineering problem and reach a valid conclusion using mathematical principal.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini bertujuan untuk meningkatkan kemahiran matematik kepada pelajar-pelajar kejuruteraan. Kursus ini mengandungi pembezaan, algebra matrik, vektor algebra, pengamilan, pengamilan berganda, kamiran garisan, kamiran permukaan, kamiran isipadu dan teori kecapahan Gauss. Kursus ini juga memperkenalkan aplikasi kejuruteraan bagi topik-topik yang diajar. <i>This course attempts to improve the mathematical skills for engineering students. This course covers differentiation, matrix and vector algebra, integration, multiple integrals, line integrals, surface integrals, volume integrals and Gauss's divergence theorem. This course also introduces the engineering application of the topics taught.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%

Rujukan Utama <i>Main Reference</i>	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.
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KIX1001: Matematik Kejuruteraan 1 / *Engineering Mathematics 1*

Minggu Week	Topik Topic
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. <i>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</i>
2	Derivatif separa: Konsep asas dan definisi. 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. <i>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</i>
3	Vektor Algebra I: Konsep asas, komponen kartesian, vektor dalam ruang, kecerunan, capahan, derivative arah curl <i>Vector Algebra I: Basic concepts, Cartesian components, Vectors in space, Gradient, Divergence, Curl Directional derivatives</i>
4	Vektor Algebra II: Hasil darab skalaan dan hasil darab vektor, hasil darab trirangkap <i>Vector Algebra II: Scalar Product and Vector Product, Triple Product</i>
5	Aplikasi kejuruteraan vektor algebra, Aplikasi kejuruteraan analisa vektor <i>Engineering Applications of Vector Algebra, Engineering Applications of Vector Analysis</i>
6	Algebra matriks: Konsep asas, penyelesaian set persamaan linear, kaedah penghapusan Gauss, nilai eigen dan vektor eigen, teori Cayley-Hamilton <i>Matrix Algebra: Basic concepts, Solutions of a set of linear equations; Gaussian elimination method, Eigenvalues and eigenvectors; Cayley-Hamilton Theory</i>
7	Pengantungan linear, matrik baris eselon, pengurangan matrik baris eselon, pepenjuru Aplikasi kejuruteraan algebra matriks <i>Linear dependence, Row echelon matrix, Reduced row echelon matrix, Diagonalization Engineering Applications of Matrix Algebra</i>

8	Pengamiran: Konsep asas dan definisi, keedah pengamiran: kaedah penggantian, mengikut bahagian, pecahan separa. Kamiran wajar dan kamiran tidak wajar. <i>Integration: Basic ideas and definitions, Techniques of Integrations: the substitution method, by parts, by partial fractions Proper and Improper Integrals</i>
9	Aplikasi pengamiran kejuruteraan: Kawasan pada satah, isipadu pepejal bagi keratan rentas yang diketahui, momen dan pusat jisim <i>Engineering Applications of Integrals: Areas of regions in the plane, Volumes of solids with known cross sections, Moment and center of mass</i>
10	Pengamiran berganda: pengamiran ganda dua, pengamiran trirangkap <i>Multiple Integrals: Double Integrals and triple Integrals</i>
11	Kamiran garisan dan kerja berlaku. Teorem Green dalam satu satah <i>Line integral and work done. Green's theorem in a plane</i>
12	Kamiran permukaan <i>Surface Integrals</i>
13	Kamiran isipadu <i>Volume Integrals</i>
14	Teorem Kecapahan Gauss <i>Gauss's Divergence Theorem</i>

KIX1002: Matematik Kejuruteraan 2 / *Engineering Mathematics 2*

Kod Kursus <i>Course Code</i>	KIX1002
Tajuk Kursus <i>Course Title</i>	Matematik Kejuruteraan 2 <i>Engineering Mathematics 2</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menjelaskan prinsip matematik seperti persamaan bezaan biasa, persamaan bezaan separa, siri kuasa, transformasi Laplace atau Fourier yang digunakan dalam bidang kejuruteraan. 2. Menggunakan prinsip matematik seperti persamaan bezaan biasa, persamaan bezaan separa, siri kuasa, transformasi Laplace atau Fourier dalam menganalisis masalah kejuruteraan. 3. Menyelesaikan masalah kejuruteraan kompleks dan mencapai kesimpulan sah dengan menggunakan prinsip matematik. <i>At the end of the course, students are able to:</i> 1. <i>Explain mathematical principles such as ordinary differential equation, partial differential equation, power series, Laplace or Fourier transform used in engineering field.</i> 2. <i>Use mathematical principles such as ordinary differential equation, partial differential equation, power series, Laplace or Fourier transform in analyzing engineering problem.</i> 3. <i>Solve complex engineering problem and reach a valid conclusion using mathematical principal.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini bertujuan untuk meningkatkan kemahiran matematik kepada pelajar-pelajar kejuruteraan. Kursus ini mengandungi persamaan pembezaan turutan pertama dan kedua, teknik untuk menyelesaikan persamaan pembezaan turutan kedua, penyelesaian siri kuasa untuk persamaan pembezaan, kaedah Frobenius, penyelesaian persamaan pembezaan dengan jelmaan Laplace, bezaan Jelmaan, kamiran Jelmaan, siri Fourier, persamaan pembezaan separa, persamaan haba, persamaan Laplace dan masalah nilai sempadan tidak homogen. Kursus ini juga memperkenalkan aplikasi kejuruteraan bagi topik-topik yang diajar. <i>This course attempts to improve the mathematical skills for engineering students. This course covers first order and second order differential equations, strategy to solve second order differential equations, power series solutions for differential equations, Frobenius method, Laplace transform solutions for differential equations, Fourier series, partial differential equations, heat equations, Laplace's equations and non-homogeneous boundary value problems. This course also introduces the engineering applications for the topics taught.</i>

Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	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.

KIX1002: Matematik Kejuruteraan 2 / Engineering Mathematics 2

Minggu Week	Topik Topic
1	Pengenalan: Definisi dan konsep asas dalam persamaan pembezaan biasa. Persamaan pembezaan turutan pertama (homogen dan tidak homogen) <i>Introduction. Definitions and fundamental concept in ODE</i> <i>First order Differential Equations (Homogeneous & Non-homogeneous)</i>
2	Teknik untuk menyelesaikan persamaan pembezaan turutan pertama <i>Strategy to solve First Order Differential Equation</i>
3	Persamaan pembezaan turutan kedua (homogen dan tidak homogen) <i>Second order ODE (Homogeneous & Non-homogeneous)</i>
4	Teknik untuk menyelesaikan persamaan pembezaan turutan kedua <i>Strategy to solve Second Order Differential Equation</i>
5	Aplikasi kejuruteraan bagi persamaan pembezaan <i>Engineering Applications of Differential Equations</i>
6	Penyelesaian siri kuasa untuk persamaan pembezaan <i>Power Series Solutions for Differential Equations</i>
7	Kaedah Frobenius <i>Frobenius Method</i>
8	Penyelesaian Persamaan Pembezaan dengan Jelmaan Laplace: Definisi, Jelmaan Songsang, Jelmaan bagi bezaan, Teorem anjakan pertama dan kedua <i>Laplace Transform Solutions for DE: Definition, Inverse Transforms, Transforms of Derivatives, First and Second Shift Theorem</i>
9	Bezaan Jelmaan, Kamiran Jelmaan: Selesaian persamaan pembezaan biasa (ODE) and persamaan kamiran <i>Derivatives of a Transform, transform of integrals: Solving ODE and integral equations</i>
10	Siri Fourier: Fungsi-fungsi berkala; Siri Trigonometri; Fungsi-fungsi Genap dan Ganjil, Siri Fourier, Pengembangan Separuh Julat <i>Fourier Series: Periodic functions; Trigonometric Series; Odd and even functions, Fourier Series, Half-range Expansion</i>
11	Persamaan Pembezaan Separa: Pengenalan, syarat-syarat awal dan sempadan, prinsip tindihan, masalah nilai sempadan (BVPs), Penyelesaian secara kamiran terus, Penyelesaian secara pembolehubah terpisah <i>Partial Differential Equations: Introduction, initial and boundary conditions, superposition principle, boundary value problems (BVPs), Solution by direct integration, Solution by separating variables</i>

12	Persamaan Haba: Persamaan haba bagi satu bar terhingga sekata, Penyelesaian bagi persamaan pengaliran haba, Persamaan Gelombang, Persamaan gelombang bagi satu tali yang diregang antara dua titik, Penyelesaian kepada persamaan <i>Heat Equations: The heat equation for a uniform finite bar, Solutions of the heat conduction equation, Wave Equations, The wave equation for a string stretched between two points, Solution of the wave equation</i>
13	Persamaan Laplace: Persamaan Laplace dalam masalah masa tak bersandar dua dimensi, Penyelesaian kepada persamaan Laplace, Persamaan Laplace dalam satah koordinat kutub <i>Laplace's Equations: The Laplace's equation in two dimensions time-independent problems, Solution of the Laplace's equation, Laplace's equation in plane polar coordinates</i>
14	Masalah nilai sempadan (BVPs) tidak homogen: Definisi, Penyelesaian kepada BVPs <i>Non-homogeneous BVPs: Definition, Solutions of the non-homogeneous BVPs</i>

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

Kod Kursus <i>Course Code</i>	KIX2005
Tajuk Kursus <i>Course Title</i>	Undang-undang, Etika dan Kemampanan untuk Jurutera <i>Law, Ethics and Sustainability for Engineers</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menghurai implikasi undang-undang, terhadap tingkah laku jurutera. 2. Menggunakan keperluan praktikal kod-kod etika untuk mengawal selia amalan kejuruteraan. 3. Menilai implikasi kemampanan dalam kerja-kerja kejuruteraan. <i>At the end of the course, students are able to:</i> 1. <i>Describe the implication of law for engineers' behaviour.</i> 2. <i>Apply the practical needs of the codes of ethics to regulate engineering practices.</i> 3. <i>Assess the implication of sustainability in engineering works.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	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. <i>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.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%

Rujukan Utama <i>Main Reference</i>	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.
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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) <i>Introduction to the Board of Engineers, Malaysia (BEM) and the Institution of Engineers, Malaysia (IEM)</i>
2	Akta Pendaftaran Jurutera (REA) 1967 <i>Registration of Engineers Act 1967 (REA)</i>
3	Pembatalan, Pengguguran dan Pengembalian Semula <i>Cancellation, Removal and Reinstatement</i>
4	Jenis Tort, Liabiliti Tort dan Pembelaan terhadap Tort <i>Type of Tort, Tort Liability and Defence against Tort</i>
5	Pengenalan dan Isi Kandungan Kontrak Liabiliti, Pembatalan dan Penyelesaian Kontrak <i>Introduction and the Content of Contracts Liability, Cancellation and Settlement of Contracts</i>
6	Jenis-jenis Perkhidmatan Kejuruteraan <i>Type of Engineering Services</i>
7	Ujian Pertengahan Semester <i>Mid-Term Test</i>
8	Peranan Jurutera Peluang dalam profesion Etika di dalam kajian dan Penyelidikan <i>Roles of Engineers Opportunities in the Profession Ethics in Experiment and Research</i>
9	Profesionalisme, Moral dan Etika <i>Professionalism, Moral and Ethics</i>
10	Etika Kejuruteraan, Konflik dan Penyelesaian <i>Engineering Ethics, Conflict and Resolution</i>
11	Pengenalan kepada Kelestarian, Rukun Kelestarian, Keselamatan Makanan, Alam Sekitar (udara dan air), Kajian Kes Industri <i>Introduction to Sustainability, Pillars of Sustainability, Food Security, Environmental (air and water) Security, Industrial Case Studies</i>

12	Penilaian Kitaran Hayat (LCA) dan Matlamat Pembangunan Mampan (SDG) <i>Life Cycle Assessment (LCA) and Sustainable Development Goals (SDG)</i>
13	Kejuruteraan Hijau (proses, bahan, bangunan, dll.) <i>Green Engineering (processess, materials, buildings, etc.)</i>
14	Rumusan Kursus <i>The Course Wrap Up</i>

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

Kod Kursus <i>Course Code</i>	KIX2006
Tajuk Kursus <i>Course Title</i>	Ekonomi Kejuruteraan dan Pengurusan Projek <i>Engineering Economics and Project Management</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	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 penyelesaian yang 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. <i>At the end of the course, students are able to:</i> 1. <i>Describe the principles, basic concepts, and methodology of engineering economy analysis and project management.</i> 2. <i>Apply engineering economics analysis methods on choosing competing design solutions.</i> 3. <i>Apply project management methods in implementing and achieving strategic goals of the organization.</i> 4. <i>Evaluate implications of both engineering economy and project management decisions on organisation and society.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	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 keputusan 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. <i>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,</i>

	<i>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.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. William G. Sullivan, Elin M. Wicks and Patrick Koelling, <i>Engineering Economy</i>, 17th Ed., Prentice Hall, 2020 2. Leland Blank and Anthony Tarquin, <i>Engineering Economy</i>, 8th Ed., McGraw-Hill, 2018 3. Erik W Larson and Clifford F Gray, <i>Project Management the Managerial Process</i>, 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 <i>Introductions to Engineering Economy and Modern Project Management</i>
2	Konsep-konsep Kos dan Ekonomik Rekabentuk <i>Cost Concepts and Design Economics</i>
3	Pentakrifan projek dan Penganggaran Kos <i>Defining the Project and Cost Estimations</i>
4	Faktor-faktor: Bagaimana masa dan kadar bunga memberi kesan kepada wang <i>Factors: How Time and Interest Affect Money</i>
5	Faktor-faktor bergabung: Kadar Bunga nominal dan Efektif <i>Combining Factors: Nominal and Effective Interest Rates</i>
6	Menilai Projek Tunggal <i>Evaluating a Single Project</i>
7	Perbandingan dan Pemilihan Antara Projek-Projek <i>Comparison and Selection Among Alternatives: Financial and non-financial criteria</i>
8	Analisa Penggantian <i>Replacement Analysis</i>
9	Menilai Projek Awam Menggunakan Kaedah Faedah-Kos <i>Evaluating Public Project Using Benefit-Cost Ratio Method</i>
10	Membangun Pelan Projek <i>Developing a Project Plan</i>
11	Mengurus Risiko <i>Managing Risk</i>
12	Pengagihan Sumber dan Penjadualan; Menjejak dan Mengawal Projek <i>Resource Allocation and Scheduling; Project Tracking and Control</i>
13	Pengkomputeran Pengurusan Projek dan Perancang Projek Microsoft <i>Project Management Computing and Microsoft Project Planner</i>
14	Pembentangan Projek Berkumpulan <i>Group Project Presentation</i>

Maklumat Kursus

Course Information

DEPARTMENT COURSES

KIE1001: Makmal 1 / Lab 1

Kod Kursus <i>Course Code</i>	KIE1001
Tajuk Kursus <i>Course Title</i>	Makmal 1 <i>Lab 1</i>
Kredit <i>Credit</i>	1
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menunjukkan kemahiran asas kejuruteraan elektrik melalui projek mini dan eksperimen. 2. Menunjukkan kemahiran kerja berpasukan untuk projek mini dan eksperimen yang berkaitan dengan asas kejuruteraan elektrik. 3. Menyelesaikan masalah asas kejuruteraan elektrik dalam projek mini mengikut peraturan keselamatan. <i>At the end of the course, students are able to:</i> 1. <i>Demonstrate electrical engineering fundamental skills through mini project and experiments.</i> 2. <i>Demonstrate teamwork skill for mini project and experiments related to electrical engineering fundamentals.</i> 3. <i>Solve electrical engineering fundamental problems in mini project according to the safety rules.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini mendedahkan pelajar kepada kemahiran praktikal berkaitan sistem digit, analisa litar dan litar elektronik. Selain itu, projek mini akan diperkenalkan di mana pelajar perlu membangunkan prototaip secara berkumpulan. <i>This course exposes students to practical skills related to digital system, circuit analysis and electronic circuit. Besides, a mini project will be introduced where students need to develop a prototype as a group.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 100% Peperiksaan Akhir / <i>Final Examination</i>: 0%
Rujukan Utama <i>Main Reference</i>	1. Thomas L. Floyd, "Digital Fundamentals", 11th Edition, Pearson, 2015. 2. James W Nilsson, Susan A Riedel, Electric Circuits, 11th Edition, Prentice Hall, 2019. 3. Adel S. Sedra, Kenneth C. Smith, Tony Chan Carusone, and Vincent Gaudet (2020). Microelectronic Circuits, 8th edition, Oxford University Press. 4. Briefing slides 5. Related reference materials and articles in Books, Journals, Conference Proceedings, Monographs, Manuals, Standards, etc.

KIE1001: Makmal 1 / Lab 1

Minggu Week	Topik Topic
1	Taklimat makmal dan seminar penulisan laporan makmal <i>Lab briefing and lab report writing seminar</i>
2	Taklimat Keselamatan, Kesihatan dan Persekitaran Pekerjaan (OSHE) <i>Occupational Safety, Health And Environment (OSHE) Briefing</i>
3	Eksperimen Sistem Digit 1 <i>Digital System Experiment 1</i>
4	Eksperimen Sistem Digit 2 <i>Digital System Experiment 2</i>
5	Eksperimen Analisa Litar 1 <i>Circuit Analysis Experiment 1</i>
6	Eksperimen Analisa Litar 2 <i>Circuit Analysis Experiment 2</i>
7	Eksperimen Litar Elektronik Asas 1 <i>Basic Electronic Circuit Experiment 1</i>
8	Eksperimen Litar Elektronik Asas 2 <i>Basic Electronic Circuit Experiment 2</i>
9	Projek Mini (Rumusan Masalah) <i>Mini Project (Problem Formulation)</i>
10	Projek Mini (Rekabentuk Penyelesaian) <i>Mini Project (Design of Solution)</i>
11	Projek Mini (Pembangunan Prototaip) <i>Mini Project (Prototype Development)</i>
12	Projek Mini (Pembangunan Prototaip) <i>Mini Project (Prototype Development)</i>
13	
14	

KIE1002: Makmal 2 / Lab 2

Kod Kursus <i>Course Code</i>	KIE1002
Tajuk Kursus <i>Course Title</i>	Makmal 2 <i>Lab 2</i>
Kredit <i>Credit</i>	1
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menganalisa keputusan eksperimen asas kejuruteraan elektrik menggunakan alatan kejuruteraan moden. 2. Menunjukkan kemahiran berkomunikasi melalui penulisan laporan teknikal berkaitan asas kejuruteraan elektrik. 3. Melaksanakan eksperimen asas kejuruteraan elektrik berdasarkan peraturan keselamatan makmal dan lembaran makmal. <i>At the end of the course, students are able to:</i> 1. <i>Analyze the results of electrical engineering fundamental experiments using modern engineering tools.</i> 2. <i>Demonstrate communication skills through technical reports writing related to electrical engineering fundamentals.</i> 3. <i>Perform electrical engineering fundamental experiments according to the lab safety rules and lab sheets.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini mendedahkan pelajar kepada kemahiran praktikal berkaitan elektromagnetik asas, litar elektronik dan rekabentuk PCB. <i>This course exposes students to practical skills related to basic electromagnetic, electronic circuit and PCB design.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 100% Peperiksaan Akhir / <i>Final Examination</i>: 0%
Rujukan Utama <i>Main Reference</i>	1. Microelectronic Circuits, Adel S. Sedra, Kenneth C. Smith, Oxford Series in Electrical & Computer Engineering, 2019. 2. Fundamentals of Applied Electromagnetics (8th Ed), Ulaby, Ravaioli, 2020. 3. Martin Peterson, Ethics for Engineers, Oxford University Press, 2020 4. Tim Williams, The circuit designer's companion, Elsevier, 2017.

KIE1002: Makmal 2 / Lab 2

Minggu Week	Topik Topic
1	Seminar Etika Menjalankan Eksperimen <i>Ethics on Conducting Experiment Seminar</i>
2	Seminar Kod Amalan <i>Code of Practice Seminar</i>
3	Eksperimen Elektromagnetic Asas 1 <i>Basic Electromagnetic Experiment 1</i>
4	Eksperimen Elektromagnetic Asas 2 <i>Basic Electromagnetic Experiment 2</i>
5	Eksperimen Elektromagnetic Asas 3 <i>Basic Electromagnetic Experiment 3</i>
6	Eksperimen Litar Elektronik 1 <i>Electronic Circuit Experiment 1</i>
7	Eksperimen Litar Elektronik 2 <i>Electronic Circuit Experiment 2</i>
8	Eksperimen Litar Elektronik 3 <i>Electronic Circuit Experiment 3</i>
9	Eksperimen Litar Elektronik 4 <i>Electronic Circuit Experiment 4</i>
10	Experimen Rekabentuk PCB 1 <i>PCB Design Experiment 1</i>
11	Experimen Rekabentuk PCB 2 <i>PCB Design Experiment 2</i>
12	
13	
14	

KIE1003: Sistem Digit / Digital System

Kod Kursus <i>Course Code</i>	KIE1003
Tajuk Kursus <i>Course Title</i>	Sistem Digit <i>Digital System</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menyelesaikan operasi aritmetik asas perwakilan nombor dan penukaran kod. 2. Menunjuk cara dengan efektif rekabentuk litar dan modul logik dengan pelbagai kaedah yang dipelajari. 3. Menganalisa operasi litar logik berjujukan di dalam sistem digit. <i>At the end of the course, students are able to:</i> 1. <i>Solve basic arithmetic operations with number representations and code conversions.</i> 2. <i>Demonstrate effectively the design of logic circuits and modules with various methods learnt.</i> 3. <i>Analyze the operation of sequential logic circuits in digital system.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus pengenalan kepada litar logic digital yang merangkumi sistem nombor, kod digital, algebra Boolean, rekabentuk kombinasi logik, kombinasi logik modular dan litar logik berjujukan. <i>An introductory course in digital logic circuits covering number representation, digital codes, Boolean Algebra, combinatorial logic design, combinational logic modules, and sequential logic circuits.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Ronald J. Tocci, Neal Widmer, and Greg Moss. "Digital Systems: Principles and Applications", Pearson, 2017. 2. Thomas L. Floyd, "Digital Fundamentals", 11th Edition, Pearson, 2015. 3. M. Morris Mano, Charles R. Kime and Tom Martin, "Logic and Computer Design Fundamentals", 5th edition, Pearson, 2016.

KIE1003: Sistem Digit / Digital System

Minggu Week	Topik Topic
1	Sistem penomboran binari, perlapanan dan perenambelasan <i>Binary, octal and hexadecimal number systems</i>
2	Algebra Boolean, logik dan get asas, identiti asas, pelengkap, jumlah-produk, produk-jumlah, minterm dan maxterm, pengisian masuk/keluar <i>Boolean Algebra, logic and basic gates, basic identities, complement, sum-of-product, product-of-sum, minterm and maxterm, fan in/out</i>
3	Peta-K, manipulasi peta, pengoptimuman litar, get jenis lain, eksklusif-OR <i>K-map, map manipulation, circuit optimization, other types of gates, exclusive-OR</i>
4	Prosedur reka bentuk litar, prosedur hierarki dan atas-bawah, pengoptimuman, pengesahan <i>Circuit design procedure, hierarchical and top-down procedure, optimization, verification</i>
5	Penyahkod dan pengekod <i>Decoder and encoder</i>
6	Pemultiplek dan penyahmultiplek <i>Multiplexer and demultiplexer</i>
7	Litar gabung berulang, penambah, penolakan, penambah-penolak binari, fungsi aritmetik lain <i>Iterative combinational circuit, adders, subtraction, binary adder-subtractor, other arithmetic functions</i>
8	Litar berurutan, latch, flip-flop <i>Sequential circuits, latches, flip-flops</i>
9	Jadual dan rajah keaddan, rajah masa, kelewatan penyebaran <i>State table and diagram, timing diagrams, propagation delay</i>
10	Asas ingatan, RAM, ROM, SRAM, DRAM <i>Memory basics, RAM, ROM, SRAM, DRAM</i>
11	Pengenalan kepada VHDL dan Verilog <i>Introduction to VHDL and Verilog</i>
12	Mesin keadaan terhingga <i>Finite state machine</i>
13	Litar daftar <i>Registers</i>
14	Pembilang <i>Counters</i>

KIE1004: Pengaturcaraan I / *Programming I*

Kod Kursus <i>Course Code</i>	KIE1004
Tajuk Kursus <i>Course Title</i>	Pengaturcaraan I <i>Programming I</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Mengenalpasti teknik-teknik pengaturcaraan yang sesuai untuk pembangunan kod komputer. 2. Menyelesaikan masalah-masalah kejuruteraan dan bukan kejuruteraan kehidupan sebenar dengan menggunakan teknik-teknik pengaturcaraan dengan pelbagai pertimbangan yang sesuai. 3. Menunjukkan sumbangan sebagai ahli dalam merekabentuk penyelesaian bagi masalah-masalah kejuruteraan dan bukan kejuruteraan. <i>At the end of the course, students are able to:</i> 1. <i>Identify appropriate programming techniques for computer code development.</i> 2. <i>Solve real-life engineering and non-engineering problems using programming techniques with various appropriate considerations.</i> 3. <i>Demonstrate the contributions as a member in designing solutions for engineering and non-engineering issues.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Pengaturcaraan komputer merupakan suatu proses yang membawa dari rumusan asal masalah pengkomputeran kepada program-program komputer boleh laku. Pengaturcaraan melibatkan aktiviti-aktiviti seperti analisa, pembangunan pemahaman, penjaan algoritma, pengesahan keperluan-keperluan algoritma termasuk kebenaran dan penggunaan sumber-sumber, serta pelaksanaan algoritma dalam bahasa pengaturcaraan tertentu. Kursus ini meliputi konsep-konsep asas pengaturcaraan komputer termasuk aritmetik dan logik, struktur kawalan, fungsi, tatasusunan, petunjuk, dan kelas. Salah satu bahasa pengaturcaraan yang paling biasa digunakan, bahasa C/C++ akan digunakan dalam kursus ini. <i>Computer programming is a process that leads from an original formulation of a computing problem to executable computer programs. Programming involves activities such as analysis, developing understanding, generating algorithms, verification of requirements of algorithms including their correctness and resources consumption, and implementation of algorithms in a target programming language. This course covers the fundamental concepts of computer programming including arithmetics and logics, control statements, functions, arrays,</i>

	<i>pointers and classes. One of the most commonly used programming languages, C/C++ language, is used in this course.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. H.M Deitel, P.J. Deitel, "C++ How to Program", 10th Edition, Pearson, 2017. 2. B. Overland, "C++ Without Fear: A Beginner's Guide That Makes You Feel Smart", Pearson, 3rd Edition, 2015. 3. Delores M. Etter, Jeanine A. Ingber, "Engineering Problem Solving With C++", 4th Edition, Pearson Education, 2017.

