Program Kejuruteraan Elektrik dan Elektronik
Programme of Electrical and Electronic Engineering

Pengenalan */ Introduction*
Program Kejuruteraan Elektrik dan Elektronik (PKE) merupakan salah satu program terawal di Fakulti Kejuruteraan dan Alam Bina. Bermula sebagai Unit Elektronik di Jabatan Fizik, Fakulti Sains pada 1hb Mei 1978, ianya telah berkembang dan akhirnya dinaiktaraf kepada Jabatan Elektronik di Fakulti Sains Fizik dan Gunaan. Dengan usaha gigih ahli-ahli akademik Jabatan Elektronik dan Jabatan Teknologi Kimia, maka Fakulti Kejuruteraan dan Alam Bina telah ditubuhkan pada 1hb November 1984. Dengan penubuhan Fakulti Kejuruteraan dan Alam Bina, nama jabatan telah diubah kepada Jabatan Kejuruteraan Elektrik, Elektronik dan Sistem. Setelah hampir 33 tahun selepas itu, melalui satu proses penstrukturan baru di Fakulti Kejuruteraan dan Alam Bina pada tahun 2018, jabatan ini telah diberi nama baru dan dikenali sebagai Program Kejuruteraan Elektrik dan Elektronik.

The Electrical and Electronic Engineering Programme (PKE) was among the first programme founded in the Faculty of Engineering and Built Environment. Initially known as the Unit of Electronic under the Department of Physics in the Faculty of Science on 1st May 1978, it became a full department known as the Department of Electronic in the Faculty of Physics and Applied Science. With joint efforts from the staff of the Department of Electronic and the Department of Chemical Technology, the Faculty of Engineering and Built Environment was established on 1st November 1984. Upon the establishment of the Faculty of Engineering and Built Environment, the name of the department was changed to the Department of Electrical,Electronic and Systems Engineering. After nearly 33 years thereafter, through a new restructuring process at the Faculty of Engineering and Architecture in 2018, the department's name was transformed as the Electrical and Electronic Engineering Program.

Program Pengajian / *Study Programmes*

Pada peringkat awal penubuhan jabatan, semua penuntut mengikuti program pengajian yang sama, dan membuat pengkhususan dengan memilih kursus-kursus elektif pada tahun akhir pengajian mereka. Bagaimana pun, mulai tahun 1996, sesuai dengan perkembangan dalam teknologi elektrik dan elektronik, beberapa program pengajian yang memerlukan pengkhususan tugas bagi para jurutera diwujudkan. Pada masa ini, PKE menawarkan 2 program pengajian untuk diikuti oleh para pelajar iaitu:

♦ Kejuruteraan Elektrik dan Elektronik (KZ)
♦ Kejuruteraan Elektronik (KT)

Dengan penawaran dua program ini, penuntut dapat difokuskan kepada bidang pengkhususan mereka seawal tahun pertama pengajian mereka. Ini diharapkan akan memantapkan lagi kualiti jurutera yang bakal dikeluarkan. Pada tahun 2013, perubahan kepada silibus kedua-dua program pengajian telah dibuat untuk memenuhi keperluan Lembaga Jurutera Malaysia supaya graduan dari program ini boleh diiktiraf sebagai jurutera dalam bidang elektrik dan elektronik. Perubahan silibus ini banyak dilakukan pada kursus-kursus tahun 3 dan 4, di mana lebih banyak kursus-kursus yang berkaitan dengan kejuruteraan elektrik dan kawalan dimuatkan dalam program pengajian kejuruteraan elektrik dan elektronik (KZ). Manakala, bagi program pengajian kejuruteraan elektronik (KT), penekanan diberikan kepada kursus-kursus berkaitan kejuruteraan komunikasi, komputer dan mikroelektronik. Pada keseluruhannya, semua program pengajian ini mendapat sambutan yang baik daripada pihak industri dan majikan. Pencapaian yang cemerlang ini seharusnya menjadi pendorong kepada pelajar-pelajar ini untuk terus mengejar kejayaan.

During the initial stage of the department's establishment, all undergraduate students had to undertake the same study programmes and specialise by choosing elective courses during their final year of study. Nevertheless, starting from year 1996, with the advancement of electrical and electronic technology which demands specialisation tasks for engineers, few study programmes have been offered. Currently, PKE offers two study programme which are:

♦*Electrical and Electronic Engineering (KZ)*
♦*Electronic Engineering (KT)*

By offering these two programmes, students can focus on their field of specialisation as early as their first year of study. This is expected to enhance the quality of potential engineers that are produced. In year 2013, the syllabus of both study programme has been changed to fulfill the requirements of the Board of Engineers so that graduates from this programme would be recognised as engineers in the field of electrical and electronic engineering. Changes in the syllabus for years 3 and 4 have been tremendously made, in which

more courses related to electrical and control engineering have been included in electrical and electronic engineering programme (KZ). Meanwhile, for electronic engineering programme (KT), emphasis is given on communication, computer and microelectronic engineering courses. In general, all the programmes in the department have been well received by the industry and employers. This achievement should inspire students to continue in pursuing success.

Objektif Pembelajaran Program (PEO)

PEO1
Jurutera/Arkitek yang mempunyai sahsiah dan etika, serta profesionalisma yang tinggi dan menyumbang kepada Aspirasi Kebangsaan. *Engineer / Architect who has character and ethics, as well as high profession- alism and contributes to the National Aspirations.*

PEO2
Jurutera/Arkitek yang kompeten dalam amalan bidang masing-masing bersesuaian dengan keperluan semasa dan masa depan. *Engineer / Architect who is competent in respective engineering practices that meets current and future needs.*

PEO3
Jurutera/Arkitek yang mempunyai daya kreatif dan inovatif, ciri keusahawanan dan sifat kepimpinan yang bersifat glokal. *Engineer / Architect who has a creative and innovative, entrepreneurial and leadership qualities that are glocal.*

Hasil Pembelajaran Program (PO)

PO1 - Ilmu Kejuruteraan - Aplikasi ilmu dalam matematik, sains, asas kejuruteraan dan pengkhususan kejuruteraan dalam memberi penyelesaian masalah kejuruteraan yang kompleks.

Engineering Knowledge - Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialisation to the solution of complex engineering problems.

PO2 - Analisis Masalah - Mengenal pasti, merumuskan, mengkaji literatur dan menganalisis masalah kejuruteraan yang kompleks den-

gan mencapai kesimpulan yang dapat menyokong dengan menggunakan prinsip pertama matematik, sains tabii dan kejuruteraan sains. *Problem Analysis - Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences;*

PO3 - Reka bentuk/Pembangunan Penyelesaian - Rekabentuk penyelesaian untuk masalah kejuruteraan yang kompleks dan sistem reka bentuk, komponen proses yang menepati keperluan spesifik dengan pertimbangan yang bersesuaian bagi kesihatan awam dan keselamatan, budaya, kemasyarakatan dan alam sekitar.

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;

PO4 - Penyiasatan - Menjalankan penyiasatan terhadap masalah kejuruteraan yang kompleks menggunakan kaedah ilmu asas penyelidikan termasuk reka bentuk ujikaji, analisis dan tafsiran data, sintesis maklumat untuk memberikan kesimpulan yang sah.

Investigation - Conduct investigation into complex problems using research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions;

PO5 - Penggunaan Alatan Moden - Mencipta, memilih dan mengaplikasikan teknik, sumber, dan alatan kejuruteraan dan teknologi maklumat yang moden, termasuk ramalan dan model, kepada masalah kejuruteraan yang kompleks dengan memahami hadnya.

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.

PO6 - Jurutera dan Masyarakat - Mengaplikasikan pemikiran yang dimaklumkan dari konteks ilmu untuk menilai isu-isu kemasyarakatan, kesihatan, keselamatan, perundangan dan budaya serta tanggung jawab berkaitan yang relevan kepada profesional amalan kejuruteraan dan penyelesaian kepada permasalah yang kompleks.

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;

PO7 - Alam Sekitar dan Kelestarian – Memahami dan menilai kemampanan dan kesan dari kerja profesional kejuruteraan dalam penyelesaian untuk masalah kejuruteraan yang kompleks dalam konteks masyarakat dan persekitaran.

Environment and Sustainability - Understand and evaluate the sustainability and the impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.

PO8 - Etika - Aplikasi prinsip etika dan komitmen terhadap etika professional serta tanggung jawab dan norma amalan kejuruteraan yang menyumbang kepada Aspirasi Kebangsaan.

Ethics - Apply ethical principles and commit to professional ethics & responsibilities and norms of engineering practice and contribute to the National Aspirations

PO9 - Komunikasi - Berkomunikasi secara efektif berkaitan aktiviti kompleks bersama komuniti kejuruteraan dan keseluruhan masyarakat, seperti berkeupayaan untuk memahami dan menulis laporan yang efektif serta mereka bentuk dokumen, melakukan pembentangan yang efektif, serta memberi dan menerima arahan.

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.

PO10 - Individu dan Kerja Berpasukan - Berfungsi secara efektif sebagai individu, dan sebagai ahli atau ketua dalam pelbagai kumpulan dan pelbagai disiplin.

Individual and Team Work - Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

PO11 - Pembelajaran Sepanjang Hayat - Mengenal pasti keperluan dan persediaan serta keupayaan untuk melibatkan diri secara bebas dalam pembelajaran sepanjang hayat dalam konteks yang luas merangkumi perubahan teknologi.

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.

PO12 - Pengurusan Projek dan Kewangan - Mendemonstrasikan ilmu dan pemahaman prinsip pengurusan kejuruteraan dan membuat keputusan secara berekonomi serta aplikasi terhadap tugas yang diberi, sebagai ahli atau ketua kumpulan, untuk mengurus projek dan dalam persekitaran yang pelbagai disiplin.

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 and in multidisciplinary environments.

Struktur Kursus Kejuruteraan Elektrik dan Elektronik
Electrical and Electronic Engineering Course Structure

Semester	Kod Kursus/ Course Code	Kategori Category	Nama Kursus Course Title
I	LMCK1621	C1	Etika dan Profesional *Ethical and Professional*
	LMCE1042 LMCE1062 LMCE1072 LMCE1082	C2	*Breakthrough English (MUET Band 1 & 2)* *Academic Interactions (MUET Band 3)* *Academic Literacy (MUET Band 4)* *Page To Stage (MUET Band 5 & 6)*
	KKKL1103	C5	CAD/ *CAE*
	KKKL1113	WJ	Teori Litar I *Circuit Theory I*
	KKKL1133	WJ	Fizik Untuk Jurutera *Physics for Engineers*
	KKKQ1123	WF	Matematik Kejuruteraan I (Kalkulus Vektor) *Engineering Mathematics I (Vector Calculus)*
II	LMCW1022	CW	Asas Keusahawanan dan Inovasi *Entreprenuership and Innovation Base*
	LMCE1052	C2	*Bridging English (MUET Band 1 & 2 only)*
	LMCXXXX2	C6	*Kursus Luar Fakulti* *Free Flow*
	LMCXXXX2	C6	*Kursus Luar Fakulti* *Free Flow*
	KKKL1123	WJ	Teori Litar II *Circuit Theory II*
	KKKL1142	WJ	Makmal Elektrik dan Elektronik I *Electrical and Electronics Laboratory I*
	KKKL1163	WJ	Bahasa Pengaturcaraan *Programming Language*
	KKKQ1223	WF	Matematik Kejuruteraan II (Aljabar Linear) *Engineering Mathematics II (Linear Algebra)*