KIE1004: Pengaturcaraan I / Programming I

Minggu Week	Topik Topic
1	Pengenalan kepada komputer dan pengaturcaraan <i>Introduction to computer and programming</i>
2	Konsep asas: Pengenalan <i>Basic concepts: Input/output, variables, expression</i>
3	Konsep asas: Aritmetik & operator <i>Basic concepts: Arithmetic & operators, formatting</i>
4	Kenyataan kawalan: Pilihan (if, if...else, switch) <i>Control statements: Selection (if, if...else, switch)</i>
5	Kenyataan kawalan: Ulangan (while, for, do..while) <i>Control statements: Repetition (while, for, do..while)</i>
6	Kenyataan kawalan: Kajian Kes <i>Control statements: Case Study</i>
7	Fungsi: Deklarasi dan prototaip <i>Functions: Declaration and prototypes</i>
8	Fungsi: Fungsi overloading dan rekursi <i>Functions: Function overloading and recursion</i>
9	Tatasusunan: Deklarasi dan hantaran tatasusunan ke fungsi <i>Arrays: Declaration and passing arrays to functions</i>
10	Tatasusunan: Tatasusunan multidimensi <i>Arrays: Multidimensional arrays</i>
11	Fungsi dan Tatasusunan: Kajian Kes (Pencarian lurus dan algoritma pengisihan primitif) <i>Function and array: Case study (Linear searching and primitive sorting algorithms)</i>
12	Penunjuk: Deklarasi dan permulaan <i>Pointers: Declaration and initialization</i>
13	Penunjuk: hantar-secara-rujukan <i>Pointers: Pass-by-Reference</i>
14	Penunjuk: Kajian Kes <i>Pointers: Case Study</i>

KIE1005: Analisa Litar I / *Circuit Analysis I*

Kod Kursus <i>Course Code</i>	KIE1005
Tajuk Kursus <i>Course Title</i>	Analisa Litar I <i>Circuit Analysis I</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Mengaplikasikan teori-teori litar dan teknik-teknik analisa kepada litar-litar AT dan AU dalam pelbagai konfigurasi litar. 2. Menganalisa sambutan-sambutan fana bagi litar-litar RL, RC dan RLC bagi pelbagai konfigurasi litar. 3. Menyelesaikan masalah litar-litar AT dan AU bagi pelbagai aplikasi secara berkumpulan. <i>At the end of the course, students are able to:</i> 1. <i>Apply circuit theorems and analysis techniques to DC and AC circuits in various circuit configurations.</i> 2. <i>Analyse transient responses of RL, RC and RLC for various circuit configurations.</i> 3. <i>Solve problems involving DC and AC circuits for various applications as a group.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini memperkenalkan teori-teori asas dan teknik-teknik analisa untuk menyelesaikan masalah dalam litar elektrik. Ia merangkumi teknik-teknik untuk menganalisa litar-litar AT dan AU, sambutan fana litar-litar RL, RC dan RLC, dan pengiraan kuasa keadaan-mantap sinusoid. <i>This course introduces the fundamental theorems and analysis techniques for problem-solving in electrical circuits. It encompasses the techniques for analysing the DC and AC circuits, the transient response of RL and RC and RLC circuits, and the sinusoidal steady-state power calculation.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	4. James W Nilsson, Susan A Riedel, Electric Circuits, 11th Edition, Prentice Hall, 2019. 5. Charles K Alexander, Matthew N. O. Sadiku, Fundamentals of Electric Circuits, 7th Edition, McGraw Hill, 2020. 6. James A. Svoboda, Richard C. Dorf, Introduction to Electric Circuits, 9th Edition, Wiley, 2013.

KIE1005: Analisa Litar I / *Circuit Analysis I*

Minggu Week	Topik Topic
1	Prinsip asas. <i>Basic principle.</i>
2	Litar-litar rintangan mudah. <i>Simple resistive circuits.</i>
3	Teknik-teknik analisa litar: Kaedah voltan-nod. <i>Circuit analysis techniques: Node-voltage method.</i>
4	Teknik-teknik analisa litar: Kaedah arus-jaring. <i>Circuit analysis techniques: Mesh-current method.</i>
5	Teori-teori litar: Penjelmaan punca dan litar-litar kesetaraan Thevenin dan Norton. <i>Circuit theorems: Source transformation and Thevenin and Norton equivalent circuits.</i>
6	Teori-teori Litar: Pemindahan kuasa maksimum dan prinsip tindihan. <i>Circuit theorems: Maximum power transfer and superposition principle.</i>
7	Elemen-elemen litar penyimpanan tenaga: Ciri-ciri aruhan dan muatan. <i>Energy storage circuit elements: Characteristic of inductance and capacitance.</i>
8	Kesan-kesan fana dalam litar-litar AT: Sambutan tabii litar RL dan RC. <i>Transient effects in DC circuits: Natural response of RL and RC circuit.</i>
9	Kesan-kesan fana dalam litar-litar AT: Sambutan langkah litar RL dan RC. <i>Transient effects in DC circuits: Step response of RL and RC circuit.</i>
10	Kesan-kesan fana dalam litar-litar AT: Sambutan tabii dan langkah litar RLC. <i>Transient effects in DC circuits: Natural and step response of RLC circuit.</i>
11	Litar-litar AU: Konsep asas, perwakilan matematik dan perwakilan pempfasa. <i>AC circuits: Basic concept, mathematical representation and phasor representation.</i>
12	Litar-litar AU: Kaedah voltan-nod dan arus-jaring. <i>AC circuits: Node-voltage and mesh-current methods.</i>
13	Litar-litar AU: Litar kesetaraan Thevenin dan Norton, dan prinsip tindihan. <i>AC circuits: Thevenin and Norton equivalent circuit and superposition principle.</i>
14	Pengiraan kuasa di dalam litar-litar AU. <i>Power calculation in AC circuits.</i>

KIE1006: Fizik Elektronik / *Electronic Physics*

Kod Kursus <i>Course Code</i>	KIE1006
Tajuk Kursus <i>Course Title</i>	Fizik Elektronik <i>Electronic Physics</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Mengaplikasikan prinsip-prinsip mekanik kuantum bagi pembawa cas dalam pepejal. 2. Menganalisa kepekatan caj pembawa dan semua faktor yang akan mempengaruhi nilai-nilai dalam semikonduktor intrinsik dan ekstrinsik. 3. Menjelaskan struktur fizikal dan prestasi peranti semikonduktor. <i>At the end of the course, students are able to:</i> 1. <i>Apply the principles of quantum mechanics of charge carriers in solids.</i> 2. <i>Analyse charge carriers concentration and all factors that will affect their values in intrinsic and extrinsic semiconductors.</i> 3. <i>Explain the physical structure and performance characteristics of semiconductor devices.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini menyediakan asas untuk memahami fizik, ciri-ciri dan sifat-sifat elektrik daripada bahan-bahan dan peranti semikonduktor. Kursus ini juga akan meliputi teori pepejal, kajian semikonduktor dalam keseimbangan, fenomena pengangkutan pengangkut dan simpang-PN. <i>This course provides a basis for understanding of physics, characteristics and electrical properties of semiconductor materials and devices. This course will also cover the theory of solids, the study of semiconductor in equilibrium, carrier transport phenomena and PN-junctions.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Donald Neamen, "Semiconductor Physics and Devices", McGraw Hill, 2014. 2. Sandip Tiwari, "Semiconductor Physics: Principles, Theory and Nanoscale", Oxford University Press, 2020. 3. Marius Grundmann, "The Physics of Semiconductor: An introduction including Nanophysics and Applications", Springer, 2016.

KIE1006: Fizik Elektronik / *Electronic Physics*

Minggu Week	Topik Topic
1	Struktur kristal semikonduktor, jenis pepejal <i>Semiconductor crystal structures, types of solids</i>
2	Struktur kristal, kekisi ruang, ikatan atom, ketidaksembelihan dalam pepejal <i>Crystal structures, space lattices, atomic bonding, imperfections in solids</i>
3	Prinsip Mekanik Kuantum <i>Principles of Quantum Mechanics</i>
4	Kuantisasi tenaga dan konsep kebarangkalian, teori band tenaga, kepekatan pembawa dan hanyut <i>Energy quantization and probability concepts, energy band theory, carrier concentrations and drifts</i>
5	Mekanik statistik <i>Statistical mechanics</i>
6	Pembawa caj dalam semikonduktor, atom dopant dan tahap tenaga <i>Charge carriers in semiconductors, dopant atoms and energy levels</i>
7	Pengagihan pembawa dalam semikonduktor ekstrinsik, statistik penderma dan penyamaan <i>Carrier distribution in the extrinsic semiconductors, statistics of donors and acceptors</i>
8	Kesan Doping dan suhu pada kepekatan pembawa dan kedudukan tahap tenaga Fermi <i>Effects of Doping and temperature on carrier concentration and position of Fermi energy level</i>
9	Pengangkut hanyut dan peresap <i>Carrier drift and diffusion</i>
10	Pengagihan kekotoran bergred <i>Graded impurity distribution</i>
11	Struktur asas persimpangan PN, berat sebelah gunaan sifar, berat sebelah terbalik dan berat sebelah hadapan <i>Basic structure of PN junction, zero applied bias, reverse bias and forward bias</i>
12	Struktur asas BJT, mod cut-off, mod aktif ke hadapan, mod tepu <i>Basic structure of BJT, cut-off mode, forward active mode, saturation mode</i>
13	Struktur asas MOSFET, mod pengumpulan, mod penyempurnaan, mod penyongsangan <i>Basic structure of MOSFET, accumulation mode, depletion mode, inversion mode</i>
14	Operasi asas LED, sel solar <i>Basic operation of LED, solar cells</i>

KIE1007: Litar Elektronik I / *Electronic Circuits I*

Kod Kursus <i>Course Code</i>	KIE1007
Tajuk Kursus <i>Course Title</i>	Litar Elektronik I <i>Electronic Circuits I</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menganalisa litar semikonduktor melalui pemerhatian intuitif dan analisa litar DC. 2. Menerapkan model frekuensi rendah AU untuk memerhatikan tukar ganti prestasi dalam litar semikonduktor. 3. Melaksanakan kajian kes mengenai litar semikonduktor mudah dan aplikasinya dalam penggunaan konsumer/industri moden. <i>At the end of the course, students are able to:</i> 1. <i>Analyze semiconductor circuits through intuitive observation and DC circuit analysis.</i> 2. <i>Apply low frequency AC model in observing the performance tradeoffs in semiconductor circuits.</i> 3. <i>Perform case study on simple semiconductor circuits and application for modern consumer/industrial use.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini memberikan pengenalan kepada rekabentuk litar elektronik moden dan konsep penggunaan peranti semikonduktor aktif dan pasif (diod, transistor dwikutub dan transistor kesan medan), serta membicarakan aplikasi peranti berkenaan dalam sebilangan litar elektronik asas, seperti penguat dan penguat operasi <i>This course provides an introduction to modern electronic circuit design and to the concepts of active and passive semiconducting devices (diodes, bipolar and MOSFET transistors), and a discussion of their use in a number of basic electronic circuits i.e. amplifiers and operational amplifiers.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Adel S. Sedra, Kenneth C. Smith, Tony Chan Carusone, and Vincent Gaudet (2020). Microelectronic Circuits, 8th edition, Oxford University Press. 2. Robert L. Boylestad, Louis Nashelsky (2013). Electronic Devices and Circuit Theory, 11th edition, Pearson. 3. Thomas L. Floyd (2018). Electronic Devices, 10th edition, Pearson.

KIE1007: Litar Elektronik I / *Electronic Circuits I*

Minggu Week	Topik Topic
1	Ciri-ciri diod semikonduktor <i>Semiconductor diode characteristics</i>
2	Aplikasi dan analisa diod semikonduktor menggunakan model diod <i>Semiconductor diode applications and analysis using diode models</i>
3	Penerus gelombang separuh dan penerus gelombang penuh <i>Half wave rectifiers and full wave rectifiers</i>
4	Struktur dan ciri BJT <i>BJT structure and characteristics</i>
5	Litar BJT AT dan model isyarat kecil <i>BJT DC circuits and small signal models</i>
6	Analisa isyarat kecil dan pincangan penguat BJT <i>BJT amplifier small signal analysis and biasing</i>
7	Penguat BJT litar diskrit <i>Discrete circuit BJT amplifiers</i>
8	Struktur dan ciri MOSFET <i>MOSFET structure and characteristics</i>
9	Litar MOSFET AT dan model isyarat kecil <i>MOSFET DC circuits and small signal models</i>
10	Analisa isyarat kecil dan pincangan penguat MOSFET <i>MOSFET amplifier small signal analysis and biasing</i>
11	Penguat MOSFET litar diskrit <i>Discrete circuit MOSFET amplifiers</i>
12	Ciri dan spesifikasi penguat kendalian (OPAMP) <i>Operational amplifier (OPAMP) characteristics and specifications</i>
13	Penguat tak menyongsang dan penguat menyongsang <i>Non-inverting amplifier and inverting amplifier</i>
14	Analisa sistem penguat kendalian litar lara <i>Analysis operational amplifier system of cascaded circuits</i>

KIE1008: Pengaturcaraan II / Programming II

Kod Kursus <i>Course Code</i>	KIE1008
Tajuk Kursus <i>Course Title</i>	Pengaturcaraan II <i>Programming II</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menggunakan teknik pengaturcaraan berorientasikan objek yang sesuai untuk pembangunan kod komputer. 2. Menyelesaikan masalah kejuruteraan dan bukan kejuruteraan sebenar menggunakan algoritma dan struktur data yang sesuai. 3. Menunjukkan sumbangan sebagai ahli dalam pasukan yang pelbagai bagi pembangunan kod komputer. <i>At the end of the course, students are able to:</i> 1. <i>Use appropriate object-oriented programming techniques for computer code development.</i> 2. <i>Solve real-life engineering and non-engineering problems using appropriate algorithms and data structures.</i> 3. <i>Demonstrate the contributions as a member in diverse teams for computer code development.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Pengaturcaraan berorientasikan objek dan struktur data adalah dua topik penting untuk pengaturcaraan komputer canggih. Kursus ini merangkumi topik yang berkaitan dengan pengaturcaraan berorientasikan objek dan pelbagai struktur data seperti susunan, barisan, pokok dan graf. Algoritma yang digunakan untuk mencari, memisahkan dan menyusun struktur data juga akan dilindungi. C / C++ digunakan dalam kursus ini. <i>Object oriented programming and data structures are two important topics for advanced computer programming. This course covers topics related to object oriented programming and various data structures such as stacks, queues, trees and graphs. Algorithms used for searching, hashing and sorting the data structures will also be covered. C/C++ language is used in this course.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. H.M. Deitel, P.J. Deitel, "C++ How to Program", Prentice Hall, 10th Edition, 2017. 2. M.A. Weiss, "Data Structures and Algorithm Analysis in C++", Pearson, 4th Edition, 2014. 3. D.S. Malik, "Data Structures using C++", Cengage Learning, 2nd Edition, 2010.

KIE1008: Pengaturcaraan II / Programming II

Minggu Week	Topik Topic
1	Pengenalan kepada Pengaturcaraan Berorientasikan Objek <i>Introduction to Object Oriented Programming</i>
2	Pengaturcaraan Berorientasikan Objek: Kelas <i>Object-Oriented Programming: Class</i>
3	Pengaturcaraan Berorientasikan Objek: Pewarisan <i>Object-Oriented Programming: Inheritance</i>
4	Pengaturcaraan Berorientasikan Objek: Pewarisan <i>Object-Oriented Programming: Inheritance</i>
5	Pengaturcaraan Berorientasikan Objek: Polimorfisma <i>Object-Oriented Programming: Polymorphism</i>
6	Pengaturcaraan Berorientasikan Objek: Polimorfisma <i>Object-Oriented Programming: Polymorphism</i>
7	Struktur Data: Senarai Terpaut <i>Data Structure: Linked-List</i>
8	Struktur Data: Senarai Terpaut <i>Data Structure: Linked-List</i>
9	Struktur Data: Timbunan <i>Data Structure: Stacks</i>
10	Struktur Data: Barisan <i>Data Structure: Queues</i>
11	Algoritma: Mencari dan Hashing <i>Algorithm: Searching and Hashing</i>
12	Algoritma: Menyusun <i>Algorithm: Sorting</i>
13	Struktur Data: Pokok Binary dan Pokok Seimbang <i>Data Structure: Binary Trees and Balanced Trees</i>
14	Struktur Data: Graf <i>Data Structure: Graphs</i>

KIE2001: Makmal 3 / Lab 3

Kod Kursus <i>Course Code</i>	KIE2001
Tajuk Kursus <i>Course Title</i>	Makmal 3 <i>Lab 3</i>
Kredit <i>Credit</i>	1
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Memilih penyelesaian yang sesuai untuk projek bersepadu mini berdasarkan keperluan yang diberikan. 2. Menunjukkan sumbangan sebagai ahli atau sebagai pemimpin dalam projek bersepadu mini dan eksperimen berkaitan disiplin kejuruteraan elektrik khusus. 3. Melaksanakan eksperimen berkaitan disiplin kejuruteraan elektrik khusus dan projek bersepadu mini berdasarkan peraturan keselamatan makmal. <i>At the end of the course, students are able to:</i> 1. Choose suitable solution for a mini integrated project based on the given requirements. 2. Demonstrate the contribution as a member or a leader in mini integrated project and experiments related to specialized electrical engineering disciplines. 3. Perform experiments related to specialized electrical engineering disciplines and mini integrated project according to the lab safety rules.
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini mendedahkan pelajar kepada kemahiran praktikal berkaitan mesin dan pemacu dan sistem komunikasi dan juga pendedahan kepada projek bersepadu mini. <i>This course exposes students to practical skills related to machines and drives and communication system and also exposure to mini integrated project.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 100% Peperiksaan Akhir / <i>Final Examination</i>: 0%
Rujukan Utama <i>Main Reference</i>	1. Harold P. E. Stern, Samy A. Mahmoud, "Communication Systems: Analysis and Design", 1st Ed, Pearson, 2019. 2. B.P Lathi, Zhi Dong, "Modern Digital and Analog Communication Systems", 5th Ed, Oxford University Press, 2018. 3. Electrical Machines, Drives, and Power Systems, New International Edition, Theodore Wildi, Pearson, 2013. 4. Related reference materials and articles in Books, Journals, Conference Proceedings, Monographs, Manuals, Standards, etc.

KIE2001: Makmal 3 / Lab 3

Minggu Week	Topik Topic
1	Taklimat projek bersepadu mini <i>Mini integrated project briefing</i>
2	Bengkel teknikal <i>Technical workshops</i>
3	Projek Bersepadu Mini (Rumusan Masalah) <i>Mini Integrated Project (Problem Formulation)</i>
4	Projek Bersepadu Mini (Rekabentuk Penyelesaian) <i>Mini Integrated Project (Design of Solution)</i>
5	Projek Bersepadu Mini (Pembangunan Prototaip) <i>Mini Integrated Project (Prototype Devemopment)</i>
6	Projek Bersepadu Mini (Pembangunan Prototaip) <i>Mini Integrated Project (Prototype Devemopment)</i>
7	Eksperimen Mesin dan Pemacu 1 <i>Machines and Drives Experiment 1</i>
8	Eksperimen Mesin dan Pemacu 2 <i>Machines and Drives Experiment 2</i>
9	Eksperimen Sistem Komunikasi 1 <i>Communication System Experiment 1</i>
10	Eksperimen Sistem Komunikasi 2 <i>Communication System Experiment 2</i>
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12	
13	
14	

KIE2002: Makmal 4 / Lab 4

Kod Kursus <i>Course Code</i>	KIE2002
Tajuk Kursus <i>Course Title</i>	Makmal 4 <i>Lab 4</i>
Kredit <i>Credit</i>	1
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Mentafsir data pengukuran yang diperoleh dari eksperimen berkaitan disiplin kejuruteraan elektrik khusus. 2. Menyelaras pelaksanaan eksperimen berkaitan disiplin kejuruteraan elektrik khusus melalui komunikasi berkesan antara ahli kumpulan. 3. Melaksanakan eksperimen berkaitan disiplin kejuruteraan elektrik khusus berdasarkan peraturan keselamatan makmal dan lembaran makmal. <i>At the end of the course, students are able to:</i> 1. <i>Interpret measurement data obtained from experiments related to specialized electrical engineering disciplines.</i> 2. <i>Coordinate the execution of experiments related to specialized electrical engineering disciplines through effective communication among group members.</i> 3. <i>Perform experiments related to specialized electrical engineering disciplines according to the lab safety rules and lab sheets.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini mendedahkan pelajar kepada kemahiran praktikal berkaitan elektromagnetik gunaan, sistem kawalan, pemprosesan isyarat digital dan lukisan kejuruteraan. <i>This course exposes students to practical skills related to applied electromagnetic, control system, digital signal processing and engineering drawing.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 100% Peperiksaan Akhir / <i>Final Examination</i>: 0%
Rujukan Utama <i>Main Reference</i>	1. David K.Cheng. "Fundamental of Engineering Electromagnetic", Pearson, 2019. 2. R. C. Dorf and R H Bishop, "Modern Control System", 13th Edition, Pearson, 2016." 3. Alan V. Oppenheim & Verghese, "Signals, Systems and Inference", Prentice Hall, 2016. 4. Giesecke, Frederick E., Alva Mitchell, ..., and Cindy Johnson, "Technical Drawing with Engineering Graphics", Pearson, 2017.

KIE2002: Makmal 4 / Lab 4

Minggu Week	Topik Topic
1	
2	Seminar Rekabentuk Experimen <i>Design of Experiment Seminar</i>
3	Eksperimen Elektromagnet Gunaan 1 <i>Applied Electromagnetic Experiment 1</i>
4	Eksperimen Elektromagnet Gunaan 2 <i>Applied Electromagnetic Experiment 2</i>
5	Eksperimen Sistem Kawalan 1 <i>Control System Experiment 1</i>
6	Eksperimen Sistem Kawalan 2 <i>Control System Experiment 2</i>
7	Eksperimen Sistem Kawalan 3 <i>Control System Experiment 3</i>
8	Eksperimen Pemprosesan Isyarat Digit 1 <i>Digital Signal Processing Experiment 1</i>
9	Eksperimen Pemprosesan Isyarat Digit 2 <i>Digital Signal Processing Experiment 2</i>
10	Eksperimen Lukisan Kejuruteraan 1 <i>Engineering Drawing Experiment 1</i>
11	Eksperimen Lukisan Kejuruteraan 2 <i>Engineering Drawing Experiment 2</i>
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13	
14	

KIE2004: Litar Elektronik II / *Electronic Circuit II*

Kod Kursus <i>Course Code</i>	KIE2004
Tajuk Kursus <i>Course Title</i>	Litar Elektronik II <i>Electronic Circuit II</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Merekabentuk penguat berbilang tahap dan penguat kebezaan praktikal bagi mencapai pencirian yang diinginkan dalam litar bersepadu moden. 2. Menunjukkan prestasi penguat menggunakan alat EDA moden dengan memahami batasannya. 3. Menganalisa penggunaan penguat sebagai peranti aktif dalam rekabentuk penapis aktif, pengayun dan pemberbilang getar dengan mempertimbangkan kesan terhadap persekitaran dan kelestarian. <i>At the end of the course, students are able to:</i> 1. <i>Design practical multistage and differential amplifiers to achieve desired characteristics in modern ICs.</i> 2. <i>Demonstrate the performance of amplifiers using modern EDA tools with good understanding of its limitations.</i> 3. <i>Analyse the use of amplifiers as an active device in the design of oscillators and voltage regulators considering the impact on the environment and sustainability.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Analisa penguat lanjutan, termasuk kesan suapbalik. Tindak balas frekuensi. Reka bentuk penguat kuasa, penguat beroperasi, penapis analog, pengayun dan pengetar berbilang. <i>Advanced amplifier analysis, including feedback effects. Frequency response. Design for power amplifiers, op-amps, analogue filters, oscillators and multivibrators.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Microelectronic Circuits, Adel S. Sedra, Kenneth C. Smith, Oxford Series in Electrical & Computer Engineering, 2019. 2. Electronic Devices and Circuit Theory, Robert L. Boylestad, Louis Nashelsky, , Pearson, 2019. 3. Electronic Circuits Fundamental and Applications (5th Edition), Mike Tooley, Taylor & Francis Group, 2019. 4. Microelectronics 2nd Edition, Jerry C. Whitaker, Taylor & Francis Group, 2018.

KIE2004: Litar Elektronik II / *Electronic Circuit II*

Minggu Week	Topik Topic
1	Rangkaian dua liang, π , Y, h, parameter, litar setara penguat <i>Two port network, π, Y, h, parameters, amplifier equivalent circuit</i>
2	Litar setara jalur-tengah untuk penguat / gandaan penguat, masukan dan keluaran. Analisa dan konfigurasi transistor <i>Midband equivalent circuits for amplifier/amplifiers gain, input and output impedances. Transistor configurations and analysis</i>
3	Pasangan transistor pembezaan <i>Differential transistor pairs</i>
4	Penguat pelbagai peringkat, lata, kaskod bagi BJT dan MOSFET <i>Multistage amplifiers, cascade, cascode of BJTs and MOSFETs</i>
5	Tindak balas frekuensi, tindak balas frekuensi tinggi / frekuensi rendah <i>Frequency response, high frequency / low frequency response</i>
6	Plot Bode, Kutub/sifar, pemuat Miller <i>Bode plots, Poles/zeros, Miller capacitors</i>
7	Penguat operasi ideal / penguat operasi praktikal <i>Ideal operational amplifier/ practical operational amplifier</i>
8	Penggunaan penguat operasi praktikal <i>Applications of practical operational amplifier</i>
9	Penrincian penguat suapbalik <i>Feedback amplifiers characteristics</i>
10	Dinamik suapbalik, kestabilan dan pampasan <i>Feedback dynamics, stability and compensation</i>
11	Penapis aktif <i>Active filters</i>
12	Pengayun RC <i>RC oscillators</i>
13	Pengayun LC <i>LC oscillators</i>
14	Pengatur Voltan <i>Voltage Regulator</i>

KIE2006: Isyarat dan Sistem / *Signals and Systems*

Kod Kursus <i>Course Code</i>	KIE2006
Tajuk Kursus <i>Course Title</i>	Isyarat dan Sistem <i>Signals and Systems</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Mengaplikasikan teknik jelmaan yang sesuai untuk isyarat masa berterusan dan masa diskrit. 2. Mengaplikasikan teknik perwakilan isyarat yang sesuai dalam isyarat dan sistem dengan mengambil kira pelbagai pertimbangan. 3. Membanding hubungan masukan-keluaran isyarat dalam laporan bertulis atau pembentangan. <i>At the end of the course, students are able to:</i> 1. <i>Apply suitable transform technique for continuous-time and discrete-time signals.</i> 2. <i>Apply suitable signal representation technique in signal and system by taking into account various considerations.</i> 3. <i>Compare the input-output relationship of signal in written report or presentation.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini memperkenalkan konsep pemprosesan isyarat termasuk transformasi antara isyarat berterusan dan diskrit, domain masa dan frekuensi menggunakan siri fourier dan transformasi fourier, dan pencirian sistem linear melalui transformasi laplace. Kursus ini menghuraikan perwakilan isyarat (isyarat berterusan dan diskrit), isyarat asas (unit impuls, langkah unit, eksponen sebenar, sinusoid, isyarat eksponen kompleks), transformasi pembolehubah bebas (pembalikan masa, peralihan masa, penskalaan masa), perwakilan fourier siri isyarat berkala dan sifat, isyarat transformasi fourier, sifat sistem (lineariti, kausal, invariasi masa, ingatan, kestabilan), dan transformasi laplace. <i>This course introduces the concepts of signal processing including transformations between continuous and discrete signals, time and frequency domains using fourier series and fourier transforms, and the characterization of linear systems via the laplace transform. The course elaborates on signal representations (continuous and discrete signals), elementary signals (unit impulse, unit step, real exponential, sinusoids, complex exponential signals), transformations of the independent variable (time-reversal, time-shift, time-scaling), fourier series representation of periodic signals and properties, fourier transform of signals, systems properties (linearity, causality, time-invariance, memory, stability), and Laplace transformation.</i>

Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. Alan V. Oppenheim, George C. Verghese, "Signals, Systems and Inference", Pearson, 2016. 2. Charles L. Phillips, John Parr, Eve Riskin, "Signals, Systems and Transforms", Pearson, 2014. 3. D. Sundararajan, "Fourier Analysis - A Signal Processing Approach", Springer, 2018. 4. Tim Olson, "Applied Fourier Analysis: From Signal Processing to Medical Imaging", Springer, 2017.

KIE2006: Isyarat dan Sistem / *Signals and Systems*

Minggu Week	Topik Topic
1	Isyarat masa berterusan dan masa diskrit <i>Continuous time and discrete time signals</i>
2	Sistem lurus masa tak berubah (LTI) dan sifat-sifat <i>Linear time invariant (LTI) systems and the properties</i>
3	Siri fourier masa berterusan dan sifat-sifat <i>Continuous time fourier series and the properties</i>
4	Siri fourier masa berterusan dan sifat-sifat <i>Continuous time fourier series and the properties</i>
5	Jelmaan fourier masa berterusan dan sifat-sifat <i>Continuous time fourier transform and the properties</i>
6	Jelmaan fourier masa berterusan dan sifat <i>Continuous time fourier transform and the properties</i>
7	Pensampelan isyarat dan pengkuantuman <i>Signal sampling and quantization</i>
8	Siri fourier masa diskrit dan sifat-sifat <i>Discrete time fourier series and the properties</i>
9	Siri fourier masa diskrit dan sifat-sifat <i>Discrete time fourier series and the properties</i>
10	Jelmaan fourier masa diskrit dan sifat-sifat <i>Discrete time fourier transform and the properties</i>
11	Jelmaan Laplace <i>The Laplace transform</i>
12	Jelmaan Laplace <i>The Laplace transform</i>
13	Jelmaan Laplace <i>The Laplace transform</i>
14	Aplikasi kehidupan sebenar (contoh : isyarat imej dan audio) <i>Real life applications (for example : image and audio signal)</i>

KIE2007: Elektromagnet Asas / *Basic Electromagnetics*

Kod Kursus <i>Course Code</i>	KIE2007
Tajuk Kursus <i>Course Title</i>	Elektromagnet Asas <i>Basic Electromagnetics</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menganalisa ungkapan bagi unsur-unsur litar sebagai fungsi parameter fizikal. 2. Mengira tenaga, daya dan tork dalam sistem elektromagnet statik. 3. Menerangkan kesan medan elektromagnet statik di bawah geometri dan media yang berbeza terhadap masalah sosial, kesihatan atau keselamatan. <i>At the end of the course, students are able to:</i> 1. <i>Analyze expressions for circuit elements as a function of their physical parameters.</i> 2. <i>Calculate the energy, forces and torque in static electromagnetic systems.</i> 3. <i>Explain the impacts of electromagnetic field under different geometries and media on societal, health or safety issues.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini memberikan pengenalan kepada medan elektromagnet statik. Pelajar mula-mula diberi asas dalam analisa vektor. Kemudian, teori elektrostatik dengan penekanan terhadap bidang vektor elektrostatik, bahan-bahan elektrik, pemuat dan tenaga dan kuasa-kuasa yang diperolehi. Kemudian, teori magnetostatik diberikan pengenalan yang serupa mengenai bidang vektor magnetostatik, bahan-bahan magnet, pengaruh dan tenaga yang diperolehi, daya dan tork. Masalah nilai sempadan dalam elektromagnet statik juga ditangani. <i>This course gives an introduction to static electromagnetic fields. The student is first given a grounding in vector analysis. Then, electrostatics are introduced, with emphasis on electrostatic vector fields, electrical materials, capacitors and its derived energy and forces. Then, magnetostatics are given similar treatment regarding magnetostatic vector fields, magnetic materials, inductors and its derived energy, force and torque. Boundary value problems in static electromagnetics are also addressed.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%

Rujukan Utama <i>Main Reference</i>	1. Fundamentals of Applied Electromagnetics (8th Ed), Ulaby, Ravaioli, 2020. 2. Elements of Electromagnetics (7th Edition), Matthew O. Sadiku, 2018. 3. Field and Wave Electromagnetics (3rd Edition), David K. Cheng, 2013.
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KIE2007: Elektromagnet Asas / *Basic Electromagnetics*

Minggu Week	Topik Topic
1	Pengenalan dan Kajian operasi vektor <i>Introduction and Review of vector operation</i>
2	Postulat elektrostatik, hukum Coulomb, medan elektrik <i>Postulates of electrostatic, Coulomb's law, electrical field</i>
3	Aplikasi hukum Gauss, Bahan Berpotensi dan Elektrik <i>Gauss law applications, Potential and Electrical Materials</i>
4	Keadaan sempadan bagi bahan elektrik <i>Boundary conditions for electrical materials</i>
5	Kapasitor, kapasitansi dan kaedah gambar <i>Capacitors, capacitance and method of images</i>
6	Persamaan Laplace dan Poisson <i>Laplace and Poisson equations</i>
7	Arus, ketumpatan arus dan rintangan <i>Current, current density and resistance</i>
8	Pengenalan kepada magnetostatik dan hukum Biot Savart <i>Introduction to magnetostatic and Biot Savart law</i>
9	Hukum Ampere <i>Ampere's law</i>
10	Bahan magnet dan kemagnetan <i>Magnetic materials and magnetization</i>
11	Keadaan sempadan bagi bahan magnet <i>Boundary conditions for magnetic materials</i>
12	Pengaruh dan aruhan <i>Inductors and inductance</i>
13	Tenaga dan daya magnet <i>Magnetostatic energy and force</i>
14	Momen dan daya kilas magnetik <i>Magnetic moment and torque</i>

KIE2008: Sistem Komunikasi / *Communication Systems*

Kod Kursus <i>Course Code</i>	KIE2008
Tajuk Kursus <i>Course Title</i>	Sistem Komunikasi <i>Communication Systems</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menerangkan prinsip kerja skim pemodulat, pengekod dan teori maklumat bagi pelbagai aplikasi dalam sistem komunikasi. 2. Menganalisa kesesuaian pelbagai skim pemodulat dan pengekod untuk pelbagai aplikasi. 3. Menilai prestasi sistem komunikasi dengan mempertimbangkan keperluan pemegang taruh. <i>At the end of the course, students are able to:</i> 1. <i>Explain the working principles of modulation scheme, coding and information theory for various applications in communication systems.</i> 2. <i>Analyze the suitability of various modulation and coding schemes for various applications.</i> 3. <i>Evaluate the performance of communication systems considering the stakeholders' requirements.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Ini adalah kursus asas sistem komunikasi analog dan digital beserta pengenalan kepada kebarangkalian dan proses rawak yang akan digunakan untuk menganalisa suatu sistem komunikasi. Kandungan kursus termasuk pengenalan kepada komunikasi analog dan digital, diikuti asas teori pemodulat, representasi signal termodulat, kelebihan dan kekurangan modulasi, jenis modulasi dan nyahmodulasi, prestasi sistem pemodulatan analog dan digital dibawah keadaan hingar. Antara sistem komunikasi analog yang dikaji adalah AM, FM dan PM, bagi sistem digital pula adalah ASK, PSK, FSK, BPSK, QPSK, and QAM. Topik lain termasuk penukaran isyarat analog ke digital seperti PCM, pengkuantuman, pengekod dan teori maklumat <i>This is a basic course on analog and digital communication theory as well as a brief introduction to probability and random process to be used in analysing communication systems. The course contents include an introduction to analogue and digital communication followed by modulation basic theory, modulating signal representation, advantage and disadvantage of modulation, types of modulation and demodulation as well as modulation performance under noisy condition for analogue and digital systems. Several analogue systems that will be studied are AM, FM and PM and in terms of digital system, ASK, PSK, FSK, BPSK, QPSK, and QAM. Other topics included are</i>

	<i>conversion of analogue signal to digital such as PCM, quantization, coding and information theory.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. B.P Lathi, Zhi Dong, "Modern Digital and Analog Communication Systems", 5th Ed, Oxford University Press, 2018. 2. Harold P. E. Stern, Samy A. Mahmoud, "Communication Systems: Analysis and Design", 1st Ed, Pearson, 2019. 3. Samual O. Agbo, "Principles of Modern Communication Systems", 1st Edition, Cambridge University Press, 2017.

KIE2008: Sistem Komunikasi / *Communication Systems*

Minggu Week	Topik Topic
1	Pengenalan kepada sistem komunikasi <i>Introduction to communication systems</i>
2	Pemodulatan amplitud <i>Amplitude modulation</i>
3	Pemodulatan sudut <i>Angle modulation</i>
4	PMF, CDF, PDF, Jangkaan, momen, transformasi, bagi satu dan sepasang pembolehubah rawak, ketidak bersandaran <i>PMF, CDF, PDF, expectation, moments, transformation, for one and pairs of Random variable, independence of two random variables</i>
5	Operasi ke atas beberapa pembolehubah rawak, taburan bersambung, ketumpatan dan ketaksandaran <i>Operations on many random variables, joint distribution, density, independence</i>
6	Pengenalan kepada proses rawak <i>Introduction to random process</i>
7	Proses rawak dalam domain frekuensi <i>Random processes in the frequency domain</i>
8	Kesan hingar ke atas system komunikasi analog / noise analysis <i>Effect of noise on analog communication system</i>
9	Penukaran analog kepada digit, pengekod gelombang <i>Analog to digital conversion, Waveform coding</i>
10	Penghantaran digital melalui saluran hingar gaussian tambah <i>Digital transmission through the additive white gaussian noise channel</i>
11	Kebarangkalian ralat untuk pengesanan isyarat dalam saluran hingar gaussian tambah <i>Probability of error for signal detection in additive white Gaussian noise</i>
12	Teori maklumat: Pemodelan punca maklumat, teori pengkodan punca, algoritma pengkodan punca <i>Information theory: Modeling information sources, source coding theorem, source coding algorithm</i>
13	Teori maklumat: Pemodelan saluran komunikasi, muatan saluran <i>Information theory: Modeling of communication channels, channel capacity</i>
14	Asas-asas komunikasi tanpa wayar dan aplikasi sistem tanpa wayar, Perambatan gelombang radio dan pelunturan pelbagai arah <i>Basics of wireless communications and applications of wireless systems, Radio wave propagation and multipath fading</i>

KIE2009: Mesin dan Pemacu / *Machines and Drives*

Kod Kursus <i>Course Code</i>	KIE2009
Tajuk Kursus <i>Course Title</i>	Mesin dan Pemacu <i>Machines and Drives</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menerangkan prinsip operasi pelbagai jenis mesin dan pemacu melalui litar setara dan pengiraan. 2. Membandingkan ciri-ciri pelbagai jenis mesin berdasarkan aplikasinya. 3. Melakukan kajian kes mengenai aplikasi baru dalam mesin dan pemacu. <i>At the end of the course, students are able to:</i> 1. <i>Explain the operation principles of various types of machines and drives through equivalent circuits and calculations.</i> 2. <i>Compare the characteristics of various types of machines based on their applications.</i> 3. <i>Perform case study on the emerging applications of machines and drives.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini mendedahkan pelajar-pelajar kepada prinsip-prinsip asas mesin elektrik dan pemacu motor ringkas. Pelajar juga diberi peluang merekabentuk, membina dan menguji mesin ringkas. <i>This course introduces the students to the basics of electrical machines and simple drives. It provides opportunities for students to have hands on experience on design and construction of simple machines.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Electrical Machines, Drives, and Power Systems, New International Edition, Theodore Wildi, Pearson, 2013. 2. Electric Machinery Fundamentals, 5th Edition, Stephen J. Chapman, McGraw-Hill, 2011. 3. Melkebeek, Jan. Electrical Machines and Drives : Fundamentals and Advanced Modelling. Cham, Switzerland: Springer, 2018.

KIE2009: Mesin dan Pemacu / *Machines and Drives*

Minggu Week	Topik Topic
1	Asas elektrik, kemagnetan dan litar <i>Fundamentals of electricity, magnetism and circuits</i>
2	Asas mekanik dan haba <i>Fundamentals of mechanic and heat</i>
3	Penjana arus-terus <i>Direct-current generators</i>
4	Penjana arus-terus <i>Direct-current generators</i>
5	Motor arus-terus <i>Direct-current motors</i>
6	Motor arus-terus <i>Direct-current motors</i>
7	Kawalan elektronik motor arus-terus dalam pembuatan pintar <i>Electronic control of DC motors in smart manufacturing</i>
8	Kuasa aktif, reaktif dan ketara <i>Active, reactive and apparent power</i>
9	Litar tiga-fasa <i>Three-phase circuits</i>
10	Motor aruhan tiga-fasa <i>Three-phase induction motors</i>
11	Motor aruhan tiga-fasa <i>Three-phase induction motors</i>
12	Litar setara motor aruhan <i>Equivalent circuit of the induction motor</i>
13	Penjana segerak <i>Synchronous generators</i>
14	Kawalan elektronik motor arus-ulangalik dalam pembuatan pintar <i>Electronic control of AC motors in smart manufacturing</i>

KIE2010: Pemproses Mikro dan Pengawal Mikro / *Microprocessors and Microcontrollers*

Kod Kursus <i>Course Code</i>	KIE2010
Tajuk Kursus <i>Course Title</i>	Pemproses Mikro dan Pengawal Mikro <i>Microprocessors and Microcontrollers</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menilai kesesuaian sistem pemproses mikro dan pengawal mikro untuk pelbagai pelaksanaan dengan mempertimbangkan faedah dan cabarannya. 2. Menyelesaikan masalah kejuruteraan menggunakan sistem pemproses mikro dan pengawal mikro. 3. Merekabentuk komponen perkakasan sistem pengawal mikro secara berkumpulan. <i>At the end of the course, students are able to:</i> 1. <i>Evaluate the suitability of microprocessor and microcontroller systems for various implementations by considering the benefits and challenges.</i> 2. <i>Solve engineering problems using microcontroller and microprocessor systems.</i> 3. <i>Design hardware components of microcontroller systems as a group.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini memberikan pengenalan praktikal kepada reka bentuk sistem elektronik berasaskan pengawal mikro. Kuliah dan kerja projek akan mendedahkan pelajar kepada pelbagai peringkat dalam projek kejuruteraan dan pelbagai konsep sistem terbenam. <i>This course provides a practical introduction to the design of microcontroller-based electronic systems. The lectures and project work will expose students to the various stages in an engineering project and a range of embedded system concepts.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%

Rujukan Utama <i>Main Reference</i>	1. Alexander G. Dean, "Embedded Systems Fundamentals with ARM Cortex-M based Microcontrollers: A Practical Approach", ARM Education Media, 2017. 2. Joseph Yiu, "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", 3rd Edition, 2013. 3. Muhammad Ali Mazidi, Shujen Chen, and Eshragh Ghaemi. 2018. STM32 ARM Programming for Embedded Systems (Volume 6). MicroDigitalEd.com.
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KIE2010: Pemproses Mikro dan Pengawal Mikro / *Microprocessors and Microcontrollers*

Minggu Week	Topik Topic
1	Pengenalan kepada sistem pemproses mikro dan pengawal mikro <i>Introduction to microprocessor and microcontroller systems</i>
2	Pengenalan kepada platform alat <i>Introduction to the tools platform</i>
3	Senibina pemproses Sesi Praktik 1: Pengenalan kepada platform alat <i>The processor architecture</i> <i>Practical Session 1: Introduction to the tools platform</i>
4	Senibina pemproses Sesi Praktik 2: Pengaturcaraan pengawal mikro <i>The processor architecture</i> <i>Practical Session 2: Microcontroller programming</i>
5	Pengaturcaraan pengawal mikro Sesi Praktik 3: Set arahan <i>Microcontroller programming</i> <i>Practical Session 3: Instruction set</i>
6	Set arahan Sesi Praktik 4: Set arahan <i>Instructions set</i> <i>Practical Session 4: Instruction set</i>
7	Masukan dan keluaran digit Sesi Praktik 5: Set arahan <i>Digital input and output</i> <i>Practical Session 5: Instruction set</i>
8	Sampukan dan ciri kuasa rendah Sesi Praktik 6: GPIO <i>Interrupts and low-power features</i> <i>Practical Session 6: GPIO</i>
9	Perpustakaan perisian Sesi Praktik 7: Sampukan <i>Software libraries</i> <i>Practical Session 7: Interrupt</i>
10	Masukan dan keluaran analog Sesi Praktik 8: Perpustakaan perisian <i>Analog input and output</i>

	<i>Practical Session 8: Software libraries</i>
11	Pemasa Sesi Praktik 9: Analog IO <i>Timer</i> <i>Practical Session 9: Analog IO</i>
12	Modulasi lebar nadi Sesi Praktik 10: Pemasa <i>Pulse width modulation</i> <i>Practical Session 10: Timer</i>
13	Komunikasi sesiri Sesi Praktik 11: PWM <i>Serial communications</i> <i>Practical Session 11: PWM</i>
14	Sistem operasi masa nyata Sesi Praktik 12: Komunikasi sesiri <i>Real-time operating systems</i> <i>Practical Session 12: Serial communications</i>

KIE2011: Rekabentuk Digit / *Digital Design*

Kod Kursus <i>Course Code</i>	KIE2011
Tajuk Kursus <i>Course Title</i>	Rekabentuk Digit <i>Digital Design</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Merekabentuk litar digital segerak dan tak segerak untuk mencapai ciri-ciri yang diinginkan dalam IC moden. 2. Menunjukkan prestasi litar digit dengan menggunakan perisian EDA moden dengan memahami batasannya. 3. Menganalisa pelaksanaan dan pengoptimuman reka bentuk digit dengan mempertimbangkan kesan terhadap persekitaran dan kelestarian. <i>At the end of the course, students are able to:</i> 1. <i>Design synchronous and asynchronous digital circuits to achieve the desired characteristics in modern ICs.</i> 2. <i>Demonstrate the performance of digital circuits using modern EDA tools with good understanding of its limitations.</i> 3. <i>Analyse the implementation and optimization of digital design considering the impacts on the environment and sustainability.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Konsep asas reka bentuk digital moden menggunakan teknologi CMOS dengan penekanan pada reka bentuk IC "hands-on" menggunakan alat CAD, gambaran keseluruhan teknologi CMOS, model litar sederhana dan lanjutan untuk transistor NMOS dan PMOS, litar logik kombinatorial dan berurutan termasuk tahap transistor reka bentuk pintu logik pada tahap peranti dan susun atur, aliran reka bentuk IC CMOS digital, Bahasa Huraian Perkakasan (HDL), aspek seni bina HDL, HDL yang disintesis pada perkakasan fizikal, metodologi reka bentuk tahap cip (kustom penuh, separa-adat dan standard sel) penerokaan dan alternatif keluarga logik rendah. <i>The fundamental concepts of modern digital design using CMOS technology with an emphasis on "hands-on" IC design using CAD tools, an overview of CMOS technology, design of combinational and sequential logic circuits, synthesis of digital systems using Hardware Description Languages (HDL) on physical hardware, architectural aspects of HDL, verification and debugging, timing analysis as well as optimization techniques.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%

Rujukan Utama <i>Main Reference</i>	1. Rabaey, Jan, Anantha Chandrakasan, and Bora Nikolic. Digital Integrated Circuits: A Design Perspective, Prentice Hall, 2017. 2. R.C Jaeger, Microelectronic Circuit Design, McGraw-Hill, 2017. 3. R. Jacob Baker, CMOS: Circuit Design, Layout and Simulation, Wiley, 2019.
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KIE2011: Rekabentuk Digit / *Digital Design*

Minggu Week	Topik Topic
1	Pengenalan kepada rekabentuk sistem digit / tinjauan logik asas, pengenalan kepada rekabentuk SOC (Langganan sepenuhnya vs Langganan-Separa) Sesi Praktik 1: Pengenalan kepada Linux dan HDL <i>Intro to digital system design/review basic logic, Intro to SOC design (Full custom vs Semi Custom)</i> <i>Practical Session 1: Intro to Linux and HDL</i>
2	Prinsip Rekabentuk Verilog dan Asas Digit: logik gabungan vs logik jujukan Sesi Praktik 2: Pengekodan logik gabungan menggunakan sistem Verilog HDL <i>Verilog and Basic Digital Design Principles: combinational logic vs sequential logic</i> <i>Practical Session 2: Combinational logic coding using system Verilog HDL</i>
3	Pengekodan HDL Verilog - tingkah laku vs struktur, menyekat vs tidak menyekat Sesi Praktik 3: Pengekodan logik berjujukan menggunakan sistem Verilog HDL <i>Verilog HDL coding - behavioural vs structural, blocking vs non-blocking</i> <i>Practical Session 3: Sequential logic coding using system Verilog HDL</i>
4	RTL Sintesis dan Pengesahan Tahap Get, penulisan Testbench, Pengesahan rawak, Sintesis logik (Kekangan rekabentuk dan pengoptimuman masa, sintesis pasca) Sesi Praktik 4: Penulisan Testbench dan sintesis logik, Tugas & Fungsi Sistem <i>RTL Synthesis and Gate-level Verification, Testbench writing, Random verification, Logic synthesis (Design constraints and timing optimization, post synthesis)</i> <i>Practical Session 4: Testbench writing and logic synthesis, System Task & Functions</i>
5	Pengenalan FPGA - seni bina FPGA, blok logik yang dapat diprogramkan dan skema saling habung yang dapat diprogramkan, aliran rekabentuk berdasarkan FPGA Sesi Praktik 5: Pengesahan FSM menggunakan sistem Verilog HDL, ModelSim dan Altera DE2. Reka bentuk FS <i>Introduction to FPGA – architecture of FPGA, Programmable logic blocks and programmable interconnect schemes, FPGA -based design flow</i> <i>Practical Session 5: FSM verification using system Verilog HDL, ModelSim and Altera DE2 board. Design of FSM according to</i>
6	Pengesahan dan penyahpejatan, pengesahan berfungsi, ATPG Sesi Praktik 6: Pengesahan tahap gerbang, pengesanan keadaan lumbaan <i>Verification and debugging, functional validation, ATPG</i> <i>Practical Session 6: Gate-level verification, race condition detection</i>
7	Pengedaran jam - Asal usul jam, kitar, teknik pengedaran jam, litar masa sendiri <i>Clock distribution – Origins of clock skew, jitter, clock distribution techniques, self-time circuits</i>
8	Sifat Alam Sekitar, Faktor yang mempengaruhi masa, kelengahan sel, peralihan input, penganggaran beban Sesi Praktik 7: Kekangan kawasan dan masa berdasarkan rekabentuk dan spesifikasi yang diberikan.

	<i>Environmental Attributes, Factors affecting timing, cell delay, input transition, load budgeting</i> <i>Practical Session 7: Area and timing constraints based on given design and specifications.</i>
9	Analisis masa statik, Laluan Masa dan Laluan Kumpulan, Kelengahan Laluan Sesi Praktik 8: Analisis Masa dan Laporan Masa <i>Static timing analysis, Timing Paths and Group Paths, Path Delays</i> <i>Practical Session 8: Timing Analysis and Timing Reports</i>
10	Pelbagai Rekabentuk Jam / Kitaran, Jam maya, jam tidak segerak, segerak & eksklusif Sesi Praktik 9: Jam yang berinteraksi dan larian STA berganda <i>Multiple Clock/Cycle Designs, Virtual clocks, asynchronous, synchronous & exclusive clock</i> <i>Practical Session 9: Interacting clocks and multiple STA runs</i>
11	Laluan palsu, Laluan berbilang kitaran Sesi Praktik 10: Penggunaan jam maya untuk mengekang laluan kombinasi dan berbilang kitaran. <i>False paths, Multicycle paths</i> <i>Practical Session 10: Use of virtual clocks to constrain combinatorial and multicycle paths.</i>
12	Teknik Pengoptimuman Sintesis: rekabentuk pemetakan Sesi Praktik 11: Masalah pemetakan <i>Synthesis Optimization Technique: design partitioning</i> <i>Practical Session 11: Partitioning problems</i>
13	Teknik Pengoptimuman Sintesis: pengoptimuman sempadan, penyesuaian semula <i>Synthesis Optimization Technique: boundary optimization, adaptive retiming</i>
14	Teknik Reka Bentuk Daya Rendah, pengegetan jam, pengoptimuman dan analisis kuasa <i>Low Power Design techniques, clock gating, power optimization and analysis</i>

KIE3001: Makmal 5 / Lab 5

Kod Kursus <i>Course Code</i>	KIE3001
Tajuk Kursus <i>Course Title</i>	Makmal 5 <i>Lab 5</i>
Kredit <i>Credit</i>	1
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Merumuskan penyelesaian eksperimen menggunakan prinsip disiplin kejuruteraan elektrik khusus. 2. Mengurus tugas yang diberikan dalam eksperimen berkaitan disiplin kejuruteraan elektrik khusus melalui komunikasi berkesan antara ahli kumpulan. 3. Melaksanakan eksperimen berkaitan disiplin kejuruteraan elektrik khusus dengan mengambil kira kod amalan dan isu etika. <i>At the end of the course, students are able to:</i> 1. <i>Formulate experiment solutions using principles of specialized electrical engineering disciplines.</i> 2. <i>Manage the tasks given in experiments related specialized electrical engineering disciplines through effective communication between group members.</i> 3. <i>Perform experiments related to specialized electrical engineering disciplines considering the code of practice and ethical issues.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini mendedahkan pelajar kepada kemahiran praktikal berkaitan komunikasi digital, elektronik kuasa, penukaran tenaga, voltan tinggi dan instrumentasi. <i>This course exposes students to practical skills related to digital communication, power electronics, energy conversion, high voltage and instrumentation.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 100% Peperiksaan Akhir / <i>Final Examination</i>: 0%
Rujukan Utama <i>Main Reference</i>	1. M. S. Naidu, V. Kamaraju, "High Voltage Engineering," 5th Ed., McGraw-Hill, 2019. 2. Curtis D. Johnson, Process Control Instrumentation Technology, Pearson. 2006, 8th Edition. 3. B. Sklar & F. Harris, "Digital Communications: Fundamentals and Applications", 3rd Edition, Prentice Hall, 2020. 4. Mohan, Underland and Robbins, "Power Electronics Converters, Applications, and Design", Wiley, 3rd Edition, 2002.