III	LMCW2163	CW	Tamadun Islam dan Tamadun Asia *Islamic and Asian Civilisation*
	LMCE1062 LMCE2082 LMCE2092 LMCE2103	C2	*Academik Interactions (MUET Band 1 & 2)* *Pro Talk English (MUET Band 3)* *Speak to Persuade (MUET Band 4)* *Advanced Communication Project* *(MUET Band 5 & 6)*
	KKKL2123	WJ	Isyarat dan Sistem *Signal and System*
	KKKL2151	WJ	Makmal Elektrik & Elektronik II *Electrical and Electronics Laboratory II*
	KKKL2173	WJ	Elektronik Analog *Analogue Electronics*
	KKKQ2123	WF	Matematik Kejuruteraan III (Persamaan Kebezaan) *Engineering Mathematics III* *(Differential Equation)*
IV	LMCW2173	CW	Hubungan Etnik *Ethnic Relation*
	LMCK2922	CW	Kemahiran Insaniah *Soft Skills*
	KKKL2121	WJ	Makmal Elektronik Digit *Digital Electronics Laboratory*
	KKKL2133	WJ	Medan dan Gelombang Elektromagnet *Electromagnetic Fields and Waves*
	KKKL2163	WJ	Elektronik Digit *Digital Electronics*
	KKKL2183	WJ	Teori Komunikasi *Communication Theory*
	KKKL2xxx3	WF	Pembelajaran Mesin Menggunakan Python *Machine Learning with Python*

V	KKKF3283	C1	Etika Kejuruteraan dan Perkembangan Teknologi *Engineering Ethics and Technological Advancement.*
	KKKL3113	WJ	Pengukuran dan Instrumentasi *Measurements and Instrumentation*
	KKKL3294	WJ	Mikropemproses dan Mikrokomputer *Microprocessor and Microcomputer*
	KKKQ3123	C3	Statistik dan Pengiraan Berangka *Statistics and Numerical Method*
	KKKZ3073	WJ	Mesin Elektrik *Electrical Machines*
VI	KKKF3103	WF	Pengurusan Projek *Project Management*
	KKKL3162	WJ	Makmal Elektrik dan Elektronik III *Electrical and Electronics Laboratory III*
	KKKL3184	WJ	Pemprosesan Isyarat Digit *Digital Signal Processing*
	KKKL3234	WJ	Rekabentuk Sistem *System Design*
	KKKZ3123	WJ	Kejuruteraan Kawalan *Control Engineering*
	KKKZ3143	WJ	Kejuruteraan Kuasa *Power Engineering*
Intersesi	KKKF3066	WF	Latihan Industri *Industrial Training*

	LMCE3051 LMCE3061 LMCE3071	C2	*Let's Get Talking (MUET Band 1 & 2)* *Corporate Storytelling (MUET Band 3)* *Professional Communication (MUET Band 4)*
VII	KKKZ4113	WJ	Elektronik Kuasa Power Electronics
	KKKZ4124	WJ	Rekabentuk Sistem Kawalan *Control System Design*
	KKKZ4033	WJ	Analisis Sistem Kuasa *Power System Analysis*
	KKKZ4162	WJ	Projek Ilmiah I *Project I*
	Kursus Elektrif (Pilih SATU sahaja) ***Elective Course (choose ONE only)***		
	KKKZ4013	P	Bioisyarat dan Sistem *Biosignal and System*
	KKKZ4023	P	Perlindungan dan Keselamatan sistem Kuasa *Power System Protection and Safety*
VIII	KKKL4124	C4	Ekonomi Kejuruteraan dan Perakaunan Kos *Engineering Economics and Cost Accounting*
	KKKZ4133	WJ	Penjanaan Kuasa Elektrik & Pertukaran Tenaga *Electrical Power Generation and Energy Conversion*
	KKKZ4164	WJ	Projek Ilmiah II *Project II*
	Kursus Elektrif (Pilih SATU sahaja) ***Elective Course (choose ONE only)***		
	KKKZ4043	P	Kualiti Kuasa *Power Quality*
	KKKZ4063	P	Sistem Kawalan Berkomputer *Computer Controlled Systems*

Kategori/Category

- WU - Kursus Wajib Universiti/ *University Courses*
- WF - Kursus Wajib Fakulti / *Faculty Courses*
- WJ - Kursus Wajib Jabatan / *Department Courses*
- P - Kursus Pilihan / *Elective Courses*
- CK - Kursus CITRA Kompetensi / *CITRA Competency Course*
- CW - Kursus CITRA Wajib / *CITRA Compulsory Course*
- C1-C6 - Kursus CITRA Rentas / *CITRA General Education*

Struktur Kursus Kejuruteraan Elektronik
Electronic Engineering Course Structure

Semester	Kod Kursus/ Course Code	Kategori/ Category	Nama Kursus/ Course Title
I	LMCK1621	C1	Etika dan Profesional *Ethical and Proffesional*
	LMCE1042 LMCE1062 LMCE1072 LMCE1082	C2	*Breakthrough English (MUET Band 1 & 2)* *Academic Interactions (MUET Band 3)* *Academic Literacy (MUET Band 4)* *Page To Stage (MUET Band 5 & 6)*
	KKKL1103	C5	CAD/CAE
	KKKL1113	WJ	Teori Litar I *Circuit Theory I*
	KKKL1133	WJ	Fizik Untuk Jurutera *Physics for Engineers*
	KKKQ1123	WF	Matematik Kejuruteraan I (Kalkulus Vektor) *Engineering Mathematics I (Vector Calculus)*
II	LMCW1022	CW	Asas Keusahawanan dan Inovasi *Entreprenuership and Innovation Base*
	LMCE1052	C2	*Bridging English (MUET Band 1 & 2 only).*
	LMCXXXX2	C6	Kursus Luar Fakulti *Free Flow*
	LMCXXXX2	C6	Kursus Luar Fakulti *Free Flow*
	KKKL1123	WJ	Teori Litar II *Circuit Theory II*
	KKKL1142	WJ	Makmal Elektrik dan Elektronik I *Electrical and Electronics Laboratory I*
	KKKL1163	WJ	Bahasa Pengaturcaraan *Programming Language*
	KKKQ1223	WF	Matematik Kejuruteraan II (Aljabar Linear) *Engineering Mathematics II (LinearAlgebra)*

III	LMCW2163	CW	Tamadun Islam dan Tamadun Asia *Islamic and Asian Civilisation*
	LMCE1062 LMCE2082 LMCE2092 LMCE2103	C2	*Academik Interactions (MUET Band 1 & 2)* *Pro Talk English (MUET Band 3)* *Speak to Persuade (MUET Band 4)* *Advanced Communication Project* *(MUET Band 5 & 6)*
	KKKL2123	WJ	Isyarat Dan Sistem *Signal and System*
	KKKL2152	WJ	Makmal Elektrik dan Elektronik II *Electrical and Electronics Laboratory I*
	KKKL2173	WJ	Elektronik Analog *Analogue Electronics*
	KKKQ2123	WF	Matematik Kejuruteraan III (Persamaan Kebezaan) *Engineering Mathematics III* *(Differential Equation)*
IV	LMCW2173	CW	Hubungan Etnik *Ethnic Relation*
	LMCK2922	CW	Kemahiran Insaniah *Soft Skills*
	KKKL2121	WJ	Makmal Elektronik Digit *Digital Electronics Laboratory*
	KKKL2133	WJ	Medan dan Gelombang Elektromagnet *Electromagnetic Fields and Waves*
	KKKL2163	WJ	Elektronik Digit *Digital Electronics*
	KKKL2183	WJ	Teori Komunikasi *Communication Theory*
	KKKL2XX3	WF	Pembelajaran Mesin Menggunakan Python *Machine Learning with Python*

V	KKKF3283	C1	Etika Kejuruteraan dan Perkembangan Teknologi *Engineering Ethics and Technology Development*
	KKKL3113	WJ	Pengukuran dan Instrumentasi *Measurements and Instrumentation*
	KKKL3294	WJ	Mikropemproses dan Mikrokomputer *Microprocessor and Microcomputer*
	KKKQ3123	C3	Statistik dan Pengiraan Berangka *Statistics and Numerical Method*
	Kursus Elektif Pengkhususan (Pilih SATU sahaja) ***Specialization Elective Courses (choose ONE only)***		
	KKKT3243	P	Peranti Komunikasi *Communication Devices*
	KKKT3253	P	Mikroelektronik *Microelectronics*
VI	KKKF3103	WF	Pengurusan Projek *Project Management*
	KKKL3162	WJ	Makmal Elektrik dan Elektronik III *Electrical and Electronics Laboratory III*
	KKKL3184	WJ	Pemprosesan Isyarat Digit *Digital Signal Processing*
	KKKL3213	WJ	Sistem Kawalan dan Kuasa *Control and Power Systems*
	KKKL3234	WJ	Rekabentuk Sistem *System Design*
	Kursus Elektif Pengkhususan(Pilih SATU sahaja) ***Specialization Elective Courses (choose ONE only)***		
	KKKT3263	P	Komunikasi Digit *Digital Communication*
	KKKT3273	P	Teknologi Pembuatan Litar Bersepadu *Integrated Circuit Manufacturing Technology*
Intersesi	KKKF3066	WF	Latihan Industri *Industrial Training*

VII	LMCE3051 LMCE3061 LMCE3071	C2	*Let's Get Talking (MUET Band 1 & 2)* *Corporate Storytelling (MUET Band 3)* *Professional Communication (MUET Band 4)*
	KKKT4053	WJ	Organisasi dan Senibina Sistem Komputer *Computer System Architecture and Organization*
	KKKT4162	WJ	Projek Ilmiah I *Project I*
	Kursus Elektif Pengkhususan (Pilih DUA sahaja) *Specialization Elective Courses (choose TWO only)*		
	KKKT4133	P	Komunikasi Data dan Rangkaian Komputer *Data Communications and Computer Network*
	KKKT4143	P	Rekabentuk VLSI *VLSI Design*
	KKKT4153	P	Kejuruteraan Elektromagnet *Electromagnetic Engineering*
	KKKT4163	P	Teknologi Fotonik *Photonics Technology*
	Kursus Elektif (Pilih SATU sahaja) *Elective Courses (choose ONE only)*		
	KKKT4193	P	Komunikasi Radio dan Satelit *Radio and Satellite Communication*
	KKKT4203	P	Rangkaian Telekomunikasi *Telecommunication Networks*
	KKKT4213	P	Kejuruteraan Perisian *Software Engineering*
	KKKT4223	P	Keboleharapan dan Pencirian Litar Bersepadu *Reliability and Characterization of Integrated Circuit*
	KKKT4273	P	Teknologi Laser *Laser Technology*

VIII	KKKL4124	C4	Ekonomi Kejuruteraan Dan Perakaunan Kos *Engineering Economics and Cost Accounting*
	KKKT4113	WJ	Sistem Multimedia *Multimedia Systems*
	KKKT4164	WJ	Projek Ilmiah II *Project II*
	Kursus Elektif Pengkhususan(Pilih SATU sahaja) ***Specialization Elective Courses (choose ONE only)***		
	KKKT4173	P	Rangkaian dan Keselamatan *Network and Security*
	KKKT4183	P	Teknologi Peranti Termaju *Advanced Devices Technology*
	Kursus Elektif (Pilih SATU sahaja) ***Elective Courses (choose ONE only)***		
	KKKT4243	P	Sistem Komunikasi Optik *Optical Communication Systems*
	KKKT4253	P	Antena dan Litar Berfrekuensi Tinggi *Antenna and High Frequency Circuits*
	KKKT4263	P	Sistem Pengoperasian *Operating Systems*
	KKKT4233	P	Optoelektronik *Optoelectronic*
	KKKT4283	P	Rekabentuk Litar Analog CMOS *CMOS Analog IC Design*
	KKKT4293	P	Pengenalan Teknologi MEMS *Introduction to MEMs Technology*

Kategori/Category
- WU - Kursus Wajib Universiti/ *University Courses*
- WF - Kursus Wajib Fakulti / *Faculty Courses*
- WJ - Kursus Wajib Jabatan / *Department Courses*
- P - Kursus Pilihan / *Elective Courses*
- CK - Kursus CITRA Kompetensi / *CITRA Competency Course*
- CW - Kursus CITRA Wajib / *CITRA Compulsory Course*
- C1-C6 - Kursus CITRA Rentas / *CITRA General Education*

Silibus Kursus
Courses Syllabus

KKKL1103   CAD/ CAE
**   *CAD/ CAE***

Kursus ini meliputi kefahaman teori mengenai komputer grafik, penggunaan perisian berasaskan CAD/CAE dan keperluan perkakasan terhadap perisian tersebut. Komputer grafik dan permodelan akan meliputi teknik permodelan 2D dan 3D bermula dengan kerangka dawai sehingga permodelan padu. Selain itu, pelajar juga akan diketengahkan kepada perisian permodelan dan simulasi kejuruteraan elektrik dan elektronik.