KIE3001: Makmal 5 / Lab 5

Minggu Week	Topik Topic
1	
2	Seminar analisa data <i>Data analysis seminar</i>
3	Eksperimen Komunikasi Digit 1 <i>Digital Communications Experiment 1</i>
4	Eksperimen Komunikasi Digit 2 <i>Digital Communications Experiment 2</i>
5	Eksperimen Elektronik Kuasa 1 <i>Power Electronics Experiment 1</i>
6	Eksperimen Elektronik Kuasa 2 <i>Power Electronics Experiment 2</i>
7	Eksperimen Instrumentasi 1 <i>Instrumentation Experiment 1</i>
8	Eksperimen Instrumentasi 2 <i>Instrumentation Experiment 2</i>
9	Eksperimen Penukaran Tenaga dan Voltan Tinggi 1 <i>Energy Conversion and High Voltage Experiment 1</i>
10	Eksperimen Penukaran Tenaga dan Voltan Tinggi 2 <i>Energy Conversion and High Voltage Experiment 2</i>
11	
12	
13	
14	

KIE3003: Latihan Industri / *Industrial Training*

Kod Kursus <i>Course Code</i>	KIE3003
Tajuk Kursus <i>Course Title</i>	Latihan Industri <i>Industrial Training</i>
Kredit <i>Credit</i>	5
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Mengaplikasikan etika dan amalan profesional kejuruteraan elektrik dalam persekitaran kerja. 2. Menyiasati isu-isu kejuruteraan elektrik ke arah pembelajaran sepanjang hayat. 3. Mengenalpasti isu-isu kesihatan dan keselamatan awam dalam persekitaran kerja kejuruteraan elektrik. 4. Mempamerkan semangat kerja berpasukan dalam persekitaran kerja. 5. Menunjukkan kemahiran komunikasi dan penyampaian yang berkaitan dengan industri. 6. Merumuskan penyelesaian yang praktikal untuk masalah berkaitan dengan industri. 7. Menilai kesan penyelesaian kejuruteraan elektrik terhadap alam sekitar yang mampan. <i>At the end of the course, students are able to:</i> 1. <i>Apply ethics and professional electrical engineering practice in working environment.</i> 2. <i>Investigate electrical engineering issues towards lifelong learning.</i> 3. <i>Identify public health and safety issues in electrical engineering working environment.</i> 4. <i>Display team working spirit in working environment.</i> 5. <i>Demonstrate industrial related communication and presentation skills.</i> 6. <i>Formulate practical solutions for industrial related problems.</i> 7. <i>Examine the impact of electrical engineering solution towards sustainable environment.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	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. <i>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</i>

	<i>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.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 100% Peperiksaan Akhir / <i>Final Examination</i> : 0%
Rujukan Utama <i>Main Reference</i>	1. Darla-Jean Weatherford (2016). Technical writing for engineering professionals, PennWell Books. 2. Manuele, F. A. (2013). On the practice of safety. USA: John Wiley & Sons. 3. Goetsch, David L. (2015). Occupational Safety and Health for Technologists, Engineers, and Managers, 8th eds. N.J.: Pearson Prentice Hall

KIE3004: Elektromagnet Gunaan / *Applied Electromagnetics*

Kod Kursus <i>Course Code</i>	KIE3004
Tajuk Kursus <i>Course Title</i>	Elektromagnet Gunaan <i>Applied Electromagnetics</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	KIE2007 KIE2007
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Merekabentuk media penghantaran mengikut spesifikasi-spesifikasi yang diberi. 2. Menganalisa kelakuan gelombang satah dan hukum berkaitan pantulan dan biasan gelombang satah. 3. Menilai kelakuan dan sifat talian penghantaran dan gelombang TEM, TE dan TM sepanjang struktur pandu gelombang secara berkumpulan. <i>At the end of the course, students are able to:</i> 1. <i>Design transmission media based on the specifications given.</i> 2. <i>Analyze the behaviour of the plane wave and the laws governing the reflection and refraction of plane waves.</i> 3. <i>Evaluate the behaviour and characteristics of transmission line and TEM, TE and TM wave along guiding structure as a group.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Bermula dari postulat asas elektromagnet, hukum Faraday diperkenalkan yang membawa kepada persamaan-persamaan Maxwell. Gelombang satah seragam, perambatan gelombang satah harmonik masa dalam media homogen tiada sempadan, konsep vektor poynting dan halatuju gelombang satah dibincangkan. Ciri-ciri talian penghantaran diterangkan. Persamaan umum talian penghantaran diterbitkan dari model litar, pemahaman keadaan mantap harmonik masa untuk talian penghantaran dimudahkan dengan penggunaan carta grafik. Pandu gelombang dan antena asas diterangkan. <i>Starting with fundamental postulates of electromagnetism, Faradays law is introduced, leading to the discussion on Maxwell's equations. The study of uniform plane wave includes the propagation of time harmonic plane wave in an unbounded homogeneous medium, the concept of pointing vector and the incidence of plane wave. Overview of the transmission lines will be explained. The general transmission-line equations can be derived from a circuit model, and the study of time harmonic steady-state properties of transmission line is facilitated by the use of graphical chart. Waveguides and basic of antennas will be explained.</i>

Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. David K.Cheng. "Fundamental of Engineering Electromagnetic", Pearson, 2019. 2. William Hayt and John Buck, "Engineering Electromagnetics", 9th Edition, McGraw-Hill, 2019. 3. Inan, Said, "Engineering Electromagnetics and Waves", 2nd Edition", Pearson 2015.

KIE3004: Elektromagnet Gunaan / *Applied Electromagnetics*

Minggu Week	Topik Topic
1	Latar belakang elektromagnetism secara umum dan aplikasinya <i>Overview of electromagnetism in general and its applications</i>
2	Hukum Faraday dan aplikasinya <i>Faraday's law and its application</i>
3	Persamaan Maxwell <i>Maxwell's equations</i>
4	Persamaan penyelesaian gelombang dan gelombang satah dalam medium tiada kehilangan dan berkehilangan <i>Solution of wave equations and plane waves in lossless and lossy medium</i>
5	Tuju normal gelombang satah <i>Normal incidence of plane waves</i>
6	Tuju serong gelombang satah pada sempadan satah <i>Oblique incidence of plane waves at plane boundaries</i>
7	Polarisasi gelombang satah <i>Polarization of plane waves</i>
8	Persamaan talian penghantaran <i>Transmission line equations</i>
9	Parameter talian penghantaran <i>Transmission line parameters</i>
10	Ciri-ciri gelombang di talian penghantaran <i>Wave characteristics of transmission line</i>
11	Carta Smith <i>The smith chart</i>
12	Sifat-sifat gelombang melalui struktur panduan seragam <i>Wave behaviour along uniform guiding structures</i>
13	Pandugelombang segiempat tepat <i>Rectangular waveguides</i>
14	Jenis-jenis lain pandu-gelombang <i>Other types of waveguides</i>

KIE3005: Analisa Berangka / *Numerical Analysis*

Kod Kursus <i>Course Code</i>	KIE3005
Tajuk Kursus <i>Course Title</i>	Analisa Berangka <i>Numerical Analysis</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Mengaplikasikan kaedah-kaedah berangka untuk menyelesaikan model matematik seperti persamaan pembezaan, pencocokan lengkung, model polinomial dan sistem pelbagai pembolehubah. 2. Membandingkan prestasi pelbagai teknik penemuan punca, pencocokan lengkung, pengamir dan penyelesai persamaan pembezaan dengan pemahaman yang baik tentang batasannya. 3. Menerangkan kod analisa berangka secara lengkap dari segi dokumentasi dan infomasi. <i>At the end of the course, students are able to:</i> 1. <i>Apply numerical methods to solve mathematical models such as differential equations, curve fitting, polynomial models and multivariable systems.</i> 2. <i>Compare the performance of various root finding techniques, curve fitting, integrators and differential equations solvers with good understanding of its limitations.</i> 3. <i>Explain numerical codes in well-documented and informative way.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Untuk meneroka sistem yang kompleks, jurutera dan ahli matematik memerlukan kaedah pengiraan kerana model matematik jarang dapat diselesaikan secara algebra. Kaedah berangka, berdasarkan matematik komputasi adalah teknik asas yang menyokong ramalan komputer dalam sains sistem moden. <i>To explore complex systems, engineers and mathematicians require computational methods since mathematical models are only rarely solvable algebraically. Numerical methods, based upon sound computational mathematics, are the basic algorithms underpinning computer predictions in modern systems science.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%

Rujukan Utama <i>Main Reference</i>	1. S.C. Chapra, R.P. Canale (2020), ISE Numerical Methods for Engineers, 8th Edition, McGraw-Hill Education. 2. G.R.Lindfield, J.E.T Penny (2012), Numerical Methods using MATLAB, 3rd Edition, Academic Press. 3. J.L. Buchanan, P.R. Turner (1992), Numerical Methods and Analysis, McGraw-Hill.
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KIE3005: Analisa Berangka / *Numerical Analysis*

Minggu Week	Topik Topic
1	Pengatucaraan dan perisian: Pengatucaraan berstruktur <i>Programming and software: Structured programming</i>
2	Ralat dalam pengiraan pengkomputeran: kejituan dan ketepatan, perwakilan binari, angka bererti <i>Errors in computing: accuracy and precision, binary representation, significant figures</i>
3	Ralat dalam pengiraan pengkomputeran: ralat bulat, ralat pemotongan, ketidakpastian data, kestabilan komputasi, nombor keadaan, analisis ralat dan anggaran <i>Errors in computing: round off errors, truncation errors, blunders, data uncertainty, computational stability, condition numbers, error analysis and estimation</i>
4	Punca persamaan: kaedah kurungan <i>Roots of equations: bracketing methods</i>
5	Punca persamaan: kaedah terbuka <i>Roots of equations: open methods</i>
6	Punca persamaan: persamaan tak lurus, polinomial, pelbagai punca-Newton Raphson <i>Roots of equations: nonlinear equations, polynomials, multiple roots-Newton Raphson</i>
7	Punca persamaan: persamaan tak lurus, polinomial, pelbagai punca-Newton Raphson <i>Roots of equations: nonlinear equations, polynomials, multiple roots-Newton Raphson</i>
8	Kaedah pengamiran: Trapezoid dan sebagainya <i>Integration methods : Trapezoidal and etc</i>
9	Penyelesai persamaan pembezaan: Kaedah Euler, Kaedah Heun <i>Differential equation solvers: Euler's method, Heun's Method</i>
10	Euler tersirat, Rungge Kutta <i>Implicit Euler, Rungge Kutta</i>
11	Model secara kaedah persamaan pembezaan perintah satu <i>Modelling using ODE</i>
12	PBL: Kaedah Menembak Lurus / Tak lurus <i>PBL: Linear/Non-Linear Shooting method</i>
13	PBL: Kaedah Menembak Lurus / Tak lurus <i>PBL: Linear/Non-Linear Shooting method</i>
14	Pencocokan lengkung: teknik regresi dan penentudalaman <i>Curve fitting: regression and interpolation techniques</i>

KIE3006: Sistem Kawalan / Control System

Kod Kursus <i>Course Code</i>	KIE3006
Tajuk Kursus <i>Course Title</i>	Sistem Kawalan <i>Control System</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	KIE2006 KIE2006
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menilai pemodelan bagi sistem fizikal dalam bentuk yang sesuai bagi kegunaan dalam analisa dan rekabentuk sistem kawalan. 2. Menganalisa kelakuan sistem-sistem Lelurus Tak Berubah Masa (LTI) dalam domain masa dan frekuensi. 3. Menyelesaikan masalah-masalah kejuruteraan kawalan secara berkumpulan. <i>At the end of the course, students are able to:</i> 1. <i>Evaluate the modelling of physical systems in forms suitable for use in the analysis and design of control systems.</i> 2. <i>Analyse the behaviour of Linear Time Invariant (LTI) systems in time and frequency domain.</i> 3. <i>Solve control engineering problems as a group.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini membentangkan pengetahuan asas sistem kejuruteraan kawalan. Topik meliputi pemodelan sistem, kelakuan sistem Lelurus Tak-berubah Masa di dalam domain masa dan frekuensi, dan reka bentuk pengawal mudah. <i>This course presents the basic knowledge of control system engineering. Topics covered include system modelling, the behaviors of linear time invariant systems in time and frequency domain, and design of simple controllers.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. R. C. Dorf and R H Bishop, Modern Control System, 13th Edition, Pearson, 2016. 2. N. S. Nise, Control System Engineering, 8th Edition, Wiley, 2020. 3. K. Ogata, Modern Control Engineering, 5th Edition, Pearson, 2009.

KIE3006: Sistem Kawalan / Control System

Minggu Week	Topik Topic
1	Pengenalan kepada sistem kawalan. <i>Introduction to control systems.</i>
2	Pemodelan sistem: Persamaan pembezaan, penghampiran lurus. <i>System modeling: Differential equation, linear approximation.</i>
3	Pemodelan sistem: Jelmaan Laplace, rangkap pindah. <i>System modeling: Laplace transforms and transfer functions.</i>
4	Pemodelan system: Gambarajah blok dan graf aliran isyarat. <i>System modelling: Block diagrams and signal flow graphs.</i>
5	Pemodelan sistem: Model pembolehubah keadaan. <i>System modelling: State variable models.</i>
6	Prestasi sistem kawalan suap balik: Ralat keadaan mantap. <i>Performance of feedback control systems: Steady state error.</i>
7	Prestasi sistem kawalan suap balik: Kepekaan sistem dan isyarat gangguan. <i>Performance of feedback control systems: System sensitivity and disturbance signals.</i>
8	Kestabilan sistem suap-balik lurus. <i>The stability of linear feedback systems.</i>
9	Kaedah londa punca. <i>The root locus method.</i>
10	Kaedah sambutan frekuensi. <i>Frequency response method.</i>
11	Kaedah sambutan frekuensi (Samb). <i>Frequency response method (Cont).</i>
12	Kestabilan dalam domain frekuensi. <i>Stability in frequency domain.</i>
13	Rekabentuk kawalan melalui sambutan frekuensi. <i>Control design via frequency response.</i>
14	Rekabentuk kawalan melalui sambutan frekuensi (Samb). <i>Control design via frequency response (Cont).</i>

KIE3007: Pemprosesan Isyarat Digit / *Digital Signal Processing*

Kod Kursus <i>Course Code</i>	KIE3007
Tajuk Kursus <i>Course Title</i>	Pemprosesan Isyarat Digit <i>Digital Signal Processing</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menganalisa sistem LTI menggunakan kaedah-kaedah asas pemprosesan isyarat digital dengan mengambil kira pelbagai pertimbangan. 2. Menilai pelbagai model isyarat dan system masa diskrit menggunakan analisa Fourier. 3. Menganalisa kajian kes dan penilaian rekabentuk penapis digital. <i>At the end of the course, students are able to:</i> 1. <i>Analyze the LTI systems using fundamental digital signal processing methods by taking into account various considerations.</i> 2. <i>Evaluate various models of discrete-time signals and systems using Fourier analysis.</i> 3. <i>Analyze the case studies and reviews of digital filter designs.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Takrif masa berterusan (analog), masa diskrit dan isyarat digit, siri Fourier dan jelmaan Fourier dibincang. Sistem pemprosesan isyarat masa tak varians masa diskrit diliputi secara terperinci dan aplikasi pelingkar domain masa dan jelmaan Fourier masa diskrit (DTFT) dalam menganalisa sistem LTI turut dibincang. Rekabentuk penapis digit FIR dan pengenalan kepada jelmaan-Z dan penapis masa diskrit jenis IIR diliputi secara terperinci. Jelmaan Fourier diskrit (DFT) dan pelaksanaanya dengan mengguna jelmaan Fourier pantas turut diliputi. <i>The definition of continuous time (analogue), discrete time and digital signals, Fourier series and Fourier Transform is discussed. The discrete time linear time-invariant (LTI) signal processing systems and the application of the time-domain convolution and the Discrete Time Fourier transform (DTFT) in analyzing LTI systems are also discussed. The design of FIR digital filters and introduction to z-transforms and IIR type discrete time filters are covered in detail. The Discrete Fourier Transform (DFT) and the implementation of the DFT by the fast Fourier Transform is also covered.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%

Rujukan Utama <i>Main Reference</i>	1. Alan V. Oppenheim & Ronald W. Schafer, "Discrete Time Signal Processing" Prentice Hall, 2013. 2. Proakis and Manolakis, "Digital Signal Processing: Principles, Algorithm and Applications", Pearson, 2022. 3. Alan V. Oppenheim & Verghese, "Signals, Systems and Inference", Prentice Hall, 2016.
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KIE3007: Pemrosesan Isyarat Digit / *Digital Signal Processing*

Minggu Week	Topik Topic
1	Pengenalan <i>Introduction</i>
2	Discrete-time signal and system <i>Isyarat dan sistem masa-diskret</i>
3	Jelmaan-Z <i>Z-transform</i>
4	Jelmaan-Z songsang <i>Inverse Z-transform</i>
5	Analisa Fourier - DTFT <i>Fourier Analysis - DTFT</i>
6	Analisa Fourier - DFT <i>Fourier Analysis - DFT</i>
7	Analisa Fourier - FFT <i>Fourier Analysis - FFT</i>
8	Penapis masa-diskret <i>Discrete-time filters</i>
9	Penapis FIR (Bahagian I) <i>FIR Filter (Part I)</i>
10	Penapis FIR (Bahagian II) <i>FIR Filter (Part II)</i>
11	Penapis IIR (Bahagian I) <i>IIR Filter (Part I)</i>
12	Penapis IIR (Bahagian II) <i>IIR Filter (Part II)</i>
13	Aplikasi DSP (Bahagian I) <i>Application of DSP (Part I)</i>
14	Aplikasi DSP (Bahagian II) <i>Application of DSP (Part II)</i>

KIE3008: Elektronik Kuasa / *Power Electronics*

Kod Kursus <i>Course Code</i>	KIE3008
Tajuk Kursus <i>Course Title</i>	Elektronik Kuasa <i>Power Electronics</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Mengaplikasikan komponen-komponen asas bagi sistem elektronik kuasa dan asas teori elektronik kuasa untuk aplikasi di dalam industri. 2. Menganalisa prestasi rangkaian elektronik kuasa dengan konfigurasi yang berbeza. 3. Menganalisa reka bentuk litar elektronik kuasa untuk aplikasi tertentu dengan mempertimbangkan isu-isu kemampanan. <i>At the end of the course, students are able to:</i> 1. <i>Apply the basic components of the power electronics system and the basic power electronics theory to industrial applications.</i> 2. <i>Analyze the performance of power electronics circuits for different configurations.</i> 3. <i>Analyze the design of power electronics circuits for a particular application considering sustainability issues.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini meliputi pengenalan kepada peranti elektronik kuasa, sistem penyejukan dan perlindungan alat. Litar elektronik kuasa termasuklah pengubah AT terkawal dan tidak terkawal (satu dan tiga fasa), beberapa jenis pengubah AT ke AT dan penerus dan penyongsang tiga fasa diperkenalkan. Pelajar juga didedahkan kepada teknik kawalan voltan dan rekabentuk teknik modulasi lebar denyut. <i>The course covers the introduction to the power electronics devices, cooling systems and device protection. Power Electronics circuit such as, uncontrolled and controlled DC (single and three phases), different types of DC to DC converter, and single and three phases rectifier and inverter is introduced. The student will be introduced with voltage control technique and pulsed width modulation techniques design.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Mohan, Underland and Robbins, "Power Electronics Converters, Applications, and Design", Wiley, 3rd Edition, 2002. 2. Muhammad H. Rashid "Power Electronics circuits, devices, and applications", Pearson Prentice Hall, 2004. 3. K Sundareswaran, "Elementary Concepts of Power Electronic Drives", Taylor and Francis, 2019.

KIE3008: Elektronik Kuasa / *Power Electronics*

Minggu Week	Topik Topic
1	Pengenalan kepada elektronik kuasa dan aplikasinya <i>Introduction to power electronics and its applications</i>
2	Peranti semikonduktor, peranti kuasa: diod kuasa, tiristor, MOSFET kuasa <i>Semiconductor devices, power devices: Power diodes, Thyristors, Power Mosfets</i>
3	GTO, IGBT, suis terkawal medan (SiT dan SiTH) (sambungan) <i>GTOs, IGBTs, Field controlled switches (SiT and SiTH) (continued)</i>
4	Penyejukan peranti pensuisan kuasa, rekabentuk penenggelam haba, litar “snubber” dan rekabentuk pemacu <i>Cooling for power switching devices, Heat sink design, snubber circuitry and driver design</i>
5	Penerus tak-terkawal, penerus satu dan tiga fasa <i>Uncontrolled rectifier, single and three phase rectifiers.</i>
6	Litar penukartertiban: penerus tak-terkawal, penerus satu dan tiga fasa, penerus frekuensi talian fasa terkawal <i>Commutation circuit: single and three phase rectifiers, phase controlled line frequency rectifier</i>
7	Bekalan kuasa ragam tersuis AT-AT: topologi penukar “Buck”, “Boost”, “Buck-Boost” <i>DC-DC switched mode power supply: Buck, Boost, Buck-boost converter topology</i>
8	Bekalan kuasa ragam tersuis AT-AT: topologi penukar “Buck”, “Boost”, “Buck-Boost” <i>DC-DC switched mode power supply: Buck, Boost, Buck-boost converter topology</i>
9	Teknik pemodulatan lebar denyut <i>Pulsed width modulation techniques</i>
10	Penukar AU-AT satu dan tiga fasa <i>Single-phase and three-phase AC-DC converter</i>
11	Penukar AT-AU satu dan tiga fasa <i>Single-phase and three-phase DC-AC converter</i>
12	Piawai EMC, harmonik dan faktor kuasa <i>EMC standards, harmonics and power factor</i>
13	Aplikasi industri dan rumah bagi elektronik kuasa seperti UPS, pemampas SVaR, aplikasi HVDC, dan aplikasi tenaga diperbaharui <i>Power electronics household and industrial applications such as UPS, SVaR compensator, HVDC applications, and renewable energy application</i>
14	Kajian kes: Aplikasi elektronik kuasa <i>Case Study: Power electronics applications</i>

KIE3009: Penukaran Tenaga dan Penghantaran Voltan Tinggi / Energy Conversion and High Voltage Transmission

Kod Kursus <i>Course Code</i>	KIE3009
Tajuk Kursus <i>Course Title</i>	Penukaran Tenaga dan Penghantaran Voltan Tinggi <i>Energy Conversion and High Voltage Transmission</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menerangkan kaedah penukaran tenaga bagi penjanaan kuasa elektrik. 2. Menganalisa litar setara peralatan kuasa dalam talian penghantaran voltan tinggi. 3. Menilai kesan reka bentuk peralatan voltan tinggi dalam aspek sosial dan persekitaran. <i>At the end of the course, students are able to:</i> 1. <i>Explain energy conversion methods for electric power generation.</i> 2. <i>Analyze power equipment equivalent circuits in high voltage transmission lines.</i> 3. <i>Evaluate the impact of high voltage equipment design in societal and environmental aspects.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Pelajar akan diperkenalkan kepada pelbagai kaedah penukaran tenaga bagi penjanaan kuasa elektrik dan komponen voltan tinggi termasuk pengubah, penjana dan peranti perlindungan sistem. Pelajar akan diajar mengenai cara menganalisa kegagalan simetri pada talian penghantaran voltan tinggi. Lebihan voltan, penyelarasan penebat dan talian penghantaran arus terus voltan tinggi juga diliputi di dalam kursus ini. <i>Students will be introduced to various energy conversion methods for electric power generation and high voltage components including transformers, generators and system protection devices. Students will be taught on how to analyse symmetrical fault on high voltage transmission line. Overvoltage, insulation coordination and high voltage direct current transmission lines are also covered in this course.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. M. S. Naidu, V. Kamaraju, "High Voltage Engineering," 5th Ed., McGraw-Hill, 2019. 2. D. Buchla, T. Kissell, T. Floyd, "Renewable Energy Systems" 1st Ed., Pearson, 2014. 3. H. Saadat, "Power System Analysis", 3rd Ed., McGraw-Hill, 2011.