This course covers the theoretical understanding of computer graphics, software, CAD/CAE based software and hardware requirements for the software. Computer graphics and modeling will include 2D and 3D modeling techniques starting with wire frame to solid modeling. In addition, students will also be featured on the software modeling and simulation of electrical and electronics engineering.

Pra-Keperluan (jika ada):   Tiada
Pre-Requisite (if any):   None

Bacaan Asas:
References:

Omura, G. 2016. Mastering AutoCAD 2016 and AutoCAD LT. *1st Edition. Sybex.*
Ramirez, A., Schmidt, J. & Smith, D. 2015. *Technical Drawing 101 with AutoCAD. SDC Publications.*
Boylestad, R. 2015. *Introductory Circuit Analysis. 13th Edition. Pearson.*
Boylestad, R. & Nashelsky, L. 2014. *Electronic Devices and Circuit Theory. 11th Edition. Pearson New International Edition* (versi terkini).
Bertoline, G., Wiebe, E., Hartman, N. & Ross, W. 2010. *Fundamentals of Graphics Communication. 6th Edition. McGraw-Hill* (versi terkini).
Mitzner, K. 2009. *Complete PCB Design using OrCAD Capture and PCB. Newnes* (versi terkini).

Hasil Pembelajaran
Course Outcomes

Bil No. Course Outcomes (CO)	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Kebolehan untuk menyusun konsep dan kaedah rekabentuk keperluan perisian dan perkakasan bagi sistem CAD/CAE. *Ability to organise the concept and design of software and hardware requirements for the CAD/CAE.*
2	Kebolehan untuk menyelesaikan masalah melalui pengiraan kejuruteraan mengenai Perihalan Geometri bagi 2D dan 3D dengan membuat latihan. *Ability to solve problems through engineering calculations on description of 2D and 3D geometry by doing practices.*
3	Kebolehan untuk mengaplikasi perisian CAD/CAE bagi merekabentuk litar elektrik dan elektronik. *Ability to apply the CAD/CAE software to design electrical and electronic circuit.*
4	Kebolehan untuk membincang dan membentang projek kejuruteraan yang berkaitan dengan bidang CAD/CAE dan membentangkannya secara individu dan berkumpulan. *Ability to discuss and present engineering projects related to the field of CAD/CAE and present them individually and in a group.*

KKKL1113   Teori Litar I
Circuit Theory I

Kursus ini memperkenalkan kepada pelajar konsep utama dan ciri-ciri asas elemen litar iaitu cas, arus, voltan, kuasa dan tenaga. Kursus ini juga menerangkan kepada pelajar mengenai topologi rangkaian, pembolehubah tak bergantung, analisis Nodal dan Mesh, teorem-teorem litar iaitu teorem Superposisi, Thevenin dan Norton serta konsep kelinearan. Ini diikuti dengan pengenalan kepada pemuat dan pearuh beserta analisis litar RL dan RC berdasarkan sumber DC.

This course will introduce to the students the main concept and basic circuit element i.e charge, current, voltage power and energy characteristics. This course will also explain to the students the network topology, independent variables, Nodal and Mesh analysis and other circuit theorems such as Superposition, Thevenin and Norton as well as linearity. This will be followed by introduction to capacitance and inductance as well as its RL and RC circuit analysis based on DC.

Pra-Keperluan (*jika ada*):   Tiada
***Pre-Requisite (if any)*:**   *None*

Bacaan Asas:
*References***:**

Alexander, C.K. & Sadiku, M.N.O. 2016. *Fundamentals of Electric Circuit. 6th Edition. New York: McGraw Hill.*

Rizzoni, G. & Kearns, J. 2016. *Principles and Applications of Electrical Engineering. 6th Edition. New York: McGraw Hill.*

Irwin, J.D. & Nelms, R.M. 2015. *Basic Engineering Circuit Analysis. 11th Edition. New York: John Wiley & Sons.*

Nilsson, J.W. & Riedel, S.A. 2019. *Electric Circuits. 11th Edition. New Jersey: Prentice Hall.*

Hyat, W.H., Kemmerly, J.E., Philips, J.D. & Durbin, S.M. 2019. *Engineering Circuit Analysis. 9th Edition. New York: McGraw Hill.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus/ *Course Outcomes (CO)*
1	Berkebolehan untuk memperihal konsep dan meringkaskan litar asas menggunakan teorem-teorem litar. *CO1 Ability to describe concept and simplify basic circuits using circuit theorems.*
2	Berkebolehan untuk menyelesaikan masalah litar DC/RLC menggunakan analisis teorem litar. *Ability to solve DC/RLC circuit problem using circuit theorems analysis.*
3	Berkebolehan untuk menerangkan konsep litar RLC. *Ability to explain RLC circuit concepts.*
4	Berkebolehan untuk mengenalpasti peralatan makmal dan mengukur parameter isyarat dan parameter litar. *Ability to identify lab equipment and measure signal and circuit parameters.*

KKKL1123 Teori Litar II
Circuit Theory II

Kursus ini adalah kesinambungan daripada kursus Teori Litar I. Ia memperkenalkan kepada pelajar mengenai teori asas dan konsep matematik bagi menganalisa litar AC. Kursus ini turut menerangkan kepada pelajar mengenai sistem kuasa sefasa dan tiga-fasa, serta pengubah. Teknik jelmaan Laplace; teorem nilai awal dan akhir; fungsi pindah; lohong dan sifar; sambutan frekuensi dan gambarajah Bode akan diaplikasikan dalam analisa litar analog dalam domain frekuensi. Rangkaian dua-pangkalan diperkenalkan kepada pelajar di akhir kursus ini.

This course is the continuation of Circuit Theory I. In this course, students will be introduced to basic theories and mathematical concepts to analyze AC circuits. Course contents will cover single-phase and 3-phase power systems; as well as transformers. Laplace transform; Initial- and Final Value Theorem; transfer functions; poles and zeros; frequency response and Bode plot will be applied in the analysis of analog circuits in frequency domain. At the end of the course, two-port networks will be introduced.

Pra-Keperluan (*jika ada*):
KKKL1113   Teori Litar I

Pre-requisite (if any):
KKKL1113   Circuit Theory I

Bacaan Asas:
References:

Alexander, C.K. & Sadiku, M.N.O. 2016. *Fundamentals of Electric Circuit. 6th Edition. New York: McGraw Hill.*
Rizzoni, G. & Kearns, J. 2016. *Principles and Applications of Electrical Engineering. 6th Edition. New York: McGraw Hill.*
Irwin, J.D. & Nelms, R.M. 2015. *Basic Engineering Circuit Analysis. 11th Edition. New York: John Wiley & Sons.*
Nilsson, J.W. & Riedel, S.A. 2019. *Electric Circuits. 11th Edition. New Jersey: Prentice Hall.*
Hyat, W.H., Kemmerly, J.E., Philips, J.D. & Durbin, S.M. 2019. *Engineering Circuit Analysis. 9th Edition. New York: McGraw Hill.*

Hasil Pembelajaran:
Course Outcomes:

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menyelesaikan masalah litar AC menggunakan teknik analisis fasor dan dan fungsi pindah dalam satah s dalam gambarajah Bode. *Ability to solve AC circuit problem using phasor analysis and transfer function in s-domain for Bode Plot.*
2	Berkebolehan untuk menganalisis litar gandaan teraruh dan menyelesaikan litar AC menggunakan Jelmaan Laplace. *Ability to analyse magnetically coupled circuits and solve AC circuit using Laplace Transform.*

3	Berkebolehan untuk menerangkan konsep poli-fasa, Jelmaan Laplace dan rangkaian dua pangkalan dalam menyelesaikan masalah litar. *Ability to explain poly-phase concept, Laplace Transform and two port network in solving circuit problem.*
4	Berkebolehan untuk membina litar menggunakan teknik analisis frekuensi. *Ability to construct circuits using frequency analysis technique.*

KKKL1133   Fizik Untuk Jurutera
Physics for Engineers

Matlamat kursus ini ialah untuk memperkenalkan pelajar kepada konsep asas hukum fizik yang boleh diaplikasikan dalam bidang kejuruteraan. Topik-topik meliputi sains bahan, asas mekanik gunaan, termodinamik dan proses pemindahan haba. Dalam sains bahan, pelajar-pelajar akan didedahkan dengan pengklasifikasian bahan, teori model dan tenaga atom, daya-daya yang mengikat atom, ion dan molekul, struktur bahan hablur dan tidak hablur, dan sifat-sifat mekanik bahan. Asas mekanik gunaan pula akan meliputi tajuk-tajuk seperti daya, vektor, komponen segiempat daya, keseimbangan dalam dua dan tiga dimensi dan beberapa jenis analisis daya. Dalam termodinamik, pelajar akan mempelajari konsep haba kerja dan sistem, keadaan bendalir kerja, hukum pertama termodinamik (keabadian tenaga, persamaan tak alir), hukum kedua termodinamik (enjin haba, entropi). Dalam proses pemindahan haba, ia merangkumi prinsip dan pengiraan asas pemindahan haba melalui konduksi, perolakan dan radiasi. Selain itu, peralatan pertukaran haba seperti penukar haba, relau dan penyejat, kesan tunggal dan kesan berganda akan turut diperkenalkan.

The objective of the course is to introduce the basic concepts of Physics to the engineering students. The topics include material science, basic applied mechanics, thermodynamics and heat transfer process. In material science, students will be exposed to the classifications of material, model theory, and atomic energy, atomic binding energy, ions and molecules, crystalline and non-crystalline structure and mechanic of material properties. Basic applied mechanics covers force, vectors, parallelogram of forces, balancing forces in two and three-dimension and types of force analysis. In thermodynamics, the students will learn the concepts of heat, work and system, state of working fluid, first law of thermodynamics (conservation of energy, non-flow equation), Second law of thermodynamics (heat engines, entropy). The topic also includes the principles and calculations of basic heat transfer through conduction, convection and radiation. The heat exchange equipment, such as heat exchanger, furnace and evaporator, single and multiple effects will also be introduced.

Pra-Keperluan (*jika ada*):   Tiada
Pre-Requisite (if any):   *None*

Bacaan Asas:
*References***:**

Callister, W. D. 2018. *Materials Science and Engineering: An Introduction. 10th Edition. New York: John Wiley* (versi terkini).
Grundmann, M. 2016. *The Physics of Semiconductors: An Introduction Including Nanophysics and Applications. 3rd Edition. Springer.*
Freedman, R.A. &Young, H.D. 2016. *University Physics with Modern Physics. 14th Edition. Pearson.*
Cutnell, J.D., Johnson, K.W., Young, D. & Stadler, S. 2015. *Introduction to Physics. 10th Edition. Wiley.*
Cengel, Y. A. 2007. *Introduction to Thermodynamics and Heat Transfer. 2nd Edition. New York: McGraw Hill.*
Serway, R.A., & Jewett, J.W. 2014. *Physics for Scientists and Engineers. 9th Edition. Cengage Learning.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan memperihalkan fungsi asas dan kegunaan sains bahan, mekanik gunaan, termodinamik dan proses pemindahan haba dalam bidang kejuruteraan. *Ability to define the general function and material science application, applied mechanics, thermodynamics and heat transfer in engineering.*
2	Berkebolehan menerangkan istilah, konsep dan prinsip-prinsip asas dalam sains bahan, mekanik gunaan, termodinamik dan proses pemindahan haba dan hubungan timbal balik setiap topik yang dipelajari. *Ability to explain terms, concepts and main principles in applied mechanics, thermodynamics, and heat transfer and reciprocity relationship for each taught topics.*
3	*B*erkebolehan mengaplikasikan konsep dan hubungan kepada permasalahan kualitatif dan kuantitatif dalam sains bahan, mekanik gunaan, termodinamik dan proses pemindahan haba. *Ability to apply the concept and relationship of qualititative and quantitative in material science, applied mechanics, thermodynamics, and heat transfer process*
4	Berkebolehan menyiapkan penyelesaian pelbagai pengiraan masalah kejuruteraan dalam sains bahan, mekanik gunaan, termodinamik dan proses pemindahan haba. *Ability to complete the solutions to mathematical engineering problems in material science, applied mechanics, thermodynamics, and heat transfer process.*

KKKL1141   Makmal Elektrik dan Elektronik I
Electrical and Electronics Laboratory I

Kursus ini bermatlamat untuk membolehkan pelajar memahami dengan lebih mendalam konsep litar elektronik analog. Kursus makmal ini melibatkan aspek-aspek uji kaji litar elektronik analog yang merangkumi asas litar, litar Thevenin/Norton, pencirian diod, litar salunan sesiri dan selari, penuras pasif, dan jambatan Wheatstone. Di penghujung semester, pelajar berpeluang untuk mengaplikasi pengetahuan dan kemahiran teknikal mereka dalam ujikaji kotak hitam.