KIE3009: Penukaran Tenaga dan Penghantaran Voltan Tinggi / *Energy Conversion and High Voltage Transmission*

Minggu Week	Topik Topic
1	Pengenalan, penjanaan kuasa hidro dan angin <i>Introduction, hydro and wind power generation</i>
2	Penjanaan kuasa solar, sel bahan api <i>Solar power generation, fuel cell</i>
3	Penjanaan kuasa haba dan nuklear <i>Thermal and nuclear power generation</i>
4	Penjanaan kuasa inovatif <i>Innovative power generation</i>
5	Penuaian tenaga <i>Energy harvesting</i>
6	Storan tenaga <i>Energy storage</i>
7	Kuasa tiga fasa <i>Three-phase power</i>
8	Komponen dan pencawang voltan tinggi <i>High voltage components and substations</i>
9	Lebihan voltan, penyelarasan penebat <i>Overvoltage, insulation coordination</i>
10	Penjana segerak: Litar setara, penyegerakan penjana <i>Synchronous generator: Equivalent circuit, generator synchronisation</i>
11	Pengubah kuasa voltan tinggi: litar setara, keraruhan bersama <i>High voltage power transformer: equivalent circuits, mutual inductance</i>
12	Sistem per unit, kegagalan simetri pada penghantaran voltan tinggi <i>Per unit system, symmetrical fault at high voltage transmission</i>
13	Perlindungan pada talian penghantaran voltan tinggi <i>Protection on high voltage transmission line</i>
14	Talian penghantaran Arus Terus Voltan Tinggi (HVDC) <i>High Voltage Direct Current (HVDC) transmission line</i>

KIE3010: Instrumentasi / *Instrumentation*

Kod Kursus <i>Course Code</i>	KIE3010
Tajuk Kursus <i>Course Title</i>	Instrumentasi <i>Instrumentation</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menerangkan prinsip-prinsip instrumentasi dan kawalan proses dalam aplikasi-aplikasi industri. 2. Menyelesaikan masalah-masalah kejuruteraan menggunakan instrumentasi yang sesuai dengan pertimbangan dari segi persekitaran atau kesihatan dan keselamatan awam. 3. Membincangkan kepentingan dan aplikasi instrumentasi dalam rekabentuk gelung kawalan proses. <i>At the end of the course, students are able to:</i> 1. <i>Explain the principles of instrumentation and process control in industrial applications.</i> 2. <i>Solve engineering problems using suitable instrumentation with consideration for environment or public health and safety.</i> 3. <i>Discuss the importance and application of instrumentation in the design of process control loops.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Ini adalah kursus dalam reka bentuk dan analisa sistem instrumentasi dan kawalan proses. Kursus dimulakan dengan pengenalan kepada instrumentasi, yang merangkumi asas-asas teknologi sensor dan teknik pengukuran, termasuk ciri-ciri dan batasan transduser di dunia nyata serta hubungannya dengan sistem kawalan. Kemudian, pengawal industri seperti PLC, DCS dan Fieldbus diperkenalkan sebagai platform untuk kawalan dan operasi automatik dalam proses kilang atau industri. <i>This is a course in the design and analysis of instrumentation and process control systems. The course starts with an introduction to instrumentation, covering the basics of sensor technology and measurement techniques, including the characteristics and real-world limitations of transducers as well as their interfacing with the control system. Then, industrial controllers such as PLC, DCS and Fieldbus are introduced as a platform for automated control and operation in a plant or industrial process.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%

Rujukan Utama <i>Main Reference</i>	1. Curtis D. Johnson, Process Control Instrumentation Technology, Pearson. 2006, 8th Edition. 2. Dally, Riley & McConnell, Instrumentation for Engineering Measurements, Wiley. 2010. 2nd Edition. 3. William Bolton, Instrumentation and Control Systems, Newnes. 2021. 3rd edition.
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KIE3010: Instrumentasi / Instrumentation

Minggu Week	Topik Topic
1	Pengenalan: Definisi instrumentasi, jenis pengukuran, penyesuaian isyarat dan antaramuka <i>Introduction: Definition to instrumentation, types of measurements, signal conditioning and interfacing</i>
2	Konsep asas pengukuran <i>Basic concepts of measurements</i>
3	Penentukuran pengukuran <i>Calibration of measurements</i>
4	Pengukuran tekanan <i>Pressure measurements</i>
5	Pengukuran tahap cecair <i>Liquid level measurements</i>
6	Pengukuran kadar aliran <i>Flowrate measurements</i>
7	Pengukuran suhu <i>Temperature measurements</i>
8	Gambarajah Proses dan Instrumentasi, Gambarajah Proses Aliran, sistem kawalan biasa seperti suap-hadapan, bertingkat, nisbah, pemilih, pembahagi julat <i>Process & Instrumentation Diagram, Process Flow Diagram, common control systems such as feed-forward, cascade, ratio, selective, split range</i>
9	Kawalan PID: Berkadaran-Kamiran-Terbitan, kaedah dan penyempurnaan penalaan, prinsip dan pelaksanaan penalaan automatik, pengawal PID industri yang tersedia dan pengoperasiannya <i>PID Controller: Proportional-Integral-Derivative, tuning methods and refinements, auto-tuning principles and implementation, available industrial PID controllers and their operation.</i>
10	Perkakasan PLC: Modul CPU, I/O, antara muka peralatan, pemasa, pembilang, fungsi aritmetik, operasi logik <i>PLC hardware: CPU, I/O modules, peripherals equipment, timers, counters, arithmetic function, logical operation</i>

11	Perisian PLC: Gambarajah Tangga, Gambarajah Masa, Fungsi Set-Reset untuk proses berurutan / aplikasi kawalan kumpulan Pengaturcaraan carta fungsi jujukan dan Grafcet <i>PLC Software: Ladder Diagram, Timing Diagram, Set-Reset Function for sequential process / batch control application</i> <i>Programming sequence function charts and Grafcet</i>
12	Pengenalan kepada Sistem Kawalan Teragih (DCS): definisi & konfigurasi DCS, seni bina struktur pengawal <i>Introduction to Distributed Control System (DCS): DCS definition & configuration, architecture of controller structures</i>
13	Gambaran Keseluruhan Protokol dan Ciri-ciri Teknologi Fieldbus, konfigurasi jarak jauh Field Control, penentukuran dan pertukaran data <i>Overview of Protocol and Features of Fieldbus Technology, Field Control-remote configuration, calibration and data exchange</i>
14	Kajian Kes <i>Case Study</i>

KIE3011: Komukasi Digit / *Digital Communications*

Kod Kursus <i>Course Code</i>	KIE3011
Tajuk Kursus <i>Course Title</i>	Komukasi Digit <i>Digital Communications</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	KIE2008 KIE2008
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menganalisa skema pemodulatan dan penyahmodulatan sistem komunikasi digit. 2. Membanding prestasi system komunikasi digit dengan mengambil kira pelbagai syarat. 3. Menerangkan secara profesional mengenai kepentingan teknik yang dicadangkan dalam komunikasi digit. <i>At the end of the course, students are able to:</i> 1. <i>Analyze modulation and demodulation schemes for digital communication system.</i> 2. <i>Compare the performance of digital communication systems by taking into account various conditions</i> 3. <i>Explain professionally on the significance of proposed technique in digital communications.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Secara umumnya, kursus ini akan membincangkan prinsip-prinsip asas penghantaran dan penerimaan maklumat digital dan bahagian-bahagian berbeza dalam sistem komunikasi digital moden. Secara khusus, kursus ini akan membincangkan beberapa skema pemodulatan digital, begitu juga analisis prestasi penerima-penerima optimum untuk saluran AWGN. Beberapa konsep teori maklumat dan pengkodan saluran akan diteliti. Seterusnya, teknik untuk penyegerakan pembawa dan simbol akan dibentangkan. Komunikasi dalam saluran jalur terhad akan dikaji dan kesan hingar antara simbol (ISI) dan teknik penyamaan saluran akan diukur. Komunikasi pelbagai pembawa dan penghantaran digital melalui saluran pudar juga akan dibincangkan. <i>In general, this course will discuss the transmission and reception fundamental principles of digital information and the different parts of a modern digital communication system. Specifically, the course will discuss various digital modulation schemes, as well as performance analysis of optimum receivers for additive white Gaussian noise (AWGN) channels. Some concepts of information theory and channel coding will be examined. Next, techniques for carrier and symbol synchronization will be deliberated. Communication over bandlimited channels will also be investigated, and the effects of inter-symbol interference (ISI) and channel equalization techniques will be</i>

	<i>measured. Multicarrier communications and digital transmission over fading channels will also be discussed.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. B. Sklar & F. Harris, "Digital Communications: Fundamentals and Applications", 3rd Edition, Prentice Hall, 2020. 2. Richard W. Middlestead, "Digital Communications with Emphasis on Data Modems: Theory, Analysis, Design, Simulation, Testing, and Applications", 1st Edition, Wiley, 2017. 3. Don Torrieri, "Principles of Spread Spectrum Communication Systems", Springer, 2015. 4. R.N Mutagi, "Digital Communication: Theory, Techniques and Applications", 2nd Edition, Oxford University Press, 2013. 5. Simon Haykin, "Digital Communication Systems", 1st Edition, Wiley, 2013.

KIE3011: Komukasi Digit / *Digital Communications*

Minggu Week	Topik Topic
1	Analisa Isyarat <i>Signal Analysis</i>
2	Kebarangkalian dan Proses Rawak <i>Probability and Random Process</i>
3	Skema Pemodulatan Digit <i>Digital Modulation Schemes</i>
4	Skema Pemodulatan Digital <i>Digital Modulation Schemes</i>
5	Rekabentuk dan analisis prestasi penerima optimum untuk saluran AWGN <i>Design and performance analysis of optimum receivers for AWGN channels</i>
6	Rekabentuk dan analisis prestasi penerima optimum untuk saluran AWGN <i>Design and performance analysis of optimum receivers for AWGN channels</i>
7	Penyegerakan pembawa dan simbol <i>Carrier and symbol synchronization</i>
8	Pengenalan kepada teori maklumat <i>Introduction to information theory</i>
9	Kod blok lurus <i>Linear block code</i>
10	Kod konvolusi <i>Convolutional Codes</i>
11	Komunikasi melalui saluran jalur terhad <i>Communication over bandlimited channels</i>
12	Hingar antara simbol (ISI) dan <i>Inter-symbol interference (ISI) and channel equalization techniques</i>
13	Teknik Spektrum Rebak <i>Spread Spectrum Techniques</i>
14	Fading Channel <i>Fading Channel</i>

KIE3012: Projek Rekabentuk Bersepadu / *Integrated Design Project*

Kod Kursus <i>Course Code</i>	KIE3012
Tajuk Kursus <i>Course Title</i>	Projek Rekabentuk Bersepadu <i>Integrated Design Project</i>
Kredit <i>Credit</i>	6
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	KIE1003, KIE1004, KIE1005, KIE1007, KIE2001
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Mengkonsepsikan rekabentuk penyelesaian bagi keadaan akhir rekabentuk kejuruteraan yang ditetapkan. 2. Mengenalpasti peralatan, sumber dan teknik yang sesuai bagi rekabentuk penyelesaian yang dicadangkan. 3. Menerapkan amalan dan penyelesaian kejuruteraan profesional terhadap masalah rekabentuk relevan dengan isu sosial, kesihatan, keselamatan, undang-undang dan budaya. 4. Berperanan secara berkesan sebagai individu, ahli kumpulan atau pemimpin dalam kumpulan pelbagai. 5. Melaksanakan pengurusan projek dan/atau mengkaji penilaian ekonomi terhadap rekabentuk penyelesaian yang dicadangkan. <i>At the end of the course, students are able to:</i> 1. <i>Conceptualize design solution of an engineering design to a defined end state.</i> 2. <i>Identify appropriate tools, resources and techniques for the proposed design solution.</i> 3. <i>Apply professional engineering practices and solutions to design problems relevant to the societal, health, safety, legal and cultural issues.</i> 4. <i>Function effectively as an individual, and as a team member or a leader in diverse teams.</i> 5. <i>Implement project management and/or economic feasibility study of the proposed design solution.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Projek rekabentuk bersepadu adalah puncak pengetahuan kejuruteraan elektrik pelajar untuk menyelesaikan masalah kejuruteraan kehidupan sebenar atau membangunkan produk dengan menggunakan kaedah rekabentuk yang sistematik. Ia harus memberi penekanan pada penggunaan peralatan moden sebagai sebahagian daripada proses rekabentuk. Pelaksanaan rekabentuk harus dilaksanakan secara menyeluruh, termasuk pengujian dan pengesahan sistem. Produk akhir dari IDP harus merangkumi faktor-faktor kemampuan dan sosial. <i>The integrated design project is a culmination of the students' electrical engineering knowledge to solve a real-world engineering problem or develop a product by application of a systematic design methodology.</i>

	<i>It should place emphasis on employment of modern tools as part of the design process. The realization of the design should be executed in a comprehensive manner, including systems testing and verification. The end product from the IDP should include sustainability and societal impact factors.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 100% Peperiksaan Akhir / <i>Final Examination</i> : 0%
Rujukan Utama <i>Main Reference</i>	1. Karl Ulrich and Steven Eppinger and Maria C. Yang. Product Design and Development, 7th Edition, McGraw-Hill Education, 2020 2. Uthayan Elangovan, Product Lifecycle Management (PLM): A Digital Journey Using Industrial Internet of Things (IIoT). CRC Press, 2020. 3. Kenneth L d'Entremont, Engineering Ethics and Design for Product Safety. McGraw-Hill Education, 2021. 4. Related reference materials and articles in Books, Journals, Conference Proceedings, Monographs, Manuals, Standards, etc.

KIE4002: Projek Tahun Akhir / *Final Year Project*

Kod Kursus <i>Course Code</i>	KIE4002
Tajuk Kursus <i>Course Title</i>	Projek Tahun Akhir <i>Final Year Project</i>
Kredit <i>Credit</i>	6
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	KIE1008, KIE2004, KIE2006, KIE2007 <i>KIE1008, KIE2004, KIE2006, KIE2007</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Mencadangkan prinsip dan metodologi kejuruteraan elektrik yang relevan untuk memastikan pencapaian objektif penyelidikan. 2. Menilai kesesuaian metodologi cadangan dalam menyelesaikan masalah kejuruteraan yang kompleks. 3. Melakukan tinjauan literatur dan kajian teori mengenai projek penyelidikan di bidang kejuruteraan elektrik. 4. Menerangkan kesan dapatan kajian dalam konteks sosial dan persekitaran. 5. Menjustifikasikan hasil kajian dalam bentuk persembahan lisan dan laporan ilmiah. <i>At the end of the course, students are able to:</i> 1. <i>Propose relevant electrical engineering principles and methodology to ensure achievement of research objectives.</i> 2. <i>Evaluate the suitability of the proposal methodology in solving the complex engineering problem.</i> 3. <i>Perform literature review and theoretical study on the research project in the area of electrical engineering.</i> 4. <i>Explain the impacts of the research finding in societal and environmental contexts.</i> 5. <i>Justify the findings of the research in the form of oral presentation and scientific report.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini memerlukan pelajar untuk menjalankan projek penyelidikan dalam bidang kejuruteraan elektrik di bawah penyeliaan seorang ahli akademik di jabatan. Kajian yang dijalankan merangkumi kajian literatur, eksperimen penyelidikan, permodelan, simulasi, pengukuran, dan lain-lain. Penemuan penyelidikan hendaklah didokumentasikan dalam bentuk pengenalan, objektif kajian, skop kajian, kajian literatur, kaedah penyelidikan, analisa data, keputusan dan perbincangan dan kesimpulan. Tesis saintifik hendaklah dikemukakan pada akhir penyelidikan dan pelajar mesti menyampaikan hasil penyelidikan dalam bentuk pembentangan lisan. <i>This course requires student to conduct a research project in the field of electrical engineering under supervision of an academician in the department. The research conducted includes literature survey, research experiment, modelling, simulation, measurement, and others.</i>

	<i>The research findings must be documented in the form of introduction, research objective, research scope, literature survey, research methodology, data analysis, results and discussion and conclusion. A scientific thesis must be submitted at the end of research and student must deliver his/her research output in the form of oral presentation.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 100% Peperiksaan Akhir / <i>Final Examination</i> : 0%
Rujukan Utama <i>Main Reference</i>	1. Catherine Dawson Little, Introduction to Research Methods, Brown Book Group. 2019. 2. UweFlick, Introducing Research Methodology: Thinking Your Way Through Your Research Project, Sage, 2020. 3. Willie Tan, Research methods: A practical guide for students and researchers, World Scientific Publishing Company, 2017. 4. Related reference materials and articles in books, journals, conference proceedings, monographs, manuals, standards, etc.

KIE4004: Sistem Kuasa / Power System

Kod Kursus <i>Course Code</i>	KIE4004
Tajuk Kursus <i>Course Title</i>	Sistem Kuasa <i>Power System</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Merekabentuk rangkaian sistem kuasa dengan mengambilkira pelbagai pertimbangan. 2. Menilai kestabilan rangkaian sistem kuasa berdasarkan analisa sistem kuasa yang berpatutan. 3. Menganalisa rangkaian sistem kuasa berkenaan isu berkaitan dengan keselamatan dan kesahan. <i>At the end of the course, students are able to:</i> 1. <i>Design a power system network by taking into account various considerations.</i> 2. <i>Evaluate the stability of a power system network based on appropriate power system analysis.</i> 3. <i>Analyse a power system network with regards to issues related to safety and legality.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini akan menyiapkan pelajar dengan pengetahuan asas mengenai analisa sistem kuasa elektrik. Pengetahuan mendalam teori, rekabentuk dan amalan sistem kuasa elektrik moden akan disediakan dalam kursus ini. Empat jenis analisa terpenting dalam sistem kuasa akan diajar iaitu; aliran beban, kegagalan, sistem perlindungan dan pusuan kestabilan. Kesemua analisa ini digunakan secara praktikal bagi perancangan, rekabentuk dan pengoperasian sistem kuasa. <i>This course will prepare students with the fundamental knowledge on electrical power system analysis. In-depth knowledge of the modern theory, design and practice of electrical power systems will be provided in this course. Four types of most important power system analyses will be taught that are: load flow, fault, protection system and transient stability. All of these analyses are used in practice for planning, design and operation of a power system.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%

Rujukan Utama <i>Main Reference</i>	1. T.K. Nagsarkar, M.S Sukhija, "Power System Analysis", Oxford Higher Education, 2016. 2. J. Duncan Glover, Thomas Overbye, Mulukutla S. Sarma, "Power System Aanalysis and Design" (6 Edition), Cengage Learning, Inc, 2016. 3. Joe H. Chow, Juan J. Sanchez-Gasca, "Power System Modeling, Computation, and Control", Wiley - IEEE, 2020.
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KIE4004: Sistem Kuasa / Power System

Minggu Week	Topik Topic
1	Pengenalan kepada sistem kuasa dan ulangkaji sistem tiga fasa dan per unit <i>Introduction to power system & revisions on three phase systems and per unit</i>
2	Pengenalan kepada analisis aliran beban (Penyelesaian persamaan tidak lurus) <i>Introduction of load flow analysis (Solution of non-linear equations)</i>
3	Analisis aliran beban – Kaedah Newton Raphson <i>Load flow analysis – Newton Raphson Method</i>
4	Analisis aliran beban – Kaedah Nyah Ganding Pantas <i>Load flow analysis – Fast Decoupled Method</i>
5	Asas komponen simetri <i>Fundamental of symmetrical components</i>
6	Analisis gagal tak seimbang – talian-ke-bumi, talian-ke-talian <i>Unbalanced fault analysis – line-to-ground, line-to-line</i>
7	Analisis gagal tak seimbang – Dua-talian-ke-bumi <i>Unbalanced fault analysis – Double line-to-ground</i>
8	Pengenalan sistem perlindungan (keperluan, pengubah alatan, CT & VT, geganti arus lebih, pemutus litar, fuis) <i>Introduction of protection system (requirements, instrument transformer, CT & VT, overcurrent relay, circuit breaker, fuses)</i>
9	Perlindungan sistem kuasa – Perlindungan talian (Perlindungan radial) <i>Power system protection – Line protection (Radial protection)</i>
10	Perlindungan sistem kuasa – Perlindungan skala besar (zon perlindungan, gengati jarak) <i>Power system protection – Large scale protection (zone of protection, distance relay)</i>
11	Perlindungan sistem kuasa – Perlindungan pengubah (geganti pembeza, geganti pemandu, geganti digital) <i>Power system protection – Transformer protection (differential relay, pilot relay, digital relay)</i>
12	Kestabilan sistem kuasa – Persamaan ayunan <i>Power system stability – Swing equations</i>
13	Kestabilan sistem kuasa – Kestabilan keadaan mantap <i>Power system stability – Steady state stability</i>
14	Kestabilan sistem kuasa – Kestabilan keadaan fana <i>Power system stability – Transient stability</i>

KIE4028: Penggunaan Tenaga Elektrik / *Electrical Energy Utilization*

Kod Kursus <i>Course Code</i>	KIE4028
Tajuk Kursus <i>Course Title</i>	Penggunaan Tenaga Elektrik <i>Electrical Energy Utilization</i>
Kredit <i>Credit</i>	3
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Merekabentuk sistem pemasangan elektrik dengan mengambil kira kod dan piawaian elektrik yang bersesuaian. 2. Menilai kaedah pencahayaan atau pemanasan yang bersesuaian untuk aplikasi tertentu. 3. Menganalisa ciri-ciri sistem penarikan elektrik dengan mengambil kira pelbagai kriteria. <i>At the end of the course, students are able to:</i> 1. <i>Design electrical installation system in observance of appropriate electrical codes and standards.</i> 2. <i>Evaluate suitable method of lighting or heating for specific application.</i> 3. <i>Analyse the characteristics of electrical traction system considering various criteria.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini menyediakan pengetahuan mendalam tentang sistem pemasangan elektrik dengan mematuhi peraturan dan piawaian tempatan dan antarabangsa. Kursus ini juga memperkenalkan pelbagai aspek penggunaan tenaga elektrik terutamanya di dalam aplikasi elektrik moden. <i>This course provides an in-depth knowledge on installation systems in observance of national and international regulations and standards. The course also introduces various aspects of electrical energy utilization especially in modern electrical applications.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Brian Scaddan 'Electrical Installation Work', Routledge, 9th edition, 2018. 2. C. L. Wadhwa, 'Generation Distribution and Utilization of Electrical Energy', New Academic Science, 3rd edition, 2013. 3. R. K. Rajput, "Utilisation of Electrical Power", Laxmi Publications (P) Ltd, 2006.

KIE4028: Penggunaan Tenaga Elektrik / *Electrical Energy Utilization*

Minggu Week	Topik Topic
1	Pengenalan kepada Penggunaan Tenaga Elektrik <i>Introduction to Electrical Energy Utilization</i>
2	Suruhanjaya Tenaga dan fungsinya, Acta Pembekalan Elektrik, peraturan dan standard <i>Energy Commission and its functions, Electricity Supply Acts, Regulations and Standards</i>
3	Pemasangan elektrik – Pembedian dan ikatan Sistem pemasangan <i>Electrical Installation – Earthing and bonding Installation systems</i>
4	Pengiraan kos berkaitan sistem pemasangan elektrik dan kos penggunaan elektrik <i>Cost calculation related to electrical system installation and costs of electricity consumption</i>
5	Pengenalan kepada lampu dan pencahayaan <i>Introduction to lighting and illuminations</i>
6	Rekaan pencahayaan <i>Lighting design</i>
7	Jenis-jenis pencahayaan <i>Types of luminaires</i>
8	Pengenalan kepada pemanasan elektrik <i>Introduction to electric heating</i>
9	Relau arka dan pemanasan aruhan <i>Arc furnace and induction heating</i>
10	Pemanasan dielektrik <i>Dielectric heating</i>
11	Pengenalan kepada sistem tarikan dan mekanik pergerakan keretapi <i>Introduction to traction system and mechanics of train movement</i>
12	Lengkungan kelajuan-masa, usaha tarikan <i>Speed-time curve, tractive efforts</i>
13	Jenis-jenis sistem penarikan elektrik <i>Different systems of electric traction</i>
14	Jenis-jenis motor penarikan elektrik <i>Type of motors used for electric traction</i>

KIE4010: Teknologi Penukaran Tenaga Elektrik / *Electrical Energy Conversion Technologies*

Kod Kursus <i>Course Code</i>	KIE4010
Tajuk Kursus <i>Course Title</i>	Teknologi Penukaran Tenaga Elektrik <i>Electrical Energy Conversion Technologies</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menilai rekabentuk, parameter angkutan dan fungsi peranti penukaran tenaga keadaan pepejal. 2. Mencadangkan peranti penukaran tenaga keadaan pepejal dengan parameter atau keadaan berkaitan yang optimum. 3. Menjustifikasi teknik atau proses pencirian dan fabrikasi yang sesuai bagi peranti penukaran tenaga keadaan pepejal dengan mempertimbangkan isu masyarakat atau persekitaran. <i>At the end of the course, students are able to:</i> 1. <i>Evaluate design, transport parameter and function of solid-state energy conversion device.</i> 2. <i>Propose solid-state energy conversion device with related optimum parameters or conditions.</i> 3. <i>Justify suitable characterization and fabrication techniques or processes for solid-state energy conversion device considering societal or environmental issues.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Pada masa kini, peranti penukaran tenaga keadaan pepejal memainkan peranan yang penting dalam teknologi pengumpulan tenaga elektrik dengan mengitar semula sumber tenaga yang terbuang. Matlamat kursus ini adalah untuk menghasilkan pelajar yang mampu mencadangkan dan merekabentuk peranti penukaran tenaga pepejal dengan pengetahuan asas yang mencukupi dalam prinsip, bahan, teknik fabrikasi dan pengukuran peranti. Melalui kursus ini, pelajar akan didedahkan dengan teknologi terkini dan asas-asas peranti termoelektrik, piezoelektrik, piroelektrik dan fotovolta. Tidak terhad kepada prinsip-prinsip asas dan rekabentuk peranti, pelajar juga akan didedahkan kepada teknik fabrikasi dan pengukuran. <i>Nowadays, solid-state energy conversion device plays an important role in harvesting electrical energy technology by recycling waste energy resources. The goal of this course is to prepare students to be able to propose and design a solid-state energy conversion device with adequate basic in knowledge of device principle, material, fabrication technique and characterization. Throughout the course, students will be exposed with current technologies and fundamentals of</i>

	<i>thermoelectric, piezoelectric, pyroelectric and photovoltaic devices. Not limited to its principles and device designs, students will also be exposed to its fabrication technique and characterization.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. S. M. Sze, "Semiconductor devices: Physics and Technology," 2nd Edition, John Wiley & Sons, 2015. 2. D. M. Rowe, "Thermoelectrics Handbook", Taylor & Francis Group, 2017. 3. K. Uchino, "Advanced Piezoelectric Materials", Elsevier, 2017. 4. P. Wurfel, U. Wurfel, "Physics of Solar Cells: From Basic Principles to Advanced Concepts", Wiley, 2016.