This course is aimed to enable the students to have in-depth understanding in analogue electronics circuit concepts. This laboratory course consists of experiments on basic analogue electronics circuits, Thevenin/Norton Circuits, diode characteristics, serial and parallel resonant circuits, passive filters, and wheatstone bridge. Towards the end of the semester, the students will be given the opportunity to apply their knowledge and technical competencies in a black box experiment.

Pra-Keperluan (*jika ada*):   Tiada
***Pre-Requisite (if any)*:**   *None*

Bacaan Asas*:*
References :

Manual Makmal Elektrik & Elektronik 1. 2017. Jabatan Kejuruteraan Elektrik, Elektronik & Sistem, Fak. Kejuruteraan dan Alam Bina, Universiti Kebangsaan Malaysia.
Alexander, C.K. & Sadiku, M.N.O. 2016. *Fundamentals of Electric Circuit. 6th Edition. New York: McGraw Hill.*
Rizzoni, G. & Kearns, J. 2016. *Principles and Applications of Electrical Engineering. 6th Edition. New York: McGraw Hill.*
Irwin, J.D. & Nelms, R.M. 2015. B*asic Engineering Circuit Analysis. 11th Edition. New York: John Wiley & Sons.*
Nilsson, J.W. & Riedel, S.A. 2014. Electric Circuits. 10th Edition. New Jersey: Prentice Hall.
Svoboda, J. & Dorf, R.C. 2013. *Introduction to Electric Circuits. 9th Edition. New York: McGraw Hill* (versi terkini).

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk mendemonstrasi ciri-ciri pelbagai litar yang berbeza, termasuk litar penuras pasif. *Ability to demonstrate the characteristics of different circuits including the different type of passive filters.*
2	Berkebolehan menerangkan pengetahuan asas dalam pemasangan litar dengan menggunakan komponen-komponen elektronik yang sesuai. *Ability to explain basic knowledge in circuit construction using suitable electronic components.*
3	Berkebolehan untuk mengaplikasi pengukuran litar salunan RLC. *Ability to apply RLC resonance circuit measurement.*
4	Berkebolehan untuk membina litar pengukuran jambatan Wheatstone dan mereka bentuk prosidur eksperimen kotak hitam *Ability to construct Wheatstone Bridge measurement circuit and design black box experiment procedure.*

KKKL1163   Bahasa Pengaturcaraan
Programming Language

Matlamat kursus ini adalah untuk memberi pengetahuan, pemahaman dan kemahiran kepada pelajar mengenai praktis pengaturcaraan komputer yang baik. Kursus ini merangkumi pengenalan kepada sistem komputer dan bahasa pengaturcaraan. Konsep dan elemen utama bahasa pengaturcaraan aras tinggi seperti pernyataan kawalan, fungsi, tatasusunan, struktur dan lain-lain akan didedahkan secara mendalam. Kursus ini menjadi asas kepada penggunaan bahasa pengaturcaraan dalam bidang kejuruteraan. Bahasa pengaturcaraan yang digunakan ialah bahasa C.

The objective of this course is to equip the student with knowledge, comprehension and ability to code based on good programming language practices. This course includes an introduction to computer systems as well as programming languages. The students are exposed to the main concepts and elements in high level programming that covers decision control, functions, arrays, structures and more. This course will be the foundation to programming language use in the field of engineering. The programming language that is used is the C language.

Pra-Keperluan (*jika ada*):   Tiada
***Pre-Requisite (if any)*:**   *None*

Bacaan Asas:
References :

Deitel, H. M. & Deitel P. J. 2015. C: *How to Program. 8th Edition. Prentice-Hall.*
Printz, P. & Crawford, T. 2015. *C in a Nutshell: The Definitive Reference. 2nd Edition. O' Reilly.*
Gustedt, J. 2019. Modern C. *Manning Publications.*
Jeri, R. H. & Elliot, B. K. 2015. *Problem Solving and Program Design in C. 8th Edition. Prentice-Hall.*
Shaw, Z. A. 2015. *Learn C the Hard Way. Addison-Wesley.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk memperihalkan konsep utama dalam bahasa pengaturcaraan. *Ability to describe key concepts in programming languages.*
2	Berkebolehan menyelesaikan masalah kejuruteraan dengan kaedah pengaturcaraan komputer. *Ability to solve engineering problems with computer programming methods.*
3	Berkebolehan membina aplikasi pengaturcaraan yang mesra pengguna. *Capable to construct a user-friendly application-based programming*
4	Berkebolehan bekerja dalam satu kumpulan untuk membangunkan satu program untuk aplikasi kejuruteraan dunia sebenar. *Ability to work in a team to develop a program for real-world engineering applications.*

KKKL2121   Makmal Elektronik Digit/
Digital Electronics Laboratory

Kursus makmal ini mendedahkan pelajar kepada implementasi get-get logik dalam unsur-unsur logik gabungan dan asas jujukan. Penggunaan get dalam penjanaan persamaan output dan jadual kebenaran bagi tujuan realisasi dengan menggunakan kaedah peminimuman rekabentuk dan kos juga diberikan penekanan. Pelajar juga didedahkan kepada jujukan dalam sistem flip flop dan penyelesaian masalah melalui rekabentuk mesin keadaan dan implementasinya dalam flip flop. Pelajar juga didedahkan kepada pengaturcaraan Verilog dan menggunakannya untuk rekabentuk mesin keadaan. Pelajar juga perlu membentangkan projek.

This laboratory-based course exposes students to logical gate implementation in the elements of combinational logic and sequential logic. Usage of gates in generating output equations and truth tables for equation realisation are covered, with the importance for minimizing design through reducing gates and

cost. Students are also exposed to sequential flip-flop system and problem solving using state machine and implementing it in flip-flops. In addition, students are taught on the Verilog programming language, using it to design state machines. In the end, students will be given a project to assess their lab skills.

Pra-Keperluan (*jika ada*):   Tiada
***Pre-Requisite (if any)*:**   *None*

Bacaan Asas:
***References*:**

Floyd, T. 2015. *Digital Fundamentals, Global Edition. 11th Edition. Pearson International.*
Mano, M.M., Kime, C.R., & Martin, T., 2016. *Logic and Computer Design Fundamentals. Pearson International.*
Vaibbhav, T. 2016. *Digital Logic Design Using Verilog: Coding and RTL Sythesis. Springer.*
Ming-bo, L. 2016. *An Introduction to Verilog HDL.; 1st Edition, CreateSpace Independent Publishing Platform.*
Roth, C.H. & Kinney, L. 2014. *Fundamentals of Logic Designs. 7th edition. Mn: West Publishing Co.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	*Berkebolehan untuk menganalisis dan mengubahsuai litar kombinasi untuk menyelesaikan persamaan logik.* *Ability to analyse and rearrange a combinational circuit to solve logical equation.*
2	Berkebolehan untuk mengenalpasti prinsip asas flip flop, rangkaian jujukan dan aplikasi. *Ability to identify the basic principles of flip-flops, sequential networks and its applications.*
3	Berkebolehan untuk menerangkan mesin keadaan, serta menyelesaikan dengan mengurangkan bilangan keadaan. *Ability to explain state machines and solving it using minimal states.*
4	Berkebolehan untuk mendefinasikan prinsip asas flip flop, rangkaian jujukan dan aplikasi *Ability to define the basic principles of flip-flops, sequential networks and its applications*
5	Berkebolehan untuk membina bahasa aturcara verilog untuk litar logik dan mengaplikasikannya pada papan litar FPGA. *Ability to construct the Verilog programming language for logical circuits and applying it on the FPGA board.*

KKKL2123 Isyarat dan Sistem
Signals and Systems

Kursus ini bertujuan untuk memberi pengetahuan asas tentang kaedah matematik untuk menganalisa isyarat dan sistem lelurus dalam domain masa dan domain frekuensi. Tajuk-tajuk yang terkandung dalam kursus ini ialah konsep isyarat dan sistem, sistem linear masa-tak-berubah (LTI), siri Fourier, jelmaan Fourier, teori pensampelan, jelmaan Laplace, sambutan frekuensi dan penuras analog.

This course aims to give basic knowledge of mathematical methods to analyze signals and the linear systems in time domain and frequency domain. Topics included in this course are the concept of signals and systems, linear time-invariant system (LTI), Fourier series, Fourier transform, sampling theorem, Laplace transform, frequency response and analog filters.

Pra-Keperluan (*jika ada*):
KKKL1113 Teori Litar I

Pre-requisite (if any):
KKKL1113 Circuit Theory I

Bacaan Asas:
References :

Lathi, B.P. 2017. *Principles of Linear Systems and Signals. 2nd Edition. New York: Oxford University Press.*

Oppenheim, A.V., Willsky, A.S. & Nawab, S.H. 2015. *Signals and Systems. 2nd Edition. Pearson.*

Roberts, M.J. 2017. *Signals and Systems: Analysis using Transform Methods and MATLAB. 3rd Edition. McGraw-Hill.*

Chaparro, L. & Akan, A. 2018. *Signals and Systems using MATLAB. 3rd Edition. Academic Press.*

Alkin, O. 2016. S*ignals and Systems: A MATLAB Integrated Approach. 1st Edition. CRC Press.*

Hasil Pembelajaran/
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan menyelesaikan permasalahan isyarat masa selanjar dan sistem linear masa tak berubah. *Ability to solve problems related to continuous-time signals and linear time-invariant (LTI) systems.*

2	Berkebolehan melakukan manipulasi ke atas siri Fourier dan jelmaan Fourier. *Ability to manipulate Fourier series and Fourier transform.*
3	Berkebolehan mempraktikkan jelmaan Laplace. *Ability to practice Laplace transform*
4	Berkebolehan menggunakan penuras analog dalam permasalahan sambutan frekuensi. *Ability to use analog filters to solve problems related to frequency response.*

KKKL2133   Medan dan Gelombang Elektromagnet
Electromagnetic Fields and Waves

Kursus ini adalah salah satu asas kepada kejuruteraan elektrik dan elektronik yang memperkenalkan konsep medan elektrik dan magnetik statik di dalam aplikasi kejuruteraan elektrik. Matlamatnya ialah supaya para pelajar dapat memahami dan mengaplikasikan ilmu pengetahuan medan dan gelombang elektromagnet di dalam kejuruteraan. Bermula dengan topik analisa skalar dan vektor dalam tiga sistem kordinat berlainan iaitu Cartesian, silinder dan sfera, seterusnya kursus ini membincangkan: ciri-ciri dan sifat elektrik statik dan magnetik statik serta persamaan-persamaan berkaitan; hukum-hukum asas dalam elektromagnet statik; Keupayaan elektrik dan magnet; Jenis-jenis dan syarat-syarat sempadan medan; Kemuatan dan Kearuhan; Persamaan Maxwell.

This course is one of the fundamental courses in electrical and electronic engineering which will introduce the concept of electromagnetic wave and magneto static in electrical engineering applications. The aim of is this subject for students to understand the basic theory and apply their knowledge of electromagnetic wave and field. The course starts with the topic of scalar and vector analysis in three different fields, which are Cartesian, Cylindrical and Spherical. Then, it follows with: Electrostatic and magneto static characteristics and related equations; Electric and magnetic potentials; types and boundary conditions; insulator and impedance in medium; Maxwell's Equation.

Pra-Keperluan (*jika ada*):
KKKQ1123   Matematik KejuruteraanI (KalkulusVektor)

Pre-requisite (if any):
KKKQ1123   *Engineering Mathematics I (Calculus)*

Bacaan Asas:
References:

Sadiku, M.N.O. 2018. *Elements of Electromagnetics. 7th Edition. Oxford University Press.*

Hayt, W. 2018. *Engineering Electromagnetics. 9th Edition. McGraw-Hill.*

Jin Jian-Ming. 2018. *Theory and Computation of Electromagnetic Fields. Wiley-IEEE*

Inan, U.S., Inan, A. & Said, R. 2014. *Engineering Electromagnetics and Waves. 2nd Edition. Prentice Hall.*

Ulaby, F.T. 2014. *Fundamentals of Applied Electromagnetics. 7th Edition. Prentice Hall International.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan menerangkan konsep algebra dan kalkulus vektor, pembezaan dan pengkamiran dalam tiga sistem koordinat, dan konsep-konsep asas medan elektromagnet statik. *Ability to describe the concept of vector algebra and calculus, differentiation, and integration in three coordinate systems, and basic concept of static electromagnetic field.*
2	Berkebolehan menganalisa masalah-masalah kejuruteraan menggunakan hukum-hukum dan konsep-konsep elektromagnetstatik . *Capable of analysing engineering problems by implementing laws and concept of static electromagnetic.*
3	Berkebolehan menentukan dan menerangkan kesan aplikasi gelombang elektromagnet terhadap kelestarian alam, dan berpegang kepada tanggungjawab awam sebagai jurutera. *Ability to identify and explain the effect of electromagnetic waves applications towards sustainability, and to adhere to the responsibility as an engineer.*
4	Berkebolehan untuk membina eksperimen di makmal bagi membuktikan konsep asas medan elektromagnet statik. *Ability to construct lab experiment to prove basic static electromagnetic field concept.*

KKKL2152   Makmal Elektrik dan Elektronik II
Electrical and Electronics Laboratory II

Kursus makmal ini ditawarkan pada Semester 1, untuk pelajar tahun 2. Makmal ini terbahagi kepada lapan ujikaji, satu projek berkumpulan serta peperiksaan pertengahan semester dan projek akhir. Eksperimen-eksperimen ini akan memberi pendedahan kepada pelajar dalam bidang elektronik analog, instrumentasi dan pengukuran, serta dalam bidang elektromagnet. Bagi projek pelajar, ianya merangkumi topik-topik berkaitan dengan instrumentasi dan elektronik analog seperti penguat, sensor dan sebagainya.

This laboratory-based course is offered for the second year students in Semester 1. The laboratory session can be divided into eight experiments, one group project, mid-semester examination and final project. These experiments will give

exposure to the students to the field of analogue electronics, instrumentation and measurement and electromagnetic field. The student project covers topics related to the electronic instrumentation and analogue devices such as amplifiers, sensors and many other topics, which are covered throughout the course.

Pra-Keperluan (*jika ada*):   Tiada
***Pre-Requisite (if any)*:**   *None*

Bacaan Asas:
References:

Boylestead, R. L. & Nashelsky, L. 2013. *Electronic Devices and Circuit Theory. 11th Edition. Pearson (versi terkini).*

Irwin, J.D. & Nelms, R.M. 2015. *Basic Engineering Circuit Analysis. 11th Edition. New York: John Wiley & Sons.*

Horowitz, P. & Hill, W. 2015. *The Art of Electronics. 3rd Edition. Cambridge University Press.*

Alexander, C.K. & Sadiku, M.N.O. 2016. *Fundamentals of Electric Circuit. 6th Edition. New York: McGraw Hill.*

Rizzoni, G. & Kearns, J. 2016. *Principles and Applications of Electrical Engineering. 6th Edition. New York: McGraw Hill.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menganalisa teori litar menerusi eksperimen. *Ability to analyse circuit theory through experimental works.*
2	Berkebolehan menganalisa penguat menggunakan peranti aktif seperti penguat kendalian atau transistor (BJT/FET). *Ability to analyse amplifier using active devices such as operational amplifier or transistor (BJT/FET).*
3	Berkebolehan menggunakan peranti aktif untuk aplikasi sebagai penuras aktif atau sistem fungsi pindah. *Ability to use active devices for the application of an active filter or a transfer function system.*
4	Berkebolehan untuk membina eksperimen yang berkaitan menggunakan teknik yang betul. *Ability to construct relevant experiments using appropriate techniques.*

KKKL2163   Elektronik Digit
        Digital Electronics

Kursus ini mendedahkan pelajar kepada sistem nombor dan kod, unsur-unsur litar logik gabungan dan asas jujukan. Penjanaan persamaan keluaran dan jadual kebenaran bagi tujuan realisasi dengan menggunakan kaedah pengurangan re-kabentuk, dimana kos juga akan diberikan penekanan. Pelajar juga akan dide-dahkan kepada jujukan dalam flip–flop dan teknik penyelesaian masalah melalui rekabentuk Mesin Mealy dan Mesin Moore dan implementasinya menggunakan flip–flop. Pelajar juga akan didedahkan kepada pengaturcaraan VerilogHDL dan mengunakannya untuk merekabentuk mesin keadaan.

In this course, the students are exposed to code and numerical system, combi-national logic elements and sequential basics. Output equation generation and truth table that are used for realization purpose using design minimization tech-nique and cost are also emphasized. Students are also exposed to sequences in flip-flop systems and problem solving teachniques through Mealy and Moore machine designs and their implementation using flip-flops. In addition, exposure on VerilogHDL programming and its use for state machine design are also put into emphasis.

Pra-Keperluan (*jika ada*):   Tiada
***Pre-Requisite (if any)*:**   *None*

Bacaan Asas:
References:

Anand Kumar, A. A. 2016. *Fundamentals of Digital Circuits, 4th edition. PHI Learning Private Limited.*

Floyd, T. 2015. *Digital Fundamentals, Global Edition. 11th Edition. Pearson International.*

Mano, M.M.R., Kime, C.R. & Martin, T. 2016. *Logic & Computer Design Fundamentals.   5th   Edition.   Pearson   International.*

Roth, C.H. & Kinney, L. 2014. *Fundamentals of Logic Designs 7th Edition. Mn: West Publishing Co.*

Brown, S. & Vranesic, Z. G. 2013. *Fundamentals of Digital Logic with VHDL Design.   4th   edition.   McGraw   Hill   Higher   Education.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menerangkan kaedah penyelesaian masalah berkaitan konsep asas dalam sistem nombor, litar berkombinasi dan litar berjujukan menggunakan kaedah konvensional dan HDL. *Able to explain the problem solving methods in fundamental concepts of number systems, combinational circuits, sequential circuits using conventional and HDL techniques.*
2	Berkebolehan untuk menganalisis masalah berkaitan litar berkombinasi dan litar berjujukan termasuk mesin keadaan menggunakan formulasi dan kemahiran analitikal. *Able to analyse problems relating to combinational circuits and sequential circuits including state machines using analytical skill and formulation.*
3	Berkebolehan untuk mengaitkan impak penyelesaian masalah kejuruteraan dalam rekabentuk litar logik dalam konteks masyarakat dan alam sekitar. *Able to relate the impact of engineering solutions in logic circuits designs in societal and environmental context.*
4	Berkebolehan untuk menyampaikan idea dan cadangan dalam penyelesaian masalah kejuruteraan kompleks dalam rekabentuk litar logik secara efektif. *Able to explain effectively ideas and propose design solutions for complex engineering problems in digital logic circuits.*

KKKL2173   Elektronik Analog
Analogue Electronics

Matlamat kursus ini ialah untuk memberikan pengetahuan, kefahamam dan sintesis dalam bidang elektronik analog. Kursus dimulakan dengan pengenalan kepada peranti peranti asas analog iaitu diod, transistor BJT, dan transistor MOS. Kefahaman tentang ciri-ciri diod, BJT dan MOS yang menjadi asas kepada pemahaman rekabentuk suatu litar elektronik akan ditekankan. Teknik-teknik pincangan dan analisa arus ulang alik juga akan diberikan secara kuantitatif. Sambutan frekuensi, kesan hingar dan kestabilan litar akan dibincangkan. Pelajar akan didedahkan kepada pelbagai jenis amplifier dan pengoperasiannya. Kegunaan amplifier operasian lelurus dan tak lelurus akan diberikan secara mendalam. Litar-litar elektronik yang lebih kompleks akan dianalisa dan kesan suap balik dan frekuensi terhadap litar akan dikaji. Penggunaan perisian simulasi litar elektronik untuk memodelkan litar-litar elektronik juga diperkenalkan.

The aim of this course is to impart knowledge, understanding and synthesis of the analogue electronic circuits. The course begins with an introduction to the basic analogue devices, such as BJT and MOS transistor. Understanding on the fundamental characteristics of the diode, BJT and MOS design will be emphasized at the later part of the course. Technical analysis and current biasing shuttle technique will also be given quantitatively. Frequency response,

noise effects and the stability of the circuit will also be discussed. Students will be exposed to various types of amplifier and its operation. Linear and non-linear operational amplifiers (op-amp) will be given in deta The aim of this course is to impart knowledge, understanding and synthesis of the analogue electronic circuits. The course begins with an introduction to the basic analogue devices, such as BJT and MOS transistor. Understanding on the fundamental characteristics of the diode, BJT and MOS design will be emphasized at the later part of the course. Technical analysis and current biasing shuttle technique will also be given quantitatively. Frequency response, noise effects and the stability of the circuit will also be discussed. Students will be exposed to various types of amplifier and its operation. Linear and non-linear operational amplifiers (op-amp) will be given in detail. More complex electronic circuits will be analyzed, where the effect of feedback and frequency will be further studied. The use of the electronic circuit simulation software to model the electronic circuits will also be introduced.il. More complex electronic circuits will be analyzed, where the effect of feedback and frequency will be further studied. The use of the electronic circuit simulation software to model the electronic circuits will also be introduced.

Pra-Keperluan (*jika ada*):
KKKL1113   Teori Litar I

Pre-Requisite (if any):
KKKL1113   Circuit Theory I

Bacaan Asas:
References:

Thomas   L.   Floyd.   2018.   *Electronic   Devices (Conventional Current Version). 10th Edition. Pearson.*
Safa O. Kasap. 2018. *Principles of Electronic Materials and Devices. 4th Edition. McGraw-Hill.*
Paul Horowitz & Winfield Hill. 2015. *The Art of Electronics. 3rd Edition. Cambridge University Press.*
Boylestead, R. L. & Nashelsky, L. 2014. *Electronic Devices and Circuit Theory. 11th Edition. Essex: Pearson Education Limited.*
Neamen, D.A. 2010. *Microelectronics: Circuit Analysis and Design. 4th Edition. Mc-Graw Hill* (versi terkini).

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk membincangkan konsep, operasi dan kegunaan pelbagai jenis peranti semikonduktor dalam litar elektronik analog. *Able to discuss the concepts, operations and applications of various semiconductor devices in analogue electronic circuits.*
2	Berkebolehan menerangkan pelbagai jenis litar penguat menggunakan analisis DC dan AC. *Able to describe various types of amplifier circuit using DC and AC analyses.*
3	Berkebolehan menyelesaikan analisis sambutan frekuensi untuk litar penguat. *Able to solve frequency response analysis of amplifier circuits.*
4	Berkebolehan untuk menganalisa rekabentuk dan simulasi pelbagai jenis litar elektronik analog. *Able to analyse the design and simulation of a variety of analogue electronic circuits.*

KKKL2183   Teori Komunikasi
Communication Theory

Kursus ini merupakan kursus asas kepada teori komunikasi analog dan digit. Sistem modulasi analog dan digit diperkenalkan. Perbandingan sistem tersebut seperti pengunaan lebar jalur dan kesan hingar akan dilakukan. Dimulakan dengan pengenalan kepada komunikasi analog dan digit. Teori asas pemodulatan, perwakilan isyarat modulatan, kebaikan dan kelemahan modulatan, jenis pemodulat dan penyahmodulatan serta prestasi modulatan dalam keadaan hingar bagi sistem analog dan digit. Antara sistem analog yang dikaji ialah AM, FM dan PM sementara sistem digit yang dikaji ialah ASK, PSK, FSK, BPSK, QPSK, QAM. Kaedah penukaran isyarat analog ke digit seperti PCM, pengkuantuman dan pengkodan turut dibincangkan. Kursus ini disimpulkan dengan perbincangan aplikasi semasa teknologi komunikasi.