KIE4010: Teknologi Penukaran Tenaga Elektrik / *Electrical Energy Conversion Technologies*

Minggu Week	Topik Topic
1	Pengenalan dan prinsip operasi bagi peranti penukaran tenaga pepejal <i>Introduction and principle of operation for solid-state energy conversion devices</i>
2	Asas-asas angkutan tenaga: Angkutan tenaga dan haba di dalam pepejal <i>Fundamentals of energy transport: Transport of heat and electricity in solids</i>
3	Bahan-bahan untuk penukaran tenaga: Semikonduktor, semikonduktor aloi dan bahan oksida <i>Materials for energy conversion: Semiconductor, semiconductor alloy and oxide material</i>
4	Termoelektrik: Asas-asas, kesan-kesan termoelektrik dan aplikasi <i>Thermoelectricity: Fundamentals, thermoelectric effects and its applications</i>
5	Termoelektrik: Peranti termoelektrik, komponen rekabentuk, struktur peranti dan bahan serta halatuju masa depan <i>Thermoelectricity: Thermoelectric device; design components, device structure and material and future directions</i>
6	Piezoelektrik dan piroelektrik: Asas-asas, sifat-sifat piezoelektrik dan piroelektrik dan aplikasi <i>Piezoelectricity dan pyroelectricity: Fundamentals, piezoelectric dan pyroelectric properties and its applications</i>
7	Piezoelektrik: Peranti piezoelektrik, komponen rekabentuk, struktur peranti dan bahan dan halatuju masa depan <i>Piezoelectricity: Piezoelectric device, design components, device structure and material and future directions</i>
8	Piroelektrik: Peranti piroelektrik, komponen rekabentuk, struktur peranti dan bahan dan halatuju masa depan <i>Pyroelectricity: Pyroelectric device, design components, device structure and material and future directions</i>
9	Fotovolta: Asas-asas, prinsip fotovolta & sel fotovolta; komponen rekabentuk, struktur peranti dan bahan dan halatuju masa depan <i>Photovoltaic: Fundamentals, photovoltaic principles & photovoltaic cell; design components, device structure and material and future directions</i>
10	Fabrikasi peranti penukaran tenaga: Teknik fabrikasi dan alat bagi peranti penukaran tenaga atas-cip <i>Fabrication of energy conversion devices: On-chip energy conversion device fabrication technique and tools</i>

11	Fabrikasi peranti penukaran tenaga: Teknik fabrikasi dan alat bagi peranti penukaran tenaga sendiri <i>Fabrication of energy conversion devices: Standalone energy conversion device fabrication technique and tools</i>
12	Pengukuran peranti penukaran tenaga: Sistem pengukuran asas <i>Measurement of energy conversion devices: Basic measurement system</i>
13	Pengukuran peranti penukaran tenaga: Sistem pengukuran lanjutan <i>Measurement of energy conversion devices: Advanced measurement system</i>
14	Sistem hibrid peranti penukaran tenaga dan inovasi masa depan <i>Hybrid system of energy conversion devices and its future innovations</i>

KIE4011: Teknologi Tenaga Boleh Diperbaharui / *Renewable Energy Technologies*

Kod Kursus <i>Course Code</i>	KIE4011
Tajuk Kursus <i>Course Title</i>	Teknologi Tenaga Boleh Diperbaharui <i>Renewable Energy Technologies</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menganalisa kesesuaian sumber tenaga boleh diperbaharui, penukaran tenaga boleh diperbaharui, dan penyimpanan untuk teknologi yang boleh diperbaharui. 2. Menilai prestasi, prospek, dan kebolehpercayaan sistem tenaga boleh diperbaharui yang berbeza. 3. Merekabentuk pelbagai jenis sistem tenaga boleh diperbaharui termasuk sistem tenaga yang berdiri sendiri, terikat dengan grid, dan hibrid dengan mengambil kira pelbagai pertimbangan. <i>At the end of the course, students are able to:</i> 1. <i>Analyze the suitability of renewable energy resources, renewable energy conversion, and storage for renewable technologies.</i> 2. <i>Evaluate the performance, prospects, and sustainability of different renewable energy systems.</i> 3. <i>Design different types of renewable energy system including stand-alone, grid-tied and hybrid energy system by taking into account various considerations.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Masyarakat moden bergantung kepada bekalan tenaga stabil sedia ada. Tenaga boleh diperbaharui merupakan komponen yang semakin penting kepada penghasilan tenaga baru. Kursus ini merangkumi penukaran tenaga, penggunaan dan penyimpanan tenaga boleh diperbaharui seperti angin, biojisim, solar, sel bahan api dan sistem hibrid. Konsep Termodinamik (termasuk undang-undang pertama dan kedua) akan menjadi asas untuk pemodelan sistem tenaga boleh diperbaharui. Kursus ini juga merangkumi kesan-kesan ke atas alam sekitar akibat daripada penukaran tenaga dan cara-cara tenaga boleh diperbaharui dapat mengurangkan pencemaran alam sekitar dan perubahan iklim global. <i>Modern society relies on stable, readily available energy supplies. Renewable energy is an increasingly important component of the new energy mix. The course covers energy conversion, utilization and storage for renewable technologies such as wind, solar, hydro, oceanic energy and hybrid systems. Besides, the course explores ways to encourage the sustainable production of renewable energy from the</i>

	<i>perspectives of advanced renewable-energy-driven technologies, renewable energy planning and integration models, creative renewable energy applications, and decision-support methods for sustainability assessment and ranking of renewable energy systems. The course also touches upon the environmental consequences of energy conversion and how renewable energy can reduce air pollution and global climate change.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. Aldo Da Rosa, "Fundamentals of Renewable Energy Processes," Elsevier Academic Press, 2016. 2. Godfrey Boyle, "Renewable Energy," Oxford University Press, 2015. 3. Viktor M. Perelmuter, "Advanced Simulation of Alternative Energy: Simulation with Simulink® and SimPowerSystem, 1st Edition, CRC Press, 2020.

KIE4011: Teknologi Tenaga Boleh Diperbaharui / *Renewable Energy Technologies*

Minggu Week	Topik Topic
1	Pengenalan kepada tenaga dan teknologi tenaga boleh diperbaharui <i>Introduction to energy and renewable energy technologies</i>
2	Isu-isu dalam sistem tenaga <i>Issues in energy systems</i>
3	Corak penggunaan tenaga <i>Energy use patterns</i>
4	Tenaga solar: Sumber solar <i>Solar Energy: Solar resources</i>
5	Tenaga solar: Sel-sel solar dan reka bentuk sistem PV solar <i>Solar Energy: Solar cells and solar PV system design</i>
6	Tenaga solar: Sistem haba solar pasif dan aktif <i>Solar Energy: Passive and active solar thermal systems</i>
7	Tenaga Angin: Sumber angin global; teknologi tenaga angin; menara angin dan reka bentuk turbin <i>Wind Energy: Global wind resources; wind energy technologies; wind tower and turbine design</i>
8	Tenaga Angin: Trajektori teknologi angin; ekonomi tenaga angin; sifat-sifat kemampanan <i>Wind Energy: Trajectory of wind technology; economics of wind energy; sustainability attributes</i>
9	Tenaga Hidro: Taburan geografi dan ketersediaan sumber kuasa hidro <i>Hydro-Energy: Geographic distribution and availability of hydropower resources</i>
10	Tenaga Hidro: Trajektori teknologi hidro; ekonomi kuasa hidro; sifat-sifat kelestarian <i>Hydro-Energy: Trajectory of hydropower technologies; economics of hydropower; sustainability attributes</i>
11	Tenaga Lautan: Penjanaan tenaga menggunakan air pasang, ombak, dan perbezaan suhu; trajektori teknologi lautan; ekonomi tenaga lautan; sifat-sifat kelestarian <i>Oceanic Energy: Energy generation using tides, waves, and temperature differentials; trajectories of oceanic technologies; economics of oceanic energy; sustainability attributes</i>
12	Tenaga Geoterma: Sumber geoterma; trajektori teknologi untuk mengeksploitasi sumber geoterma; ekonomi tenaga geoterma; sifat-sifat kelestarian

	<i>Geothermal Energy: Geothermal resources; technological trajectories for exploiting geothermal resources; economics of geothermal energy; sustainability attributes</i>
13	Reka bentuk sistem tenaga boleh diperbaharui menggunakan perisian Homer <i>Design of renewable energy systems using Homer software</i>
14	Sistem tenaga boleh diperbaharui hibrid <i>Hybrid renewable energy systems</i>

KIE4012: Nanoteknologi untuk Tenaga Mampan / *Nanotechnology for Sustainable Energy*

Kod Kursus <i>Course Code</i>	KIE4012
Tajuk Kursus <i>Course Title</i>	Nanoteknologi untuk Tenaga Mampan <i>Nanotechnology for Sustainable Energy</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menentukan jenis-jenis asas partikel nano dan fungsi yang berkenaan untuk peningkatan pencapaian peranti penukaran/penyimpanan tenaga. 2. Menilai kemampunan teknologi penukaran/ penyimpanan tenaga yang mengandungi nanoteknologi menggunakan prinsip kemampunan. 3. Merekabentuk komponen dan sistem untuk peranti penyimpanan tenaga berdasarkan nanoteknologi menggunakan prinsip rekabentuk penukaran/penyimpanan tenaga. <i>At the end of the course, students are able to:</i> 1. <i>Determine basic nanoparticle types and their functions for increased performance of energy conversion/storage devices.</i> 2. <i>Evaluate the sustainability of respective energy conversion/storage technologies employing nanotechnology using sustainability principles.</i> 3. <i>Design components and systems for nanotechnology-based energy storage device using energy conversion/storage design principles.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Nanoteknologi merupakan cabang sains, kejuruteraan dan teknologi yang menarik, yang dilangsungkan pada skala nano. Bahan yang beroperasi pada skala nano, seperti titik kuantum, dawai nano dan grafin mempunyai ciri-ciri yang amat berbeza berbanding dengan bahan yang sama pada skala yang lebih besar. Ciri-ciri ini boleh digunakan untuk menambahbaik pencapaian peranti mampan untuk menukar dan menyimpan tenaga, contohnya sel solar, termoelektrik, sel fuel dan bateri. Kursus ini memperkenalkan konsep nanoteknologi dan peranannya dalam memperbaiki pencapaian dan aspek kemampunan peranti-peranti ini. Kes-kes teknologi terkini akan dibincangkan dalam kursus ini untuk memaparkan perkembangan teknologi terbaharu menggunakan nanoteknologi dalam peranti-peranti tenaga ini. <i>Nanotechnology is an exciting study of science, engineering and technology conducted at the nanoscale. Materials operating at the</i>

	<i>nanoscale, such as quantum dots, nanowires and graphene nanosheets behave significantly different compared to the same materials at a larger scale. This behaviour can be exploited to enhance the performance of sustainable energy harvesting and storage devices, such as solar cells, thermoelectrics, fuel cells and batteries. This course introduces nanotechnology and its role improving the performance and sustainability aspect of these devices. Case studies of state of the art technology will showcase the cutting edge development of nanotechnology in energy devices.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. Jhavier Garcia-Martinez, Zhong Lin Wang, "Nanotechnology for the Energy Challenge," 2nd Edition, Wiley, 2013. 2. Mehmet Kanoglu, Yunus Cengel, John Cimbala. Fundamentals and Applications of Renewable Energy, McGraw-Hill Education, 2020. 3. Baldev Raj, Marcel Van de Voorde, Yashwant Mahajan, "Nanotechnology for Energy Sustainability", Wiley, 2017.

KIE4012: Nanoteknologi untuk Tenaga Mampan / *Nanotechnology for Sustainable Energy*

Minggu Week	Topik Topic
1	Pengenalan kepada nanoteknologi: Penambahbaikan pencapaian melalui dimensi rendah <i>Introduction to nanotechnology: Performance enhancement through low dimensionality</i>
2	Kriteria untuk teknologi tenaga mampan <i>Criteria for sustainable energy technologies</i>
3	Sel solar – ringkasan prinsip operasi, status teknologi terkini, halangan kepada perkembangan teknologi <i>Solar cells – review of principle of operation, current status of technology, barriers to development</i>
4	Nanoteknologi dalam sel solar Kajian kes 1: Nanoantenna <i>Nanotechnology in solar cells</i> <i>Case study 1: Nanoantennas</i>
5	Termoelektrik – ringkasan prinsip operasi, status teknologi terkini, halangan kepada perkembangan teknologi <i>Thermoelectrics – review of principle of development, current status of technology, barriers to development</i>
6	Nanoteknologi dalam termoelektrik Kajian kes 2: Kelahiran nanoteknologi dalam termoelektrik <i>Nanotechnology in thermoelectrics</i> <i>Case study 2: The birth of nanotechnology in thermoelectrics</i>
7	Sel bahan api – operasi asas, jenis sel bahan api <i>Fuel cells – basic principle of operation, types of fuel cell</i>
8	Potensi komersil sel bahan api Kajian kes 3: Sel bahan api vs Tesla <i>Commercial potential of fuel cells</i> <i>Case study 3: Fuel cells vs Tesla</i>
9	Nanoteknologi dalam sel bahan api <i>Nanotechnology in fuel cells</i>
10	Struktur karbon 0D, 1D dan 2D: Dot kuantum, tiub nano karbon, graphene dalam peranti tenaga mampan <i>0D,1D and 2D carbon structures: Quantum dots, carbon nanotubes and graphene in sustainable energy devices</i>

11	Selepas grafin <i>Beyond graphene</i>
12	Bateri Kajian kes 4: Adakan bateri sebuah teknologi yang mengganggu sektor tenaga <i>Batteries</i> <i>Case study 4: Are batteries a disruptive technology in the power sector</i>
13	Nanoteknologi dalam bateri <i>Nanotechnology in batteries</i>
14	Peranan nanoteknologi dalam peranti tenaga mampan <i>The role of nanotechnology in sustainable energy devices</i>

KIE4013: Kejuruteraan Voltan Tinggi / *High Voltage Engineering*

Kod Kursus <i>Course Code</i>	KIE4013
Tajuk Kursus <i>Course Title</i>	Kejuruteraan Voltan Tinggi <i>High Voltage Engineering</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menerangkan generasi voltan tinggi dan keruntuhan penebat dalam peralatan kuasa. 2. Menganalisa data berasaskan pemantauan keadaan dari peralatan voltan tinggi. 3. Menilai kesan reka bentuk penebat pada sesendal voltan tinggi dalam konteks sosial dan persekitaran. <i>At the end of the course, students are able to:</i> 1. <i>Explain high voltage generation and insulation breakdown in power equipment.</i> 2. <i>Analyze condition based monitoring data from high voltage equipment.</i> 3. <i>Evaluate the impact of insulation design on high voltage bushing in societal and environmental contexts.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Pelajar akan diperkenalkan kepada fenomena keruntuhan di dalam gas, cecair dan pepejal dielektrik, keruntuhan separa, lebihan voltan dan voltan pemulihan fana. Pelajar juga akan diajar tentang generasi voltan DC, AC dan dedenyut dan rekabentuk sesendal voltan tinggi. Pelbagai jenis bahan penebatan, penebatan kabel, aplikasi bahan penebat dan teknik pemantauan berasaskan keadaan juga didedahkan kepada pelajar dalam kursus ini. <i>Students will be introduced to phenomena of breakdown in gases, liquids and solid dielectrics, partial discharge, overvoltages and transient recovery voltage. Student will also be taught on the generation of DC, AC and impulse voltages and high voltage bushing design. Various types of insulation materials, cable insulation, applications of insulating materials and techniques of condition based monitoring are exposed to students in this course.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%

Rujukan Utama <i>Main Reference</i>	1. M.S. Naidu, V. Kamaraju, "High Voltage Engineering," 5nd edition, McGraw-Hill, 2019. 2. E. Kuffel, W.S. Zaengl, J. Kuffel, W. Ziomek, "High Voltage Engineering: Fundamentals", 3rd edition, Elsevier Science, 2016. 3. Y.-J. Li, A. U.-Rehman, "High Voltage Engineering," 1st edition, Scitus Academics LLC, 2019.
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KIE4013: Kejuruteraan Voltan Tinggi / High Voltage Engineering

Minggu Week	Topik Topic
1	Penjanaan voltan AC, DC dan denyut dan pembinaan litar voltan tinggi <i>Generation of AC, DC and impulse voltages and high voltage circuit construction</i>
2	Bahan penebat dielektrik: Pengenalan, kehilangan dielektrik, polimer <i>Dielectric insulation materials: Introduction, dielectric loss, polymers</i>
3	Kabel kuasa bawah tanah: Struktur, litar setara kabel XLPE <i>Underground power cables: Structure, XLPE cable equivalent circuit</i>
4	Penebatan dalam peralatan voltan tinggi dan kawalan tegangan medan <i>Insulation in high voltage equipment and field stress control</i>
5	Keruntuhan dalam gas: Pelepasan Townsend dan Streamer <i>Breakdown in gases: Townsend and Streamer discharge</i>
6	Aplikasi keruntuhan dalam gas: Runtuhan vakum, Hukum Paschen <i>Application of breakdown in gases: Vacuum breakdown, Paschen's law</i>
7	Penyelenggaraan minyak pengubah kuasa: Analisis gas terlarut <i>Power transformer oil maintenance: Dissolved gas analysis</i>
8	Pemutus litar dan gear suis: Jenis minyak, SF6 dan vakum <i>Circuit breaker and switchgear: Oil, SF6 and vacuum type</i>
9	Voltan pemulihan fana (TRV) untuk pemutus litar voltan tinggi AC <i>Transient recovery voltage (TRV) for AC high voltage circuit breakers</i>
10	Pelepasan separa: Pengenalan, teknik pengukuran dan corak pelepasan <i>Partial discharge: Introduction, measurement techniques and discharge patterns</i>
11	Pemantauan berdasarkan keadaan (CBM) bagi peralatan voltan tinggi <i>Condition based monitoring (CBM) for high voltage equipment</i>
12	Lokasi kegagalan kabel: Kaedah eko denyut, kaedah arus denyut, kaedah pantulan arka <i>Cable fault location: Pulse echo method, impulse current method, arc reflection method</i>
13	Pengukuran kerintangan tanah: Kaedah Wenner dan Schlumberger <i>Soil resistivity measurements: Wenner and Schlumberger methods</i>
14	Sistem pembumian, ikatan dan sistem perlindungan kilat <i>Earthing system, bonding and lightning protection system</i>

KIE4014: Komunikasi Tanpa Wayar / *Wireless Communication*

Kod Kursus <i>Course Code</i>	KIE4014
Tajuk Kursus <i>Course Title</i>	Komunikasi Tanpa Wayar <i>Wireless Communication</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menilai prestasi sistem komunikasi tanpa wayar dalam saluran pudar. 2. Menganalisa keberkesanan skema capaian pelbagai dalam persekitaran tanpa wayar yang berbeza. 3. Menerangkan dengan efektif kepada rakan sebaya konsep komunikasi tanpa wayar moden. <i>At the end of the course, students are able to:</i> 1. <i>Evaluate the performance of wireless communication systems in fading channel.</i> 2. <i>Analyse the effectiveness of multiple access schemes in different wireless environments.</i> 3. <i>Explain effectively to the peers on the concept of modern wireless communications.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini bertujuan untuk membincangkan dan menilai prestasi sistem komunikasi mudah alih dan tanpa wayar. Pelbagai isu berkaitan dengan asas-asas saluran radio, model kehilangan laluan, kepudaran, kepelbagaian dan teknik akses pelbagai akan dibincangkan. Selain dari itu, topik-topik terkini yang penting dalam komunikasi tanpa wayar juga akan diperhalusi. <i>The course is intended to discuss and evaluate the performance of mobile and wireless communication systems. Various issues pertinent to radio channel fundamentals, path loss models, fading, diversity and multiple access techniques will be discussed. Apart from that, recent topics important to wireless communications will also be deliberated.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Andrea Goldsmith, <i>Wireless Communications</i>, Cambridge University Press, 2012. 2. Gordon L. Stüber, "Principles of Mobile Communication", 4th Edition, Springer; 2017. 3. Andreas Molisch, <i>Wireless Communications</i>, Wiley, 2012. 4. Recent relevant journal papers

KIE4014: Komunikasi Tanpa Wayar / *Wireless Communication*

Minggu Week	Topik Topic
1	Evolusi komunikasi tanpa wayar <i>Evolution of wireless communications</i>
2	Konsep selular <i>Cellular concept</i>
3	Kehilangan laluan berskala besar <i>Large scale path loss</i>
4	Kehilangan laluan berskala besar <i>Large scale path loss</i>
5	Kehilangan laluan berskala kecil <i>Small scale path loss</i>
6	Kehilangan laluan berskala kecil <i>Small scale path loss</i>
7	Kapasiti saluran tanpa wayar <i>Capacity of wireless channel</i>
8	Teknik kepelbagaian <i>Diversity Techniques</i>
9	Pemultipleksan pembahagian frekuensi ortogonal (OFDM) <i>Orthogonal Frequency Division Multiplexing (OFDM)</i>
10	Pemultipleksan pembahagian frekuensi ortogonal (OFDM) <i>Orthogonal Frequency Division Multiplexing (OFDM)</i>
11	Sistem pelbagai input pelbagai output (MIMO) <i>Multiple input multiple output (MIMO) System</i>
12	Sistem pelbagai input pelbagai output (MIMO) <i>Multiple input multiple output (MIMO) System</i>
13	Isu-isu semasa dalam komunikasi tanpa wayar (IoT untuk Industri 4.0) <i>Recent issues in wireless communications (IoT for Industry 4.0)</i>
14	Isu-isu semasa dalam komunikasi tanpa wayar <i>Recent issues in wireless communications</i>

KIE4015: Komunikasi Optik / *Optical Communication*

Kod Kursus <i>Course Code</i>	KIE4015
Tajuk Kursus <i>Course Title</i>	Komunikasi Optik <i>Optical Communication</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menilai sistem komunikasi gantian fiber yang tipikal, fungsi setiap komponen dalam sistem tersebut dan bajet kuasa pautan dengan mengambilkira pelbagai pertimbangan. 2. Menerangkan kerosakan seperti penyerakkan, kehilangan dan kesan tak lurus dalam sistem komunikasi gantian optik dalam konteks masyarakat dan alam sekitar. 3. Menerangkan proses pemancaran, pengesanan dan pembesaran isyarat optik. <i>At the end of the course, students are able to:</i> 1. <i>Evaluate typical fiber-optic communication system, the function of each component in the system and power link budget by taking into account various considerations.</i> 2. <i>Explain on the impairments such as dispersion, loss and nonlinear effects in the fiber-optic system in societal and environmental contexts.</i> 3. <i>Explain the process of optical signal emission, detection and amplification.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini memberi pengenalan kepada struktur gantian optik, ciri penyebaran, fabrikasi, pemasangan kabel, pengukuran optik, kehilangan, serakan, kesan tak lurus, pancaran optik, pengesanan optik, penguatan optik dan peranti gantian optik. <i>The course provides an introduction to optical fiber structures, propagation characteristics, fabrication, cabling, optical measurements, loss, dispersion, nonlinear effects, optical emission, optical detection, optical amplification and fiber-optic devices.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. G. Agrawal, "Fibre-optic Communication Systems", Wiley, 2010 2. John M. Senior, "Optical Fiber Communications: Principles and Practices", Prentice Hall, 2009. 3. J. Palais, "Fiber Optic Communications", Prentice Hall, 2005. 4. T. L. Singal, "Optical Fiber Communications: Principles and Applications", Cambridge University Press, 2018.

KIE4015: Komunikasi Optik / *Optical Communication*

Minggu Week	Topik Topic
1	Teori elektromagnet gelombang optik dalam gentian <i>Electromagnetic theory of optical waveguiding in a fiber</i>
2	Gentian pelbagai ragam vs ragam tunggal <i>Multimode vs. single mode fibre</i>
3	Punca, pengesan, penguat optik <i>Sources, detector, optical amplifier</i>
4	Serakan dan pelemahan <i>Dispersion and attenuation</i>
5	Pertimbangan jalur lebar <i>Bandwidth consideration</i>
6	Fabrikasi serat optik <i>Optical fibre fabrication</i>
7	Pemancar dan penerima <i>Transmitters and receiver</i>
8	Pengurusan serakan <i>Dispersion management</i>
9	Rangkaian gentian optik <i>Fibre optic networks</i>
10	Pengekoden digit <i>Digital coding</i>
11	Penghantaran data berbilang saluran <i>Multichannel data transmission</i>
12	Teknik pembetulan ralat <i>Error correction techniques</i>
13	Ketak-lelurusan dalam gentian optik <i>Nonlinearities in optical fibre</i>
14	Perkembangan terkini teknologi gentian optik <i>Recent development on fiber-optic technology</i>

KIE4016: Antena dan Perambatan / *Antenna and Propagation*

Kod Kursus <i>Course Code</i>	KIE4016
Tajuk Kursus <i>Course Title</i>	Antena dan Perambatan <i>Antenna and Propagation</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menilai antena dwikutub elektrik dan antena gelung dalam bentuk medan jarak dekat dan jauh. 2. Membangunkan pelbagai jenis antena untuk aplikasi yang berbeza dengan mengambil kira pelbagai pertimbangan. 3. Membandingkan konsep teknik-teknik pengukuran antena secara berkumpulan. <i>At the end of the course, students are able to:</i> 1. <i>Evaluate the electric dipole and loop antennas in terms of its near and far fields.</i> 2. <i>Develop various types of antennas for different applications by taking into account various considerations.</i> 3. <i>Compare the concepts of antenna measurements techniques as a group.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini memberi pengenalan kepada prinsip asas antena iaitu bermula dari gelombang satah elektromagnetik dan hukum berkaitan dengan perambatan gelombang antara antena penghantar dan penerima. Parameter penting antena seperti corak, kearah dan gandaan juga akan diterangkan. Akhirnya, konsep asas pengukuran antena akan diterangkan. <i>This course provides introduction to the basic principles of antennas that start from electromagnetic plane waves and the laws related to wave propagation between transmitter and receiver antennas. Important antenna parameters such as pattern, direction and gain will also be described. Finally, the basic concepts of antenna measurement will be described.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. Constantine A. Balanis, "Antenna Theory: Analysis and Design", Wiley, 2016. 2. John D. Krauss and Ronald J. Marhefka, "Antennas for All Applications", McGraw-Hill, 5th edition, 2017. 3. Binod Kumar Kanaujia, Surendra Kumar Gupta, Jugul Kishor, Deepak Gangwar, "Printed Antenna, Theory and Design", CRC Press, 2020.