This is a basic course on analog and digital communication theory. Analogue and digital modulation systems are introduced. System comparisons will be carried out based on broadband and noise effects. The course starts with 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 conversion of analogue signal to digital such as PCM, quantization and coding. This course is concluded with discussions on current applications of communication technology.

Pra-Keperluan (jika ada):
KKKL2123   Isyarat dan Sistem

Pre-Requisite (if any):
KKKL2123   Circuit and System

Bacaan Asas:
References:

Lathi, B.P. & Zhi Ding. 2018. *Modern Digital and Analog Communication (The Oxford Series in Electrical and Computer Engineering). 5th Edition. Oxford University Press. Samuel O. A & Sadiku, M.N.O. 2017. Principles of Modern Communication Systems. Cambridge University Press.*
Frenzel, L. 2015. *Principles of Electronic Communication Systems (Engineering Technologies & the Trades). 4th Edition. McGraw-Hill.*
Couch, L. W. 2012. *Digital and Analog Communication Systems. 8th Edition. New Jersey: Prentice-Hall.*
Blake, R. 2012. *Electronic Communication Systems. 2nd Edition. Cengage Learning India Pvt. Ltd.* (versi terkini).

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menerangkan blok asas sistem komunikasi. *Able to describe basic blocks of communication system.*
2	Berkebolehan untuk mengaplikasi teori pemodulatan analog dan digit dalam sistem komunikasi. *Able to apply analogue and digital modulation theory in communication system.*
3	Berkebolehan untuk menentukan kesan hingar terhadap prestasi sistem komunikasi analog dan digit. *Able to identify noise effect on communication system performance of both analogue and digital.*
4	Berkebolehan untuk menerangkan hubungkait teori komunikasi dengan memberi contoh aplikasi dunia sebenar. *Ability to describe the relations of communication theory through examples of real applications.*

KKKL3113 Pengukuran dan Instrumentasi
Measurements and Instrumentation

Kursus ini membincangkan aspek pengukuran seperti unit, simbol, piawai dan jenis-jenis-jenis ralat. Kursus ini juga menerangkan jenis-jenis instrumen-instrumen elektronik yang biasa digunakan dalam industri untuk pengukuran arus, voltan, rintangan, jarak, suhu, tekanan. Ini diikuti dengan pengenalan kepada litar penyesuaian dan penukaran analog-digital dan digital-analog.

This course discusses aspects of measurement such as unit, symbol, standard and types of error. Various electronics instrumentations commonly used in industry to measure current, voltage, resistance, displacement, temperature and pressure are also explained followed with introduction to matching circuit and analogue-digital and digital-analogue conversion circuits.

Pra-Keperluan (*jika ada*): Tiada
Pre-Requisite (if any) : *None*

Bacaan Asas:
References:

Morris, A.S. & Langari, R. 2016. *Measurement and Instrumentation: Theory and Application Academic. 2nd Edition. Academic Press.*
Figliola, R.S. & Beasley, D.E. 2015. *Theory and Design for Mechanical Measurements. 6th Edition. John Wiley & Sons, Inc.*
Bolton, W. 2015. *Instrumentation and Control Systems. 2nd Edition. Newnes-*
Bakshi, U.A. & Bakshi, A.V. 2014. *Electrical Measurements and Instrumentation. Technical Publications* (versi terkini).
Holman, J.P. 2011. *Experimental Methods for Engineers. 8th Edition. McGraw Hill* (versi terkini).
Bentley, J.P. 2005. *Principles of Measurement Systems. Prentice Hall* (versi terkini).

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menerangkan konsep asas system pengukuran. *Able to explain basic concept of measurement system.*

2	Mempunyai kebolehan untuk menerangkan dan mengenalpastikan ralat pengukuran dan spesifikasi instrumen. *Able to explain and identify measurement error and instrument specification.*
3	Berkebolehan untuk mengaplikasi dan memilih elemen utama sensor, konsep asas elemen litar penyesuaian dan pemprosesan isyarat dalam sistem pengukuran. *Able to apply and choose the key element of sensors, basic concept of signal conditioning and signal processing of a measurement system.*
4	Berkebolehan untuk merancangkan, merekabentuk dan mencadangkan suatu sistem pengukuran. *Able to plan, design and propose a measurement system.*

KKKL3123   Sistem Kawalan dan Kuasa
Control and Power System

Matlamat kursus adalah memberikan pengetahuan asas dan pemahaman tentang sistem kawalan dan kuasa. Topik-topik yang berkaitan dengan sistem kuasa termasuklah struktur sistem kuasa, penjanaan kuasa, penghantaran dan pengagihan kuasa, komponen-komponen sistem kuasa, dan konsep asas kuasa aktif, kuasa reaktif, kuasa ketara dan faktor kuasa. Sistem 3 fasa, sistem per unit, parameter talian penghantaran, pemodelan talian penghantaran pendek, sederhana dan panjang, pengalir, kabel dan penebatan. Penekanan yang sama turut diberikan terhadap topik-topik yang berkaitan dengan sistem kawalan; struktur kawalan suapbalik, model rangkap pindah, sambutan fana, analisis domain masa, analisis domain frekuensi, analisis kestabilan dan jenis-jenis pengawal.

The course aims to provide basic knowledge and comprehension on power and control systems. Topics related to power systems include power system structure, power generation, power transmission and distribution, components of power systems, and basic concept of active power, reactive power, apparent power and power factor. 3-phase system, per unit system, parameters of transmission line, modeling of short, medium and long transmission lines, conductors, cabels and insulations. Equal emphasis is given on control systems-related topics; feedback control structure, transfer function model, transient response, time-domain analysis, frequency-domain analysis, stability analysis and types of controllers.

Pra-Keperluan (jika ada):
KKKL1123   Teori Litar II

Pre-Requisite (if any):
KKKL1123   Circuit Theory II

Bacaan Asas:
References:

Dorf, R. C. and Bishop, R. H. 2017. *Modern Control System 13/e. Pearson Education.*
Glover, J. D., Sarma, M. S. and Overbye, T. J. 2017. *Power System Analysis and Design 6/e, Thompson Learning.*
Nise, S. N. 2015. *Control Systems Engineering 7/e. John Wiley & Sons Inc.*
Gopal, M. 2012, *Control Systems: Principle and Design. McGraw Hill*
Saadat, H. 2010. *Power System Analysis 3/e. McGraw Hill.*
Wildi, T. 2013. *Electrical Machines, Drives and Power Systems 6/e. Prentice Hall.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Kebolehan untuk menerangkan konsep asas sistem kawalan dan kebolehan untuk menerbitkan fungsi pindah. *Ability to explain basic control system concept and ability to generate transfer function.*
2	Berkebolehan untuk memformulasikan representasi domain masa dan frekuensi bagi sistem kawalan. *Ability to formulate time and frequency domain representation of control system.*
3	Berkebolehan untuk menerangkan penjanaan, penghantaran dan pengagihan kuasa. *Ability to explain power generation, transmission and distribution.*
4	Berkebolehan menganalisis talian penghantaran menggunakan teori tiga fasa dan sistem per unit. *Ability to analyze transmission lines using three phase theory and per unit system.*

KKKL3162   Makmal Elektrik dan Elektronik III
Electrical and Electronics Laboratory III

Kursus makmal ini masing-masing mengandungi empat ujikaji teras dan empat ujikaji elektif serta sebuah projek mini makmal. Ujikaji teras terdiri daripada pengawal logik boleh aturcara, rangkaian komputer, motor sangkar tupai dan simulasi penyongsang CMOS. Manakala ujikaji elektif disesuaikan mengikut program: kejuruteraan elektrik & elektronik (KZ) atau kejuruteraan elektronik (KT). Kursus ini dinilai berdasarkan kepada laporan makmal, peperiksaan bertulis dan demonstrasi projek mini.

This laboratory course contains four common experiments and four elective experiments as well as a mini laboratory project respectively. The common experiments are comprised of programmable logic controller (PLC), computer network, squirrel cage motor and CMOS inverter simulation. The elective

experiments are tailored to each program; electrical & electronics engineering (KZ) and electronics engineering (KT). This course is assessed based on laboratory reports, written examinations and mini project demonstration.

Pra-Keperluan (*jika ada*): Tiada
Pre-Requisite (if any): None

Bacaan Asas:
References:

Electric and Electronics Laboratory III Manual. 2017. Department of Electrical, Electronics and Systems Engineering, Faculty of Engineering, Universiti Kebangsaan Malaysia.

Roth, C. H. & Kinney L., 2013. Fundamentals of Logic Designs. 7th Edition. West Publishing Co.

Boylestead, R. L. & Nashelsky, L. 2015. Electronic Devices and Circuit Theory. 11th Edition. Essex: Pearson Education Limited.

Horowitz, P. & Hill, W. 2015. The Art of Electronics. 3rd Edition. Cambridge University Press.

Alexander, C. K. & Sadiku, M. N. O. 2013. Fundamentals of Electric Circuit. 5th Edition. McGraw Hill.

Wildi, T. 2013. Electrical Machines, Drives and Power Systems. 6th Edition. Pearson New International Edition.

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk melaksana dan mempraktikkan sistem kejuruteraan elektrik & elektronik asas melalui ujian makmal. *Ability to perform and practice basic system in electrical & electronics engineering in through lab measurements.*
2	Berkebolehan untuk mengadaptasi dan mengubah sistem bidang pengkhususan kejuruteraan elektrik & elektronik. *Ability to adapt and change a system in the specialized area in electrical & electronics engineering.*
3	Berkebolehan untuk membincangkan teori kejuruteraan elektrik & elektronik dalam bidang yang dikaji. *Ability to discuss theory in electrical & electronics engineering in the area of investigation.*
4	Berkebolehan untuk mempraktik dan melaksanakan projek makmal. *Ability to practice and perform a laboratory project.*

KKKL2xx3   Pembelajaran Mesin Menggunakan Python
**   *Machine Learning with Python***

Matlamat kursus ini ialah memberikan pengetahuan dan kefahaman mengenai algoritma pembelajaran mesin menggunakan perisian Python Kursus ini memperkenalkan beberapa kaedah pembelajaran mesin secara teori dan praktikal. Kursus ini terdiri daripada tiga komponen utama iatu asas-asas pengaturcaraan menggunakan Python, algoritma pembelajaran berpenyelia dan algoritma pembelajaran tanpa penyelia.

The aim of this course is to provide knowledge and understanding of machine learning algorithms using Python. This course introduces several machine learning methods through theoretical explanation and practical applications. This course consists of three main components, which are basic programming principles using Python, supervised learning algorithm and unsupervised learning algorithm.

Pra-Keperluan (jika ada): Tiada
Pre-Requisite (if any)   : None

Bacaan Asas:
References:

Deitel, H. M. & Deitel, P. J. 2019. *Intro to Python for Computer Science and Data Science. Prentice-Hall.*
Jones, M. 2015. *Pyhton for Complete Beginners: A Friendly Guide to Coding, No Experience Required. Createspace Independent Publishing.*
Kirk, M. 2017. *Thoughtful Machine Learning with Python: A Test Driven Approach. O'Reilly.*
Muller, A. C. & Guido, S. 2016. *Introduction to Machine Learning with Python: A Guide for Data Scientists. O'Reilly.*
Ramalho, L. 2015. *Fluent Python: Clear, Concise, and Effective Programming. O'Reilly.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berupaya menggunakan bahasa pengaturcaraan Python bagi aplikasi kejuruteraan. *Ability to use the Python programming language for engineering applications.*
2	Berkeupayaan membangunkan algoritma pembelajaran berpenyelia untuk aplikasi kejuruteraan. *Ability to develop supervised learning algorithm for engineering applications*
3	Berkeupayaan membangunkan algoritma pembelajaran tanpa penyelia untuk applikasi kejuruteraan. *Ability to construct unsupervised learning algorithm for engineering applications.*
4	Berkeupayaan menilai keberkesanan algoritma pembelajaran mesin. *Ability to evaluate the effectiveness of the machine learning algorithm.*

KKKL3184   Pemprosesan Isyarat Digital
Digital Signal Processing

Kursus ini merangkumi asas bagi teknik pemprosesan isyarat digital. Matlamat kursus ini adalah untuk membolehkan pelajar untuk menganalisis sistem diskret masa dalam domain masa dan frekuensi. Ia dimulakan dengan pengenalan kepada isyarat, ciri dan klasifikasi, teori pensampelan, penukar analog-ke-digital dan digital-ke-analog. Isyarat dan sistem diskret masa dianalisis dan diperihalkan dengan menggunakan persamaan pembeza dan gambarajah blok. Kaedah analisis termasuk menggunakan domain masa domain Z dan domain Fourier. Sistem masa tak-varian (LTI) dianalisis dan disintesis. Di akhir kursus, pelajar didedahkan dengan rekabentuk dan analisis bagi penuras sambutan denyut terhingga (FIR) dan sambutan denyut tak-terhingga (IIR).