KIE4016: Antena dan Perambatan / *Antenna and Propagation*

Minggu Week	Topik Topic
1	Gambaran keseluruhan gelombang satah seragam <i>Overview of uniform plane waves</i>
2	Perambatan gelombang satah dan hukum-hukum yang mengaturnya <i>Plane wave propagation and laws that governs it</i>
3	Perambatan gelombang dan parameter antena (corak, keluasan rasuk, kecekapan rasuk) <i>Propagation of waves and antenna parameters (patterns, beam area, beam efficiency)</i>
4	Parameter antena (kearahkan, gandaan dan resolusi, bukaan, ketinggian efektif) <i>Antenna parameters (directivity, gain and resolution, aperture, effective height)</i>
5	Punca titik dan medannya <i>Point sources and their field</i>
6	Corak kuasa dan fasa <i>Power and phase patterns</i>
7	Medan dwikutub pendek <i>Fields of short dipoles</i>
8	Rintangan sinaran dan kecekapan dwikutub pendek <i>Radiation resistance and efficiency of short dipoles</i>
9	Antena lurus nipis <i>Thin linear antenna</i>
10	Analisa corak medan antena gelung bulat <i>Field patterns analysis of circular loop antennas</i>
11	Rintangan sinaran, pengarahkan dan kecekapan gelung <i>Radiation resistance, directivity and efficiency of loops</i>
12	Tatasusunan lurus seragam <i>Uniform linear arrays</i>
13	Konsep asas pengukuran antena <i>Basic concept of antenna measurements</i>
14	Julat pengukuran antena <i>Measurement ranges of antenna</i>

KIE4017: Pandu Gelombang Optik / *Optical Waveguides*

Kod Kursus <i>Course Code</i>	KIE4017
Tajuk Kursus <i>Course Title</i>	Pandu Gelombang Optik <i>Optical Waveguides</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menerangkan struktur pandu gelombang dan peranti optik bersepadu dengan mengambil kira pelbagai pertimbangan. 2. Menganalisa prestasi peranti optik bersepadu menggunakan kaedah beranalisis dan berangka. 3. Mencadangkan penyelesaian kepada situasi sebenar isu-isu yang berkaitan dengan peranti-peranti optik. <i>At the end of the course, students are able to:</i> 1. <i>Describe waveguide structures and integrated optical devices by taking into account various considerations.</i> 2. <i>Analyse the performance of integrated optical devices using analytical and numerical methods.</i> 3. <i>Propose solutions to real-situation issues relating to optical devices.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini akan memperkenalkan pelajar kepada analisa pandu gelombang optik, dan disusuli oleh fokus kepada isu yang berkaitan dengan peranti optik bersepadu termasuk rekaan, fabrikasi, dan pencirian. Kita akan melihat kitar nilai fotonik, dan membezakan antara optik berasaskan gentian dan optik bersepadu. Aplikasi yang melibatkan optik bersepadu juga akan dikaji. Aplikasi-aplikasi tersebut termasuklah dalam bidang komunikasi dan pengesanan. <i>The course will provide an introduction to optical waveguide analysis, and will then focus on issues relating to integrated optical devices such as design, fabrication and characterisation. We will first look at the photonic value chain, and make the distinction between fibre-based, bulk, and integrated optics. Applications involving integrated optics will also be elaborated. These applications include communication, and sensing.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%

Rujukan Utama <i>Main Reference</i>	1. Robert Hunsperger, "Integrated Optics: Theory and Technology", Springer, 2009. 2. Gines Lifante, "Integrated Photonics: Fundamentals", Wiley, 2003. 3. Ajoy Ghatak and K. Thyagarajan, "An Introduction to Fiber Optics", Cambridge Press, 2012. 4. Hecht, Optics, Prentice Hall, 2016. 5. Bahaa E. A. Saleh and Malvin Carl Teich, "Fundamentals of Photonics", Wiley, 2019.
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KIE4017: Pandu Gelombang Optik / *Optical Waveguides*

Minggu Week	Topik Topic
1	Pengenalan kepada pandu gelombang optik – gentian optik <i>Introduction to optical waveguides – optical fiber</i>
2	Pengenalan kepada pandu gelombang optik – pandu gelombang satah <i>Introduction to optical waveguides – planar waveguide</i>
3	Pengenalan dan semakan: Persamaan Maxwell dan keadaan sempadan <i>Introduction and review: Maxwell equations and boundary conditions</i>
4	Mod pandu gelombang optik <i>Modes of optical waveguides</i>
5	Pemalar penyebaran, indeks yang berkesan, susuk mod <i>Propagation constants, effective index, mode profiles</i>
6	Kaedah fabrikasi untuk pandu gelombang optik (Bahagian 1) <i>Fabrication methods for optical waveguides (Part 1)</i>
7	Kaedah fabrikasi untuk pandu gelombang optik (Bahagian 2) <i>Fabrication methods for optical waveguides (Part 2)</i>
8	Gentian optik khusus – gentian fotonik kristal <i>Specialty optical fibers – photonic crystal fibre</i>
9	Gentian optik khusus – Gentian leper <i>Specialty optical fibers – Flat Fibre</i>
10	Alat berangka untuk analisa dan reka bentuk gelombang optik (Bahagian 1) <i>Numerical tools for optical waveguide analysis and design (Part 1)</i>
11	Alat berangka untuk analisis dan reka bentuk gelombang optik (Bahagian 2) <i>Numerical tools for optical waveguide analysis and design (Part 2)</i>
12	Aplikasi: Penderiaan indeks refraktif <i>Applications: Refractive index sensing</i>
13	Aplikasi: Pemantauan kesihatan struktur <i>Applications: Structural health monitoring</i>
14	Aplikasi: Penderiaan bio <i>Applications: Biosensing</i>

KIE4018: Rekebentuk VLSI / VLSI Design

Kod Kursus <i>Course Code</i>	KIE4018
Tajuk Kursus <i>Course Title</i>	Rekebentuk VLSI <i>VLSI Design</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Merekabentuk logik VLSI sebagai litar, gambarajah liti, dan bentangan berdasarkan peraturan rekabentuk dan spesifikasi. 2. Menganalisa prestasi CMOS dalam terma keluasan, kuasa dan kelajuan. 3. Menilai ciri-ciri teknologi VLSI dan bagaimana ia memberi impak kepada implementasi logik, rekabentuk optima dan rekabentuk sistem dalam konteks masyarakat dan alam sekitar. <i>At the end of the course, students are able to:</i> 1. <i>Design VLSI logic as circuits, stick diagrams and layout subject to design rules and specification.</i> 2. <i>Analyse CMOS performance in terms of area, power and speed.</i> 3. <i>Evaluate the properties of VLSI technology and how they affect logic implementation, optimisation and system design in societal and environmental contexts.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini bertujuan memberi pengenalan pada rekabentuk litar pengamiran skala sangat besar (VLSI). Topik lanjutan termasuk: teknologi IC, alat CAD, bentangan, peraturan rekabentuk, pencirian litar CMOS dan anggaran prestasi, sel piawai dan rekabentuk langganan penuh, seni bina untuk VLSI, pemasaan dan kebolehujian. <i>This course is intended to be an introduction to the design of very large scale integration (VLSI) circuits. Advanced topics includes: IC technology, CAD tools, layout, design rules, CMOS circuit characterization and performance estimation, standard cells and full custom designs, architectures for VLSI, timing, and testability.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Principles of CMOS VLSI Design: A Systems Perspective (4th ed.), Weste, N.H.E. & Eshraghian, K., Addison-Wesley (2017). 2. Fundamentals of Modern VLSI Devices, Yuan Taur, Tak H. Ning, Cambridge University Press (2016). 3. CMOS: Circuit Design, Layout and Simulation, R. Jacob Baker, Wiley (2016). 4. VLSI Design, M Michael Vai, Taylor & Francis Group (2017).

KIE4018: Rekebentuk VLSI / VLSI Design

Minggu Week	Topik Topic
1	Pengenalan kepada konsep asas rekabentuk VLSI Sejarah dan perspektif pembangunan IC Isu-isu dalam rekabentuk VLSI <i>Introduction of basic concepts in VLSI design</i> <i>History and perspective on IC development</i> <i>Overview of VLSI design issues</i>
2	Transistor MOS – struktur dan operasi, yield dan reliabiliti Pengenalan kepada CMOS <i>MOS transistors – structure and operation; yield and reliability</i> <i>Introduction to CMOS</i>
3	Rekabentuk CMOS statik: CMOS penyongsang, usaha logik <i>Static CMOS design: CMOS inverter, logical effort</i>
4	Rekabentuk dinamik CMOS: keluarga logik dinamik dan prestasi Rekabentuk dan analisis get CMOS NAND/NOR dan get logik CMOS kombinasi kompleks <i>Dynamic CMOS design: Dynamic logic families and performances.</i> <i>Design and analysis of CMOS NAND/NOR gates and complex combinational CMOS logic gates</i>
5	Rekabentuk litar sequential. Pemasaan <i>Designing sequential circuits. Clocking</i>
6	Isu penyambungan dan masa: bebanan, disperse, hingar, pencong, penyarian litar. Pelan lantai, alatan place & route <i>Interconnect and timing issues: loading, dispersion, noise, skew. Circuit extraction.</i> <i>Floor-planning, place & route tools.</i>
7	Rekabentuk memori dan struktur tatasusunan <i>Designing memory and array structures</i>
8	Teknik bentangan CMOS dan peraturan rekabentuk Isu skala <i>CMOS layout techniques & design rules</i> <i>Scaling Issues</i>
9	Introduction to CAD for IC design <i>CAD untuk rekabentuk IC</i>
10	Kajian kes menggunakan CAD <i>Case study using CAD</i>

11	Rekabentuk bagi kebolehujian: asas, kerosakan dalam litar digital <i>Design for Testability (DFT): fundamentals, faults in digital circuits</i>
12	Rekabentuk bagi kebolehujian: Kebolehkawalan dan keboleherhatian Model kegagalan: kegagalan "stuck-at", kegagalan "bridging", kegagalan "intermittent" <i>Design for Testability (DFT): Controllability and observability</i> <i>Fault models: Stuck-at faults, Bridging faults, intermittent faults</i>
13	Pelesenan kuasa, pensuisan kuasa, kuasa bocor, dan teknik rekabentuk kuasa-rendah <i>Power dissipation, switching power, leakage power, and low-power design techniques</i>
14	Teknologi fabrikasi CMOS: Langkah pemprosesan <i>CMOS fabrication technology: Processing steps</i>

KIE4019: Rekabentuk Litar VLSI Analog / *Analog VLSI Circuit Design*

Kod Kursus <i>Course Code</i>	KIE4019
Tajuk Kursus <i>Course Title</i>	Rekabentuk Litar VLSI Analog <i>Analog VLSI Circuit Design</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menganalisa konsep teori litar VLSI CMOS analog. 2. Menilai integrasi litar CMOS analog asas dengan mengambil kira pelbagai pertimbangan. 3. Merumuskan prestasi litar CMOS analog bersepadu dengan mengadaptasikan perisian canggih. <i>At the end of the course, students are able to:</i> 1. <i>Analyze the theoretical concepts of analog CMOS VLSI circuits.</i> 2. <i>Evaluate the integration of basic analog CMOS VLSI circuits by taking into account various considerations.</i> 3. <i>Formulate the performance of integrated CMOS analog circuits adapting standardized state-of-the-art tools.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini berperanan dalam memperkenalkan konsep pemodelan, rekabentuk dan analisa litar CMOS VLSI analog. Pelajar dilengkapi dengan latar belakang teori litar analog bersepadu yang kukuh berdasarkan rekabentuk dan analisa masing-masing. Litar arus cermin berasaskan CMOS, penguat pembezaan bersepadu, voltan/arus rujukan kepersisan dan litar analog ketaklurusan direkabentuk dengan mengambil kira parameter praktikal, mengadaptasikan faedah dan batasan masing-masing. Pelajar didedahkan dalam penggunaan perisian EDA bertahap industri dalam merekabentuk, mengoptimumkan dan simulasi litar CMOS analog bersepadu. <i>The goal of this course is to introduce the modelling, design and analysis of analog CMOS VLSI circuits. A strong theoretical background of integrated analog circuits design is imparted to the students along with the emphasis on their design and analysis. Design of CMOS based current mirrors, integrated differential amplifiers, precision voltage/current reference and nonlinear analog circuits are discussed considering practical parameters, adapting their advantages and limitations. Students will be exposed to use industry standard EDA tools to design, optimize and simulate analog CMOS integrated circuits.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%

Rujukan Utama <i>Main Reference</i>	1. B.Razavi. (2018). Design of Analog CMOS Integrated Circuit, 2nd Ed. McGraw Hill. 2. T. C. Carusone, D. Johns, K. W. Martin. (2012). Analog Integrated Circuit Design, 2nd Ed. Wiley. 3. Philip E. Allen, Douglas R. Holberg. (2012). CMOS Analog Circuit Design, 3rd Ed. Oxford University Press Inc.
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KIE4019: Rekabentuk Litar VLSI Analog / *Analog VLSI Circuit Design*

Minggu Week	Topik Topic
1	Pengenalan kepada model arus MOS <i>Introduction to MOS current models</i>
2	Perwakilan isyarat kecil AU MOS & kekuatan berparasit <i>MOS small signal AC representation & parasitic capacitance</i>
3	Penguat tahap tunggal: Sumber sepunya dan pengikut sumber <i>Single Stage Amplifiers: Common source and source follower</i>
4	Penguat tahap tunggal: Get sepunya <i>Single Stage Amplifiers: Common Gate</i>
5	Penguat menyongsang dengan beban pemuat dan rintangan <i>Inverting amplifiers with capacitive and resistive loading</i>
6	Cermin arus MOS asas <i>Basics MOS Current Mirror</i>
7	Analisis cermin arus rintangan keluaran tinggi <i>Analysis of high output resistance current mirrors</i>
8	Penguat pembezaan: Gandaan pembezaan <i>Differential amplifier: Differential gain</i>
9	Penguat pembezaan: Gandaan mod sepunya <i>Differential amplifier: Common mode gain</i>
10	Penguat tahap dua <i>Two stage amplifier</i>
11	Penguat kaskod <i>Cascode amplifier</i>
12	Litar pincangan: Cermin arus yang diubah <i>Biasing Circuits: Modified current mirror</i>
13	Litar pincanga: Litar rujukan sela jalur <i>Biasing Circuits: Bandgap reference circuits</i>
14	Teknik termaju <i>Advanced techniques</i>

KIE4020: Elektronik dan Sistem Gelombang Mikro / *Microwave Electronics and Systems*

Kod Kursus <i>Course Code</i>	KIE4020
Tajuk Kursus <i>Course Title</i>	Elektronik dan Sistem Gelombang Mikro <i>Microwave Electronics and Systems</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menghuraikan konsep teori rangkaian liang-2 (galangan dan matriks ABCD) dalam konteks masyarakat dan alam sekitar. 2. Menganalisa konsep parameter penyerakan litar gelombang mikro. 3. Merekabentuk litar padanan galangan dengan carta Smith dengan mengambil kira pelbagai pertimbangan. <i>At the end of the course, students are able to:</i> 1. <i>Describe the theoretical concepts of 2-port network (impedance and ABCD matrix) in societal and environmental contexts.</i> 2. <i>Analyze the scattering parameter concepts of microwave circuit.</i> 3. <i>Design impedance matching network with Smith Chart by taking into account various considerations.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini memperkenalkan elektronik gelombang mikro dan aplikasi sistem. Kursus ini dibentuk untuk memenuhi permintaan industri. Latar belakang teori yang kukuh dari galangan dan matriks ABCD rangkaian liang-2, konsep talian penghantaran dan parameter penyerakan akan dirangkumi. Gambaran keseluruhan Carta Smith dan perlaksanaan dan rangkaian padanan galangan dan jelmaan akan diperkenalkan. Komponen elektronik gelombang mikro dan teknologi peranti, reka bentuk penapis gelombang mikro, penguat berhingar rendah, pengayun, penguat berkuasa tinggi, dan gelung terkunci fasa akan dibincangkan. Selain itu, sistem penghantar-terima gelombang mikro akan disertakan sebagai persepadaan sistem keseluruhan. Pelajar akan diberikan pendedahan kepada penggunaan alat EDA standard industri untuk merekabentuk, mengoptimumkan dan simulasi litar dan sistem elektronik gelombang mikro. <i>The goal of this course is to introduce microwave electronics and system applications. This course is developed to meet the industrial requirements. A strong theoretical background from the impedance and ABCD matrix of 2-port network, transmission line concept and the scattering parameter will be covered. Overview of Smith Chart and the implementations and impedance matching network and transformations will be given. Microwave electronics components and device technologies, microwave filter design, low noise amplifier,</i>

	<i>oscillator, high power amplifier and phased-lock loop will be covered. Also, microwave transceiver system will be included as overall system integration. Students will be exposed to the use of industry standard EDA tools to design, optimize and simulate microwave electronics circuit and systems.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. D. Pozar, Microwave Engineering – 4th Edition, Wiley & Sons, 2011. 2. R. E. Collin, Foundation for Microwave Engineering – 2nd Edition, Mc-Graw Hill, 2001. 3. R.L. Yadava, Microwave Engineering: Principle and Devices, Notion Press, 2018.

KIE4020: Elektronik dan Sistem Gelombang Mikro / *Microwave Electronics and Systems*

Minggu Week	Topik Topic
1	Perkenalan Kejuruteraan Gelombang Mikro and Aplikasi <i>Introduction to Microwave Engineering and their Applications</i>
2	Galangan dan Matriks ABCD <i>Impedance and ABCD Matrix</i>
3	Teori Gelombang Mikro <i>Microwave Circuit Theory</i>
4	Konsep Talian Penghantaran dan Jenis Talian Penghantaran <i>Transmission Line Concept and Types of Transmission Lines</i>
5	Parameter Penyerakan <i>The Scattering Parameter</i>
6	Carta Smith dan Perlaksanaan <i>The Smith Chart and Implementations</i>
7	Litar Padanan Galangan dan Jelmaan <i>Impedance Matching Network and Transformations</i>
8	Komponen Elektronik Gelombang Mikro dan Teknologi Peranti <i>Microwave Electronics Components and Device Technology</i>
9	Rekabentuk Penapis Gelombang Mikro <i>Microwave Filter Design</i>
10	Rekabentuk Pengayun Gelombang Mikro <i>Microwave Oscillator Design</i>
11	Rekabentuk Penguat Berhingar Rendah Gelombang Mikro <i>Microwave Low Noise Amplifier Design</i>
12	Rekabentuk Gelung Terkunci Fasa Gelombang Mikro <i>Microwave Phased-Lock Loop Design</i>
13	Rekabentuk Penguat Berkuasa Tinggi Gelombang Mikro <i>Microwave High Power Amplifier Design</i>
14	Sistem Penghantar-terima Gelombang Mikro: Rekabentuk Penerima dan Penghantar <i>Microwave Transceiver System: Receiver and Transmitter Design</i>

KIE4021: Rekabentuk Elektronik Analog / *Analog Electronics Design*

Kod Kursus <i>Course Code</i>	KIE4021
Tajuk Kursus <i>Course Title</i>	Rekabentuk Elektronik Analog <i>Analog Electronics Design</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Merekabentuk penguat jenis dengan mempertimbangkan tabiat berbilang tahap dan pengehadan praktikalnya. 2. Merekabentuk pengayun jenis kepada spesifikasi dengan mempertimbangkan faktor-faktor yang mempengaruhi kestabilan dan prestasi litar pengayun bentuk sinus dan bukan bentuk sinus. 3. Merekabentuk bekalan kuasa jenis dengan voltan keluaran tertentu dengan mempertimbangkan perubahan talian dan beban dan perlindungan sedia ada. <i>At the end of the course, students are able to:</i> 1. <i>Design a typical amplifier considering its multistage nature and practical limitations.</i> 2. <i>Design a typical oscillator to specifications considering the factors influencing the stability and performance of sinusoidal and non-sinusoidal oscillator circuits.</i> 3. <i>Design typical power supplies with specific output voltage considering line and load variations and build in protection.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Matlamat kursus ini adalah untuk membina latar belakang pada litar analog, khususnya pada penguat berasaskan BJT dan MOSFET yang digunakan dalam litar diskret dan litar bersepadu, iaitu litar mikroelektronik. Sambutan frekuensi penguat litar diskret juga akan dibincangkan dalam kursus ini. Selain itu, beberapa elemen litar bersepadu berguna berdasarkan kedua-dua transistor ini akan diperkenalkan dan dianalisa yang termasuk sumber arus malar, cermin arus dan litar pandu arus. Kursus ini juga bertujuan untuk meliputi penguat kebezaan, peringkat gandaan, peralihan tahap dan peringkat keluaran, serta konsep suap balik dan kestabilan dalam penguat. Konsep asas pengayun, PLL dan pengatur voltan juga diliputi. <i>The goal of this course is to establish a background on analog circuits, specifically on BJT- and MOSFET-based amplifiers used in discrete circuits and integrated circuits, namely the microelectronic circuits. The frequency response of discrete circuit amplifiers will also be covered in this course. Furthermore, some useful integrated circuit elements based on these two transistors will be introduced and analyzed which include constant-current sources, current mirrors and current steering circuits. The course also aims to cover the differential amplifiers, gain</i>

	<i>stage, level shifters and output stages, as well as the feedback and stability concept in the amplifiers. Basic concepts of oscillators, PLL and voltage regulators are covered.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. Donald Neamenm, Microelectronics circuit analysis and design. 4th edition, Pearson, 2016. 2. Sedra & Smith, Microelectronic circuits, 5th edition, Oxford Press, 2014. 3. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 4th Edition, McGraw-Hill, 2015

KIE4021: Rekabentuk Elektronik Analog / Analog Electronics Design

Minggu Week	Topik Topic
1	Pengenalan kepada penguat Litar Bersepadu, Penguat Lata, Cermin arus <i>Introduction to Integrated-Circuit amplifiers, Cascade amplifiers, Current mirrors</i>
2	Sumber arus malar, Litar pandu arus (BJT, MOSFET) <i>Constant-current sources, Current steering circuits (BJT, MOSFET)</i>
3	Penguat kebezaan dan peringkat gandaan <i>Differential Amplifiers and gain stages</i>
4	Penganjak aras dan penimbal <i>Level shifters and buffers</i>
5	Peringkat keluaran, suap balik dan kestabilan dalam peringkat keluaran penguat <i>Output stage, feedback and stability in amplifier output stage</i>
6	Suap balik dan kestabilan dalam penguat <i>Feedback and stability in amplifiers</i>
7	Teknik canggih dalam reka bentuk litar bersepadu (perspektif industri) <i>Advanced techniques in design of integrated circuit (industry perspectives)</i>
8	Teknik canggih dalam reka bentuk litar bersepadu (perspektif industri) <i>Advanced techniques in design of integrated circuit (industry perspectives)</i>
9	Pengenalan kepada pengayun. Prinsip am ayunan. Syarat-syarat untuk pengayunan yang berterusan, klasifikasi pengayun, operasi dan ciri-ciri RC, LC, dan pengayun kristal. <i>Introduction to oscillators. General principles of oscillation. Conditions for sustained oscillation, classifications of oscillators, operation and characteristics of RC, LC, and crystal oscillator.</i>
10	Teknik reka bentu pengayun <i>Oscillator design techniques</i>
11	Gelombang penjana (sinus, segi empat sama, segi tiga), teknik batasan amplitud <i>Waveform generators (sine, square, triangular), Amplitude limitation technique</i>
12	Gelung berkunci fasa <i>Phase locked loop</i>
13	Reka bentuk bekalan kuasa menggunakan diod zener dan transistor, peraturan garisan dan beban, siri dan pengawal selia shunt <i>Power supply design using zener diodes and transistors, line and load regulation, series and shunt regulators</i>
14	Pengature suap balik dan lipat balik, penggunaan penguat kendalian dalam bekalan kuasa terkawal, reka bentuk IC yang dikawal voltan. <i>Feedback and fold back regulators, use of op amps in regulated power supplies, Voltage regulated IC design.</i>

KIE4022: Sistem Terbenam / *Embedded Systems*

Kod Kursus <i>Course Code</i>	KIE4022
Tajuk Kursus <i>Course Title</i>	Sistem Terbenam <i>Embedded Systems</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menentukan ciri-ciri sistem terbenam serta faedah dan cabarannya. 2. Menilai kesesuaian pelbagai komponen perisian dalam sistem terbenam. 3. Merekabentuk komponen perkakasan sistem terbenam secara berkumpulan. <i>At the end of the course, students are able to:</i> 1. <i>Determine the characteristics of embedded systems as well as its benefits and challenges.</i> 2. <i>Evaluate the suitability of various software components of embedded systems.</i> 3. <i>Design various hardware components of embedded systems as a group.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini memberikan pengenalan praktikal kepada reka bentuk sistem terbenam berasaskan FPGA. Kuliah dan kerja projek akan mendedahkan pelajar kepada pelbagai peringkat dalam projek kejuruteraan dan pelbagai konsep sistem terbenam. <i>This course provides a practical introduction to the design of FPGA-based embedded systems. The lectures and project work will expose students to the various stages in an engineering project and a range of embedded system concepts.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Ronald Sass and Andrew G. Schmidt. 2010. Embedded Systems Design with Platform FPGAs: Principles and Practices (1st. ed.). Morgan Kaufmann Publishers Inc. 2. Peter Athanas et al. 2015. Embedded Systems Design with FPGAs. Springer. 3. Uwe Meyer-Baese. 2021. Embedded Microprocessor System Design using FPGAs. Springer

KIE4022: Sistem Terbenam / *Embedded Systems*

Minggu Week	Topik Topic
1	Pengenalan kepada sistem terbenam <i>Introduction to embedded systems</i>
2	Senibina FPGA <i>FPGA architecture</i>
3	Rantaian alat pelantar FPGA <i>FPGA platform tool chain</i>
4	Rekabentuk FPGA menggunakan skematik <i>FPGA design using schematic</i>
5	Bahasa penerangan perkakasan <i>Hardware description language (HDL)</i>
6	Rekabentuk FPGA menggunakan HDL <i>FPGA design using HDL</i>
7	Prinsip rekabentuk sistem <i>Principle of system design</i>
8	Graf kawalan aliran <i>Control flow graph</i>
9	Rekabentuk perkakasan <i>Hardware design</i>
10	Rekabentuk perisian <i>Software design</i>
11	Prinsip selari <i>Principle of parallelism</i>
12	Komunikasi FPGA <i>FPGA Communications</i>
13	Sistem isyarat campuran <i>Mixed signal system</i>
14	Sistem dalam Cip <i>System on Chip (SOC)</i>

KIE4023: Sistem Kawalan Digit / *Digital Control System*

Kod Kursus <i>Course Code</i>	KIE4023
Tajuk Kursus <i>Course Title</i>	Sistem Kawalan Digit <i>Digital Control System</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	KIE3006 KIE3006
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menerangkan sifat asas gelung terbuka dan tertutup bagi sistem diskrit. 2. Membina perwakilan sistem menggunakan persamaan kebezaan, rangkap pindah dan model keadaan-ruang. 3. Menganalisa prestasi dan kestabilan untuk masalah-masalah kawalan digit. <i>At the end of the course, students are able to:</i> 1. <i>Explain basic features of open and closed loop discrete systems.</i> 2. <i>Construct systems representation using difference equations, transfer function and state space models.</i> 3. <i>Analyze digital system performance and stability for digital control problems.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini merangkumi topik yang berkaitan dengan teori kawalan klasik menggunakan reka bentuk kawalan digit: perihalan ruang dan analisis sistem dinamik masa berterusan dan diskrit termasuk penyelesaian kawalan optimum <i>This course covers topic related to the theory of classical control using digital control design: state space description and analysis of continuous and discrete time dynamic systems including optimal control solutions</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Charles L. Phillips, Troy Nagle, Aranya Chakraborty, Digital Control System Analysis and Design, Prentice Hall, 4th Edition, 2021. 2. Katsuhiko Ogata, Discrete-Time Control Systems, Prentice-Hall, 2nd Edition, 1995. 3. Benjamin C. Kuo, Digital Control System, Oxford University Press, 2nd Edition, 2007.