This course covers the basis for digital signal processing techniques. The aim of this course is to enable students to analyze the discrete-time systems in time and frequency domains. It begins with an introduction to the signal, characteristics and classifications, sampling theory, analog-to-digital and digital-to-analog converters. Signals and discrete-time systems are analyzed and described by differential equations and block diagram. Analysis methods include using time domain, z-domain and Fourier domain. Linear time-invariant system (LTI) are analysed and synthesized. At the end of the course, students are exposed to the design and analysis of finite impulse response filter (FIR) and non-finite impulse response (IIR).

Pra-Keperluan (jika ada):
KKKL2123   Isyarat dan Sistem

Pre-Requisite (if any):
KKKL2123   Signal and System

Bacaan Asas:
References:

Oppenheim & Schafer. 2015. Digital Signal Processing. 1st Edition. Pearson Education.

Kumar. 2015. Digital Signal Processing. 2nd Edition. Prentice Hall India Learn ing Private Limited.

Ingle , V.K. & Proakis J.G. 2016. Digital Signal Processing Using MATLAB: A Problem Solving Companion, 4th Edition. Cengage Learning.

Jiang, L.T.J. 2018. Digital Signal Processing: Fundamentals and Applications. 3th Edition. Academic Press.

Mitra, S. 2011. Digital Signal Processing: A Computer-Based Approach. 4th Edition. New York: McGraw-Hill (versi terkini)

Proakis J. G. & Manolakis, D. K. 2006. Digital Signal Processing: Principles, Algorithms and Applications. 4th Edition. New Jersey: Pearson. (versi terkini).

Ambardar. 2012. Digital Signal Processing: A Modern Introduction. Cengage Learning (versi terkini).

Lyons R.G. & Fugal D.L. 2014. The Essential Guide to Digital Signal Processing (Essential Guide Series). Prentice Hall.

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan menganalisis isyarat diskret masa dari segi pensampelan, aliasing, pendigitalan, dan pengkuantuman. *Ability to analyse discrete time signals in terms of sampling, aliasing, digitization, and quantization.*
2	Berkebolehan menganalisis isyarat dan sistem diskret masa dalam domain masa dan domain frekuensi. *Able to analyse discrete time signals and systems in the time and frequency domains.*
3	Berkebolehan menganalisis penuras digital IIR dan FIR. *Ability to analyse the IIR and FIR digital filters.*
4	Berkebolehan membina program MATLAB untuk merekabentuk, menilai dan mensintesis isyarat dan juga system diskret masa. *Able to build MATLAB program to design, evaluate and synthesize the signal behaviour and discrete-time systems.*

KKKL3294   Mikropemproses dan Mikrokomputer
Microprocessor and Microcomputer

Kursus ini bermula dengan pengenalan kepada jenis-jenis mikroprosesor (4-bit hingga 16-bit) yang terdapat di pasaran. Mikroprosesor 16-bit keluaran Intel, iaitu Intel 8086 aka digunakan sebagai mikropemproses kajian di mana pelajar akan didedahkan kepada konsep asas, arkitektur dalaman, perantaramukaan ingatan dan pengurusannya, sistem pemasaan, termasuk konfigurasi dan fungsi pin-pin mikropemproses. Ini diikuti dengan konsep pengaturcaraan bahasa mesin dan penghimpun serta teknik-teknik pengaturcaraan. Kursus ini juga mendedahkan pelajar kepada teknik-teknik pengalamatan ingatan dan I/O serta peranti perantaramuka selari dan sesiri. Di akhir kursus, pelajar akan didedahkan kepada pengawal mikro.

The course introduces the various types of microprocessors (4-bit to 16-bit) available in the market. Microprocessor 8086 by Intel will be made as a case study. The students will be exposed to the fundamental concepts of microprocessor, internal architecture, programming model, functions and configuration of the pins. This will be followed by the assembly languages programming concepts, and programming techniques. This course will also introduce the students to memory addressing techniques and I/O devices. The students will also acquire the knowledge on the operations and applications of serial and parallel peripherals. Finally, the microcontroller will be exposed to the students.

Pra-Keperluan (jika ada): Tiada
Pre-Requisite (if any): None

Bacaan Asas:
References:

Techno, G. 2018. *Microprocessors and Microcontrollers: Architecture, Programming, 8086/8088, 8085 Microprocessor. Amazon Digital Services LLC.*

Mary, P & Jeebananda, P. 2016. *Microprocessors and Microcontrollers. PHI Learning Pvt. Ltd.*

Ganguly, A.K & Ganguly, A. 2015. *Microprocessors and Microcontrollers: 8085, 8086 and 8051. 3rd edition. Alpha Science International, Ltd.*

Brey, B. B. 2014. *INTEL Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, PrentiumProProcessor, Pentium II, III, 4 .8/e. Pearson International)* (versi terkini).

Kant, K. 2014. *Microprocessors and Microcontrollers: Architecture, Program ming and System Design 8085, 8086, 8051, 8096. PHI Learnig Private Limited.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menganalisis masalah kejuruteraan menggunakan asas sains dalam mengenalpasti arkitektur mikrokomputer dan hubungkait antara perkakasan dan perisian dari aspek rekabentuk sistem. *Ability to analyse engineering problems using basic science to identify microcomputer systems and the relations between hardware and software design aspect.*

2	Berkebolehan untuk merekabentuk dan membangunkan litar perantaramuka dan menulis aturcara untuk menyiasat dan mengenalpasti masalah. *Ability to design and develop interfacing circuits and to write codes to investigate and troubleshoot problems.*
3	Berkebolehan untuk mencadangkan dan mengesahkan sistem mikrokomputer lengkap dalam aktiviti berkumpulan dengan efektif. *Ability to propose and verify complete microcomputer systems in group activities effectively.*
4	Berkebolehan untuk menerangkan dengan efektif idea dan cadangan rekabentuk sistem mikrokomputer lengkap yang dibangunkan. *Ability to explain effectively ideas and proposals of complete microcomputer system that has been developed.*

KKKL3234   Rekabentuk Sistem
Systems Design

Kursus ini memerlukan pelajar bekerja dalam kumpulan untuk menyelesaikan masalah teknikal yang dihadapi oleh suatu komuniti. Ia bermula dengan mengenalpasti punca masalah dan seterusnya mencadangkan pelbagai penyelesaian yang mungkin dengan menggunakan pengetahuan teknikal yang telah dipelajari. Kemudian, pelajar akan mengaplikasi kaedah penyelesaian yang optimum dalam rekabentuk mereka. Pelajar perlu mengubahsuai proses rekabentuk untuk memenuhi spesifikasi tertentu dengan mengambilkira kekangan yang ada dalam menghasilkan prototaip kejuruteraan dan prototaip hasilan. Secara keseluruhan, pelajar perlu merancang dan mengurus suatu projek berdasarkan kepada pendekatan kejuruteraan sistem.

The course requires the student to work in a group in order to solve technical problems encountered by a community. It starts with identifying the root cause and proposing various possible solutions using learned technical knowledge. Then, the student will apply the optimum solution method in their design. Student needs to modify the design process in order to meet certain specifications by considering constraints to produce engineering and product prototype. Overall, student should plan and manage a project based on the system engineering approach.

Pra-Keperluan (*jika ada*):   Tiada
Pre-Requisite (if any):   *None*

Bacaan Asas:
References:

Paul Sherz & Simon Monk. 2016. *Practical Electronics for Inventors, 4th edition.* McGraw-Hill.

Paul Horowitz & Winfield Hill. 2015. The Art of Electronics, 3rd edition. Cambridge University Press.

Ulrich, K. & Eppinger, S. 2015. *Product Design and Development. 6th edition, New York: McGraw-Hill.*

Michael Jay Geier. 2015. *How to Diagnose and Fix Everything Electronic, 2nd edition. McGraw-Hill.*

Dennis M. Buede. 2011. *The Engineering Design of Systems: Models and Methods. 2nd edition. John Wiley & Sons* (versi terkini).

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk mengenalpasti punca masalah dan mencadangkan pelbagai penyelesaian kepada suatu masalah teknikal. *Ability to identify the root cause and propose various possible solutions for a technical problem.*
2	Berkebolehan untuk membina suatu prototaip bagi menyelesaikan masalah teknikal dengan menggunakan pengetahuan teknikal yang telah dipelajari. *Ability to construct a prototype for solving the technical problem using learned technical knowledges.*
3	Berkebolehan untuk mengubahsuai proses rekabentuk untuk memenuhi spesifikasi tertentu dengan mengambil kira isu-isu setempat. *Ability to modify design process in order to meet certain specification concerning with local issues.*
4	Berkebolehan untuk mengkaji maklumat berkenaan dengan isu-isu projek rekabentuk sistem. *Ability to study information on given issue of the system design project.*

KKKL4124 Ekonomi Kejuruteraan dan Perakaunan Kos
Engineering Economics and Cost Accounting

Kursus ini meliputi prinsip-prinsip asas ekonomi kejuruteraan dan perakaunan. Objektif kursus ini adalah untuk melatih bakal jurutera untuk menganggar kos berpatutan, serta menilai dan mengenalpasti projek-projek kejuruteraan yang dapat memberikan pulangan ekonomi yang optimum. Teknik-teknik anggaran kos, peruntukan kos, penetapan-kos-berdasarkan-aktiviti, dan analisis penetapan kos kitaran-hidup akan diperkenalkan. Analisis ekonomi berkala bagi projek-projek kejuruteraan dalam keadaan ketentuan dan ketidaktentuan juga akan dibincangkan.

This course covers the fundamental principles of engineering economics and accounting. The objective of this course is to train future engineers to estimate appropriate costs, as well as to evaluate and identify engineering projects that can

yield optimal economic returns. Techniques of cost estimation, cost allocation, activity-based costing, and life-cycle costing analysis will be introduced. Periodic economic analysis of engineering projects under conditions of certainty and uncertainty will also be discussed.

Pra-Keperluan (*jika ada*):   Tiada
***Pre-Requisite (if any)*:**   *None*

Bacaan Asas:
***References*:**

Blank, L. & Tarquin, A. 2014. Basics of Engineering Economy. 2nd Edition. McGraw-Hill.

Blank, L. & Tarquin, A. 2018. Engineering Economy. 8th Edition. McGraw-Hill.

Newman, D., Eschenbach, T. & Lavelle, J. 2017. Engineering Economic Analysis. 13th Edition. Oxford University Press.

Marnell, P. 2016. Engineering Economics for the 21st Century. John Wiley & Sons.

Park, C. 2015. Contemporary Engineering Economics. 6th Edition. Pearson.