KIE4023: Sistem Kawalan Digit / *Digital Control System*

Minggu Week	Topik Topic
1	Pengenalan kepada Keadaan-Ruang <i>Introduction to State-Space</i>
2	Representasi dalam Keadaan-Ruang <i>Representations In State-Space</i>
3	Perwakilan dalam Keadaan-Ruang <i>Representations In State-Space</i>
4	Analisa Sistem Lelurus <i>Analysis of Linear Systems</i>
5	Analisa Sistem Lelurus <i>Analysis of Linear Systems</i>
6	Sifat Struktur: Kestabilan, Pengawalan, Pemerhatian <i>Structural Properties: Stability, Controllability, Observability</i>
7	Sifat Struktur: Kestabilan, Pengawalan, Pemerhatian <i>Structural Properties: Stability, Controllability, Observability</i>
8	Rekabentuk Kawalan Suap Balik Keadaan <i>State Feedback Control Design</i>
9	Rekabentuk Kawalan Suap Balik Keadaan <i>State Feedback Control Design</i>
10	Rekabentuk Pengawal dengan Rujukan Masukan <i>Controller Design with Reference Input</i>
11	Rekabentuk Pemerhati untuk Sistem Lelurus <i>Observer Design for Linear Systems</i>
12	Rekabentuk kawalan optimal: Teori dan Aplikasi <i>Optimal Control Design: Theory and Application</i>
13	Rekabentuk Projek: Aplikasi kawalan digit dalam kehidupan manusia <i>Project Design: Digital control application in human life</i>
14	Projek kawalan digital dalam industri kejuruteraan <i>Digital control project in engineering industry</i>

KIE4024: Kaedah Pengoptimuman / *Optimization Methods*

Kod Kursus <i>Course Code</i>	KIE4024
Tajuk Kursus <i>Course Title</i>	Kaedah Pengoptimuman <i>Optimization Methods</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menerangkan dengan efektif teori dan model kawalan optimum. 2. Menentukan sistem kawalan optimum melalui kriteria tenaga minimum dan masa minimum menggunakan pakej perisian yang diketahui. 3. Merekabentuk kawalan masukan dan penyelesaian sistem kawalan optimum yang dibatasi oleh keadaan. <i>At the end of the course, students are able to:</i> 1. <i>Explain effectively the optimal control theory and model.</i> 2. <i>Determine optimal control systems via minimum-energy and minimum-time criteria using known software packages.</i> 3. <i>Design input control and state constrained optimal control systems solutions.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini bertujuan memberikan pendedahan kepada para pelajar bagi belajar, memahami, membina, menyelesaikan dan menilai masalah pengoptimuman dalam masalah dinamik menggunakan kalkulus variasi. <i>This course aims to provide platform for students to study, understand, develop, solve and assess the optimization in dynamic problem using calculus of variation.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Kirk, Donald. Optimal Control Theory: An Introduction. New York, NY: Dover, 2004. ISBN: 9780486434841. 2. Zhongjing Ma, Suli Zou, Optimal Control Theory. Springer, January 2021. ISBN: 9789813362925. 3. Bryson, Arthur, and Yu-Chi Ho. Applied Optimal Control: Optimization, Estimation, and Control. Abingdon, UK: Taylor & Francis, 1975. ISBN: 9780891162285.

KIE4024: Kaedah Pengoptimuman / *Optimization Methods*

Minggu Week	Topik Topic
1	Kajian sistem perwakilan pembolehubah keadaan <i>Review of state variable representation of systems</i>
2	Ukuran prestasi <i>Performance measure</i>
3	Kalkulus variasi <i>Calculus of variations</i>
4	Fungsi melibatkan fungsi tunggal dan beberapa fungsi <i>Functional involving single functions and several functions</i>
5	Syarat-syarat yang diperlukan untuk pengawalan optimum <i>Necessary conditions for optimal control</i>
6	Prinsip Minimum Pontryagin <i>Pontryagin's Minimum Principle</i>
7	Masalah arka tunggal <i>Singular arc problem</i>
8	PBL : Menyelesaikan kawalan optima secara komputasi tidak berterusan <i>PBL : Solving optimal control using indirect computational methods</i>
9	Masalah masa minimum <i>Minimum time problem</i>
10	Masalah usaha kawalan minimum <i>Minimum control effort problem</i>
11	Kawalan optimum terhadap keadaan dan masukan terhad <i>State and input constrained optimal control</i>
12	Kawalan optimum terhadap keadaan dan masukan terhad <i>State and input constrained optimal control</i>
13	Keadaan perintah pendua yang mencukupi <i>Second order sufficient condition</i>
14	PBL: Menyelesaikan kawalan optima keadaan kekangan bagi terapi kanser <i>PBL: Solving state constrained optimal control for cancer therapy</i>

KIE4026: Rangkaian Komunikasi Data / *Data Communication Networks*

Kod Kursus <i>Course Code</i>	KIE4026
Tajuk Kursus <i>Course Title</i>	Rangkaian Komunikasi Data <i>Data Communication Networks</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menjelas secara profesional kepentingan cadangan penyelesaian yang sesuai untuk masalah rangkaian komunikasi data. 2. Menganalisa operasi protokol-protokol komunikasi untuk memenuhi syarat-syarat rangkaian. 3. Menilai prestasi pelbagai protokol dalam rangkaian moden. <i>At the end of the course, students are able to:</i> 1. <i>Explain professionally the significance of proposing suitable solution for data communication networking problem.</i> 2. <i>Analyze the operation of communication protocols in fulfilling network requirements.</i> 3. <i>Evaluate the performance of various protocols in modern networking.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini bertujuan untuk memberikan gambaran keseluruhan bagi bidang luas komunikasi data dan rangkaian. Ia merangkumi seni bina protokol TCP/IP, dan konsep yang digunakan di setiap lapisan TCP/IP, termasuk teknik isyarat pengekodan, teknologi dan senibina protokol bagi rangkaian kawasan setempat, protokol pepohon rentang, protokol pepohon rentang cepat, protokol jalur lebar, pertukaran dan penghalaan, teknik protokol pengangkutan dan kawalan kesesakan. Selain itu, standard terkini bagi rangkaian komunikasi juga akan dipelajari. <i>This course attempts to provide a unified overview of the broad field of data communications and networking. It encompasses the TCP/IP protocol architecture, and the concepts used at every TCP/IP layer, including signal encoding techniques, technology and protocol architecture for local area network (LAN), spanning tree protocol, rapid spanning tree protocol, internet protocol, switching and routing, and transport protocol mechanism and congestion control. Besides, the current standards for communication networks are also studied.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%

Rujukan Utama <i>Main Reference</i>	1. William Stallings, Data and Computer Communications, 10th Ed, Pearson, 2014. 2. James Kurose and Keith Ross, Computer Networking: A top-down Approach, 7th Ed., Pearson, 2017. 3. Oliver C. Ibe, Fundamentals of Data Communication Networks, 1st Ed., Wiley, 2017.
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KIE4026: Rangkaian Komunikasi Data / *Data Communication Networks*

Minggu Week	Topik Topic
1	Pengenalan kepada Komunikasi Data <i>Introduction to Data Communications</i>
2	Protokol TCP/IP dan Model OSI <i>TCP/IP Protocol and OSI Model</i>
3	Lapisan Fizikal: Media Penghantaran dan Teknik Pengecodan Isyarat <i>Physical Layer: Transmission Media and Signal Encoding Techniques</i>
4	Lapisan Link Data: Rangkaian Kawasan Setempat <i>Data Link Layer: Local Area Networks</i>
5	Lapisan Link Data: Rangkaian Kawasan Setempat (Bahagian 2) <i>Data Link Layer: Local Area Networks (Part 2)</i>
6	Lapisan Link Data: Protokol Pepohon Rentang <i>Data Link Layer: Spanning Tree Protocol</i>
7	Lapisan Link Data: Protokol Pepohon Rentang Cepat <i>Data Link Layer: Rapid Spanning Tree Protocol</i>
8	Lapisan Rangkaian: Protokol IP <i>Network Layer: IP Protocol</i>
9	Lapisan Rangkaian: ICMP & ARP <i>Network Layer: ICMP & ARP</i>
10	Lapisan Rangkaian: Penghalaan IP <i>Network Layer: IP Routing</i>
11	Lapisan Rangkaian: Penghalaan IP (BGP & OSPF) <i>Network Layer: IP Routing (BGP & OSPF)</i>
12	Lapisan Pengangkutan: Protokol TCP <i>Transport Layer: TCP Protocol</i>
13	Lapisan Pengangkutan: Protokol UDP <i>Transport Layer: UDP Protocol</i>
14	Lapisan Aplikasi <i>Application Layer</i>

KIE4029: Kualiti Kuasa Elektrik / *Electrical Power Quality*

Kod Kursus <i>Course Code</i>	KIE4029
Tajuk Kursus <i>Course Title</i>	Kualiti Kuasa Elektrik <i>Electrical Power Quality</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menganalisa masalah kualiti kuasa di dalam rangkaian sistem kuasa. 2. Menilai kesan-kesan masalah kualiti kuasa kepada prestasi pengoperasian sistem kuasa. 3. Mencadangkan penyelesaian yang sesuai untuk masalah kualiti kuasa dengan mengambilkira pelbagai pertimbangan. <i>At the end of the course, students are able to:</i> 1. <i>Analyse power quality problems in power system network.</i> 2. <i>Evaluate the effects of power quality problems on the performance of power system operation.</i> 3. <i>Propose feasible solutions for power quality problems by taking into account various considerations.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini menyediakan pengenalan kepada kualiti kuasa di dalam sistem kuasa. Kursus ini fokus kepada dua isu utama kualiti kuasa; voltan lendut dan harmonik. Pelajar akan mempelajari untuk merekabentuk penyelesaian yang sesuai bagi meminimakan kesan masalah kualiti kuasa. Di samping itu, keperluan piawaian tempatan dan antarabangsa berkenaan dengan kualiti kuasa turut diperkenalkan. <i>This course provides introduction of power quality issues in power system network. The course focus on two main power quality problems; Voltage sags and harmonic. Student will learn to design appropriate solution to mitigate the impact of power quality problem. Besides, the present national and international standards on power quality definition and requirements are also introduced.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. J. C. Das, "Power System Harmonics and Passive Filter Designs", IEEE Press Series on Power, Engineering, 2015. 2. R.C. Dugan, M.F. McGranaghan, Surya Santoso and H.W. Beatty, "Electrical Power Systems Quality", McGraw-Hill, 3rd Edition, 2012. 3. J. Duncan Glover, Thomas Overbye, Mulukutla S. Sarma, "Power System Analysis and Design", Cengage Learning, Inc, 6th Edition, 2016.

KIE4029: Kualiti Kuasa Elektrik / *Electrical Power Quality*

Minggu Week	Topik Topic
1	Definisi kualiti kuasa, sejarah awal, tanda-tanda kualiti kuasa <i>Definition of power quality, history, symptom of power quality</i>
2	Kesan kualiti kuasa <i>Impact of power quality</i>
3	Jenis-jenis kualiti kuasa, Piawaian kualiti kuasa <i>Type of power quality, Standard on power quality</i>
4	Kualiti kuasa dan keboleharapan sistem <i>Power quality and system reliability</i>
5	Punca voltan lendut <i>Source of voltage sags</i>
6	Pengiraan voltan lendut <i>Calculation of voltage sags</i>
7	Kaedah pencirian voltan lendut <i>Characterization techniques of voltage sags</i>
8	Analisa voltan lendut – Kaedah beranalisa <i>Analysis of voltage sag performance – analytical technique</i>
9	Tebatan voltan lendut – kaedah dan teknologi terkini <i>Mitigation of voltage sag – technique and current technology</i>
10	Pembetulan Faktor Kuasa <i>Power Factor correction</i>
11	Pengenalan harmonik – punca dan kesan <i>Harmonic Introduction – sources and impact</i>
12	Harmonik – model matematik, index-index, pengiraan <i>Harmonic – mathematical modelling, indices, calculation</i>
13	Harmonik – resonan sesiri dan selari <i>Harmonic – series and parallel resonance</i>
14	Tebatan Harmonik – kaedah dan teknologi terkini <i>Harmonic Mitigation – technique and current technology</i>

KIE4030: Ekonomi Sistem Kuasa / *Power System Economics*

Kod Kursus <i>Course Code</i>	KIE4030
Tajuk Kursus <i>Course Title</i>	Ekonomi Sistem Kuasa <i>Power System Economics</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menganalisa aspek ekonomi pasaran tenaga elektrik dan rangkaian penghantaran. 2. Menilai pelaburan di dalam pengembangan rangkaian penghantaran menggunakan kaedah harga penghantaran yang bersesuaian. 3. Mencadangkan perkhidmatan sampingan yang berpatutan untuk mengekalkan keselamatan sistem. <i>At the end of the course, students are able to:</i> 1. <i>Analyse the economic aspects of electrical energy market and transmission network.</i> 2. <i>Evaluate investment in transmission network expansion using suitable transmission pricing methods.</i> 3. <i>Propose the appropriate ancillary service to maintain system security.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini memperkenalkan aspek ekonomi di dalam sistem kuasa melalui keperluan pasaran, kesan kepada keselamatan dan penghantaran kepada harga elektrik serta membincangkan isu-isu pelaburan di dalam kuasa penjana dan peralatan penghantaran <i>This course introduces the economics aspects in power system in terms of its market requirement, effects of security and transmission to the electricity pricing and discusses the issues of investments in power generation and transmission equipment.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i>: 40% Peperiksaan Akhir / <i>Final Examination</i>: 60%
Rujukan Utama <i>Main Reference</i>	1. Daniel S. Kirschen and Goran Strabac, "Fundamental of Power System Economics", 2nd Edition, John Wiley and Sons, 2018. 2. Jin Zhong, "Power System Economic and Market Operations", 1st Edition, Jin Zhong, 2018. 3. Steven Stoft, "Power System Economics: Designing Markets for Electricity", Wiley-IEEE Press, 2002.

KIE4030: Ekonomi Sistem Kuasa / *Power System Economics*

Minggu Week	Topik Topic
1	Pengenalan kepada pasaran tenaga elektrik <i>Introduction to electrical energy markets</i>
2	Pasaran tenaga elektrik terbuka dan pasaran spot <i>Open electrical energy market and spot market</i>
3	Pengenalan kepada penglibatan di dalam pasaran tenaga elektrik <i>Introduction to participation in electrical energy markets</i>
4	Perspektif pengguna dan pengeluar, penglibatan bercampur <i>Consumer's and producer's perspective, hybrid participation</i>
5	Pengenalan kepada keselamatan sistem dan perkhidmatan sampingan <i>Introduction to system security and ancillary services</i>
6	Keseimbangan dan isu rangkaian <i>Balancing and network issues</i>
7	Pemulihan sistem dan perkhidmatan sampingan <i>System restoration and ancillary services</i>
8	Pengenalan kepada rangkaian penghantaran dan pasaran elektrik <i>Introduction to transmission networks and electricity markets</i>
9	Perniagaan ternyahpusat dan terpusat untuk rangkaian penghantaran <i>Decentralised and centralized trading over a transmission network</i>
10	Pengenalan kepada pelaburan generasi <i>Introduction to generation investment</i>
11	Kapasiti generasi daripada perspektif pelabur dan pengeluar <i>Generation capacity from investor's and customer's perspective</i>
12	Pengenalan kepada pelaburan rangkaian penghantaran <i>Introduction to transmission networks investment</i>
13	Pengembangan rangkaian penghantaran berdasarkan modal <i>Cost-based transmission network expansion</i>
14	Pengembangan rangkaian penghantaran berdasarkan penghantaran <i>Transmission-based transmission system expansion</i>

KIE4031: Pembelajaran Mesin / *Machine Learning*

Kod Kursus <i>Course Code</i>	KIE4031
Tajuk Kursus <i>Course Title</i>	Pembelajaran Mesin <i>Machine Learning</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menyiasat ciri-ciri teknik pembelajaran mesin untuk masalah pengecaman pola. 2. Menganalisa prestasi teknik pembelajaran mesin menggunakan perisian pengiraan atau algoritma yang sesuai dengan pemahaman yang baik tentang batasannya. 3. Melaksanakan kajian kes mengenai teknik-teknik pembelajaran mesin untuk masalah pengecaman pola. <i>At the end of the course, students are able to:</i> 1. Investigate the characteristics of machine learning technique for pattern recognition problem. 2. Analyze the performance of machine learning technique using suitable computational software or algorithm with good understanding of its limitations. 3. Perform case study on machine learning techniques for pattern recognition problem.
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini memperkenalkan asas pembelajaran mesin untuk masalah pengecaman pola. Topik-topik ini meliputi teori keputusan Bayesian, teori anggaran, dan pelbagai teknik pembelajaran mesin. Teknik pengecaman pola berguna dalam banyak aplikasi seperti pengambilan maklumat, perlombongan data, analisis imej dan pengecaman, linguistik pengiraan, biometrik dan bioinformatik. <i>This course introduces the fundamental of machine learning algorithm for pattern recognition problems. The topics cover bayesian decision theory, estimation theory, and various machine learning techniques. Machine learning techniques are useful in many applications such as information retrieval, data mining, image analysis and recognition, computational linguistics, biometrics and bioinformatics.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%

Rujukan Utama <i>Main Reference</i>	1. An Introduction to Machine Learning (2nd edition), Miroslav Kubat, 2017, Springer. 2. Introduction to Deep Learning From Logical Calculus to Artificial Intelligence, Sandro Skansi, 2018 Springer. 3. Pattern Recognition (4th edition), Elsevier Science and Technology, 2014. 4. Deep Learning for Coders with Fastai and PyTorch, Jeremy Howard and Sylvain Gugger, 2020.
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KIE4031: Pembelajaran Mesin / *Machine Learning*

Minggu Week	Topik Topic
1	Konsep asas dalam algoritma pembuatan mesin <i>Basic concept in machine learning algorithm</i>
2	Jenis-jenis algoritma pembuatan mesin <i>Types of machine learning algorithm</i>
3	Pembelajaran yang diselia dan tidak diselia <i>Supervised and unsupervised learning</i>
4	Klasifikasi rangkaian neural buatan <i>Artificial neural network classification</i>
5	Klasifikasi rangkaian neural buatan <i>Artificial neural network classification</i>
6	Klasifikasi pembelajaran yang mendalam <i>Deep learning classification</i>
7	Rangkaian neural konvolusi <i>Convolutional neural network</i>
8	Pengoptimuman rangkaian neural konvolusi <i>Optimizing convolutional neural network</i>
9	Rangkaian neural berulang <i>Recurrent neural network</i>
10	Rangkaian neural berulang <i>Recurrent neural network</i>
11	Penilaian prestasi pengiktirafan <i>Recognition performance evaluation</i>
12	Teknik pembuatan mesin untuk masalah pengecaman corak: kajian kes <i>Machine learning technique for pattern recognition problem: case study</i>
13	Teknik pembuatan mesin untuk masalah pengecaman corak: kajian kes <i>Machine learning technique for pattern recognition problem: case study</i>
14	Batasan kaedah pembelajaran mesin <i>Limitations of machine learning methods</i>

KIE4032: Interaksi Manusia-Komputer / *Human-Computer Interaction*

Kod Kursus <i>Course Code</i>	KIE4032
Tajuk Kursus <i>Course Title</i>	Interaksi Manusia-Komputer <i>Human-Computer Interaction</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Mengenalpasti kepentingan komponen-komponen interaksi manusia dan komputer. 2. Membangunkan sistem interaksi manusia dan komputer dengan menggunakan analisa fokus rekabentuk, perisian dan pengetahuan peraturan rekabentuk. 3. Menyelesaikan masalah-masalah berkaitan dengan interaksi manusia dan komputer secara berkumpulan. <i>At the end of the course, students are able to:</i> 1. <i>Identify the important components of human-computer interaction.</i> 2. <i>Develop human-computer interaction system using design focus analysis, software and design rules knowledge.</i> 3. <i>Solve problems related to human-computer interaction as a group.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Merancang sistem komputer interaktif agar berkesan, cekap, mudah, dan menyenangkan untuk digunakan adalah penting, supaya orang dan masyarakat dapat mengetahui kelebihan peranti berasaskan pengiraan. Tenunan batasan yang halus dan pertukarannya - manusia, komputer atau mesin, algoritma, perisian, perkakasan, tugas, sosial, estetika, dan ekonomi - menimbulkan kesukaran. Kursus ini bertujuan untuk menawarkan pengenalan, reka bentuk dan penyiasatan sistem interaksi manusia-komputer selaras dengan teknologi semasa terutama untuk memenuhi Revolusi Industri 4.0. <i>Designing interactive computer systems to be effective, efficient, easy, and enjoyable to use is important, so that people and society may realize the benefits of computation based devices. The subtle weave of constraints and their trade-offs – human, computer or machine, algorithmic, software, hardware, task, social, aesthetic, and economic – generates the difficulty. This course aims to offer identification, design and investigation of human-computer interaction systems in pace with the current technologies especially to cater Industry Revolution 4.0.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%

Rujukan Utama <i>Main Reference</i>	1. Alan Dix, Janet E. Finlay, Gregory D. Abowd and Russell Beale, "Human-Computer Interaction", Prentice Hall, 2004. 2. Donald A. Norman, "The Design of Everyday Things, Revised And Expanded Edition", Basic Books, 2014. 3. Simon T. Yates, "Machine Vision and Human-Machine Interface: Technologies, Applications and Challenges", Nova Science Publishers, 2016.
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KIE4032: Interaksi Manusia-Komputer / *Human-Computer Interaction*

Minggu Week	Topik Topic
1	Pengenalan kepada interaksi manusia-komputer <i>Introduction to human-computer interaction (HCI)</i>
2	Rekabentuk dan kebolegunaan berpusatkan pengguna <i>User centered design and usability</i>
3	Kerangka HCI dan kemampuan manusia <i>HCI framework and human abilities</i>
4	Analisis keperluan dan tugas <i>Requirement and task analysis</i>
5	Cara interaksi <i>Interaction styles</i>
6	Jenis ralat, panduan pencegahan dan pemulihan <i>Type of errors, prevention and recovery guidelines</i>
7	Isu socio-organisasi dan keperluan pihak yang berkepentingan <i>Socio-organizational issues and stakeholder requirements</i>
8	Proses rekabentuk bahagian 1 <i>Design process part 1</i>
9	Proses rekabentuk bahagian 2 <i>Design process part 2</i>
10	Proses penilaian <i>Evaluation process</i>
11	Sistem model <i>Models of the system</i>
12	Isyarat, antara muka pen dan peranti mudah alih <i>Gesture, pen interface and mobile devices</i>
13	Antara muka pertuturan dan bahasa semula jadi <i>Speech and natural language interfaces</i>
14	Teknologi bantuan bagi manusia <i>Human Assistive Technology</i>

KIE4033: Analitik Data / *Data Analytics*

Kod Kursus <i>Course Code</i>	KIE4033
Tajuk Kursus <i>Course Title</i>	Analitik Data <i>Data Analytics</i>
Kredit <i>Credit</i>	2
Bahasa Pengantar <i>Medium of Instruction</i>	Bahasa Inggeris <i>English</i>
Prasyarat/Keperluan Minimum Kursus <i>Course Pre-requisite(s)/ Minimum Requirement(s)</i>	Tiada <i>No</i>
Hasil Pembelajaran Kursus <i>Course Learning Outcomes</i>	Di akhir kursus ini, pelajar dapat: 1. Menunjukkan penggunaan teknik analisa dalam memanipulasi dan mewakili pelbagai data mentah. 2. Membangun penyelesaian untuk masalah kejuruteraan menggunakan teknik analisa data. 3. Melaksanakan kajian kes mengenai kaedah analisa data dalam aplikasi pelbagai disiplin. <i>At the end of the course, students are able to:</i> 1. <i>Demonstrate the use of analysis techniques in manipulating and representing of various raw data.</i> 2. <i>Develop solutions for engineering problems using data analysis techniques.</i> 3. <i>Perform case study on data analysis methods in multidisciplinary applications.</i>
Sinopsis Kandungan Kursus <i>Synopsis of Course Contents</i>	Kursus ini berkaitan dengan inti dari manipulasi, pemprosesan, pembersihan, dan penghancuran data di Python. Ini juga merupakan pengenalan praktikal dan moden untuk pengkomputeran saintifik di Python, disesuaikan untuk aplikasi intensif data. Dalam kursus ini, bahasa dan perpustakaan Python yang diperlukan untuk menyelesaikan masalah analisa data dengan berkesan dipelajari. <i>This course is concerned with the nuts and bolts of manipulating, processing, cleaning, and crunching data in Python. It is also a practical, modern introduction to scientific computing in Python, tailored for data-intensive applications. In this course, the parts of the Python language and libraries needed to effectively solve a broad set of data analysis problems are studied.</i>
Pemberatan Penilaian <i>Assessment Weightage</i>	Penilaian Berterusan / <i>Continuous Assessment</i> : 40% Peperiksaan Akhir / <i>Final Examination</i> : 60%
Rujukan Utama <i>Main Reference</i>	1. Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, O'Reiley, 2016. 2. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and iPython, O'Reiley, 2017. 3. Dietrich, David. Data science and big data analytics: discovering, analyzing, visualizing and presenting data, Wiley, 2015.

KIE4033: Analitik Data / Data Analytics

Minggu Week	Topik Topic
1	Pengenalan kepada Analisa Data dan Pengaturcaraan Python <i>Introduction to Data Analysis and Python Programming</i>
2	Asas NumPy dan Panda <i>Basic of NumPy and Panda</i>
3	Manipulasi Data: Data Hilang dan Penggabungan <i>Data Manipulation: Missing Data and Merging</i>
4	Manipulasi Data: Pembentuk-semula dan Berpusing <i>Data Manipulation: Reshaping and Pivoting</i>
5	Manipulasi Data: Transformasi Data <i>Data Manipulation: Data Transformation</i>
6	Manipulasi Data: Siri Masa <i>Data Manipulation: Time-Series</i>
7	Visualisasi Data <i>Data Visualization</i>
8	Pengumpulan Data <i>Data Aggregation</i>
9	Operasi dan Transformasi Kumpulan <i>Group Operation and Transformation</i>
10	Pembelajaran Mesin: Pengelasan Bayesian dan Regresi Linear <i>Machine Learning: Bayesian Classification and Linear Regression</i>
11	Pembelajaran Mesin: Mesin Sokongan Vektor <i>Machine Learning: Support Vector Machine</i>
12	Pembelajaran Mesin: Pengkluseran k-Min <i>Machine Learning: k-Means Clustering</i>
13	Kajian Kes 1 <i>Case Study 1</i>
14	Kajian Kes 2 <i>Case Study 2</i>



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 |

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