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	*Berkebolehan untuk menyatakan tujuan dan kepentingan melakukan analisis ekonomi ke atas projek-projek kejuruteraan.* *Ability to state the purpose and significance of performing economic analysis on engineering projects.*
2	Berkebolehan untuk menilai projek-projek kejuruteraan menggunakan konsep nilai-masa wang, dan teknik-teknik anggaran kos, peruntukan kos, dan kawalan kos. *Ability to evaluate engineering projects by applying the concept of time-value of money, and techniques of cost estimation, cost allocation and control.*
3	Berkebolehan membandingkan alternatif-alternatif menggunakan kriteria ekonomi yang berbeza yang mengambilkira risiki-risiko dan ketidaktentuan. *Ability to compare alternatives based on different economic criterias that incorporate risks and uncertainties.*
4	Berkebolehan untuk menaksir anggaran kos, dan menilai serta memilih projek-projek kejuruteraan yang mempunyai nilai ekonomi paling optimum. *Ability to estimate appropriate costs, as well as to evaluate and select economically optimal engineering projects.*

KKKT3243   Peranti Komunikasi
             Communication Devices

Ini merupakan kursus asas ataupun pengenalan kepada sistem telekomunikasi. Pelajar akan mempelajari peranti-peranti sistem komunikasi dan perkakasan untuk pelbagai aplikasi dan teknologi komunikasi. Kursus dimulai dengan pengenalan kepada blok sistem komunikasi seperti penghantar, penerima dan media saluran komunikasi. Antara sistem komunikasi yang terkini yang akan dibincangkan ialah sistem tanpa wayar, komputer berhalaju tinggi, jalur lebar, komunikasi optik, telefon, radio, TV, satelit dan rangkaian peribadi. Peranti-peranti komunikasi dan perkakasan yang akan dipelajari termasuklah antena asas, pendupleks, pendipleks, modem, pemultipleks dan penyahmultipleks, penguat hingar rendah, pencampur, pemisah, penggabung, pemencil, hab, router, and pengulang. Kursus ini juga melibatkan makmal dan ujikaji-ujikaji yang berkaitan dengan konfigurasi peranti komunikasi dan pengantaramuka.

This is a basic and introductory course related to telecommunication systems. Students will learn about communication system devices and hardware for various communication technologies and applications. It begins with an introduction to communication system block such as transmitter, receiver and communication channel medias. Among the current communication system that will discussed are cellular, wireless, high speed computer, broadband, optical communication, telephony, radio, TV, satellite and personal area networks. The communication devices and hardware includes basic antenna, duplexer, diplexer, modem, multiplexer and de-multiplexer, low noise amplifier, mixer, splitter, combiner, isolator, hub, router, and repeater. This course also included laboratories and experiments related to communication devices configuration and interface.

 Pra-Keperluan (jika ada):   Tiada
Pre-Requisite (if any):   *None*

Bacaan Asas:
References:

Smith, K. 2019. *Telecommunications Essentials, Clanrye International.*
Weldon, M.K. 2016. *The Future X Network: A Bell Labs Perspective, CRC Press.*
Frenzel, L.E. 2015. *Principles of Electronic Communication Systems, 4th Edition. McGraw-Hill.*
Butler, J. (Editor). 2013. *Wireless Networking in The Developing World, Third Edition. CreateSpace Independent Publishing Platform.*

Green, J.H. 2006. *The Irwin Handbook of Telecommunications, Fifth Edition. Mcgraw-Hill.*
Blake, R. 2001. *Electronic Communication Systems, 2nd Edition. Delmar Cengage Learning.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Kebolehan untuk menghuraikan fungsi asas setiap blok untuk pelbagai sistem dan aplikasi komunikasi. *Ability to describe the basic function of each block in various communication system and applications.*
2	Kebolehan untuk menganalisis dan menilai parameter-parameter untuk pelbagai peralatan komunikasi. *Ability to analyse and appraise parameters for various communication equipments.*
3	Kebolehan untuk menyatupadu peralatan komunikasi dalam pelbagai sistem telekomunikasi. *Ability to integrate usage of communication equipment in various telecommunication systems.*
4	Kebolehan untuk menjelaskan aplikasi komunikasi berdasarkan pelbagai peranti komunikasi dan antara muka *Ability to describe communication application based on various communication devices and interfaces*

KKKT3253   Mikroelektronik
Microelectronics

Kursus ini bertujuan untuk memberi pengetahuan dan membangunkan pemahaman serta kemahiran sintesis dalam fizik peranti semikonduktor. Konsep asas dan sifat-sifat fizikal bahan semikonduktor diperkenalkan dan diterokai, iaitu termasuk bahan semikonduktor intrinsik dan ekstrinsik, sifat statik dan pengangkutan caj, jalur tenaga, kesan dopan, simpang p-n , simpang logam-semiconductor dan simpang MOS. Dari sini, struktur, mekanisma operasi dan sifat peranti uni-polar dan dwi-polar diperkenalkan, seperti p-n diod, transistor simpang dwikutub (BJT), kapasitor MOS, dan transistor kesan medan (MOSFET, JFET dan MESFET). Asas fenomena kuantum dan kesan yang berkaitan, serta konsep yang mendasari heterosimpang, dan beberapa peranti optoelektronik diperkenalkan di akhir kursus.

This course is aimed to provide knowledge and to develop understanding and synthesis skills in the physics of semiconductor devices. Basic concepts and physical properties of semiconductor materials are introduced and explored, which includes intrinsic and extrinsic semiconductor materials, static properties and transportation of charge, energy band theory, doping effect, p-n junction,

metal-semiconductor junction and MOS junction. Furthermore, the structure, working mechanism and properties of unipolar and bipolar devices are introduced, such as p-n junction diode, bipolar junction transistors (BJT), MOS capacitor, and field effect transistors (MOSFET, JFET and MESFET). Basic quantum phenomena and associated effects, concepts underlying heterojunctions, and some optoelectronics devices are also introduced towards the end of the course.

Pra-Keperluan (jika ada): Tiada
Pre-Requisite (if any): None

Bacaan Asas:
*References***:**

Maurizio, D. P. E. 2017, *Microelectronics: From Fundamentals to Applied Design. Springer.*
Streetman, B.G. 2015. *Solid State Electronic Devices, 7th Edition (Global). Pearson.*
Li, Y., Goyal, D. (Editor), 2017, *3D Microelectronic Packaging: From Fundamentals to Applications. 1st Edition. Springer.*
Christo, P 2014. *Solid-State Electronic Devices: An Introduction. Springer*
Hu, C. C. 2010. *Modern Semiconductor Devices* for Integrated Circuits. New Jersey: Pearson.
Parker, G. 2004. *Introductory Semiconductor Device Physics. London: Institute of Physics*

Hasil Pembelajaran:
Course Outcomes:

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menerangkan konsep asas fizik semikonduktor (jalur tenaga, kepekatan pembawa, angkutan cas) dan peranannnya dalam pembentukan simpangan p-n. *Ability to explain basic concepts of semiconductor physics (energy band, carrier concentration, charge transport) and its role in the formation of p-n junction.*
2	Berkebolehan untuk menerangkan fizik dan mengenalpasti ciri-ciri utama simpangan semikonduktor-semikonduktor, semikonduktor-logam serta variasi simpangan yang lain yang membentuk peranti-peranti elektronik *Ability to explain the physics and identify key features of the semiconductor-semiconductor junctions, metal-semiconductor junction as well as other structure variations that make up electronic devices.*

3	Berkebolehan memperihalkan fungsi asas peranti mikroelektronik seperti kapasitor MOS, transistor kesan medan (MOSFET, JFET, MESFET), transistor simpang dwikutub (BJT), peranti optoelektrinik termasuk fenomena quantum dan kesannya, serta konsep asas heterosimpang. *Ability to describe the basic functions of microelectronic devices such as the MOS capacitor, field effect transistors (MOSFET, JFET and MESFET), bipolar junction transistors (BJT), optoelectronic devices including quantum phenomena and their effects, and the basic concept of heterojunction.*
4	Berkebolehan untuk mengatur kajian kepustakaan dan membuat laporan bertulis tentang penyelidikan terkini dalam teknologi mikroelektronik. *Ability to organise literature review and make written reports on the latest research in the current advancement in microelectronic technologies.*

KKKT3263   Komunikasi Digit
Digital Communication

Ini merupakan kursus asas kepada teori dan rekabentuk komunikasi digit. Pelbagai sistem modulasi denyut jalur asas dan modulasi laluan lulus akan diperkenalkan seperti PCM, FSK dan ASK. Perbandingan prestasi sistem tersebut seperti penggunaan lebar jalur dan kesan hingar akan dilakukan. Kemudian diikuti dengan modulasi spektrum tersebar dan komunikasi radio berbilang pengguna. Teknik pengekodan dalam pengawalan ralat juga akan diketengahkan. Batasan asas dalam teori maklumat yang mempengaruhi muatan saluran akan juga dibincangkan.

This is a fundamental course to digital communication theory and design. Various types of digital baseband modulation and pass band modulation will be introduced e.g. PCM, FSK and ASK. Comparison on the system performance, such as bandwidth application and noise effect will be covered. This is followed by spread spectrum modulation and multi user radio communications. Coding techniques in error control also will be introduced. Fundamental limits in information theory which influence the channel capacity will also be discussed.

Pra-Keperluan (jika ada):
KKKL2183   Teori Komunikasi

Pre-Requisite (if any):
KKKL2183   *Communication Theory*

Bacaan Asas:
References:

Singh, R.P. & Sapre, S. 2017. Communication Systems: Analog and Digital, 3/e. McGraw Hill Education.
Arthur, A. G. & Allen, H. L. 2015. Modeling of Digital Communication Systems Using SIMULINK 1/e. New York. John Wiley & Sons

Safak, M. 2017. Digital Communications, 1/e. New York. John Wiley & Sons

Heath, R.W.J. 2017. Introduction to Wireless Digital Communication: A Signal Processing Perspective, 1/e. Prentice Hall

Pischella, M. & LeRuyet, D. 2015. Digital Communications 2: Digital Modulations, 1/e. New York. John Wiley & Sons.

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menerangkan penghantaran denyut jalur asas, jalur lulus (pass band) dan teknik pelbagai akses. *Ability to explain transmission of base-band pulse, pass-band and multiple access techniques*
2	Berkebolehan untuk mengenalpasti dan menganalisa kesan hingar dalam sistem komunikasi digit. *Ability to identify and analyse the effect of noise in digital communication systems.*
3	Berkebolehan untuk menganalisa masalah di dalam modulasi dan demodulasi digit dan juga dalam kaedah penyamaan (equalization) digit *Ability to analyze problem in digital modulation and demodulation and also digital equalization method*
4	Berkebolehan untuk bekerja dalam satu kumpulan untuk merekabentuk dengan menggunakan kajian ICT yang bersaintifik moden dengan etika profesional dan pertimbangan berdasarkan pengetahuan kontekstual dalam kejuruteraan profesional. *Ability to work in a team to design using modern scientific ICT experiment committing to professional ethics and apply reasoning based on contextual knowledge in professional engineering.*

KKKT3273   Teknologi Pembuatan Litar Bersepadu
Integrated Circuit Manufacturing Technology

Matlamat kursus ini ialah memberikan pengetahuan dan kefahaman konsep dalam proses-proses fabrikasi peranti semikonduktor dan litar bersepadu. Topik-topik yang diliputi adalah penggunaan bilik-bersih, proses-proses fotolitografi, punaran, oksidasi, difusi, pembenaman ion, deposit filem-nipis, pelogaman, perwayaran dan pempakejan litar bersepadu.

The aims of this course are to provide knowledge and comprehension on the chronological fabrication processes of semiconductor devices, mainly integrated circuits. Topics covered are cleanroom facility, photolitography, etching, oxidation, diffusion, ion-implantation, thin-film deposition, metallization, interconnects, and IC packaging.

Pra-Keperluan (jika ada): Tiada
Pre-Requisite (if any): None

Bacaan Asas:
References:

Hwaiyu, G. 2017. *Semiconductor Manufacturing Handbook, Second Edition. McGraw-Hill Education.*

Swaminathan, P. 2017. *Semiconductor Materials, Devices and Fabrication, Wiley.*

Balasinski, A. 2017. *Semiconductors: Integrated Circuit Design for Manufacturability. CRC Press.*

Van-Zant, P. 2014. *Microchip Fabrication: A Practical Guide to Semiconductor Processing, 6th edition. McGraw Hill.*

Jaeger, R.C. 2002. *Introduction to Microelectronic Fabrication. Prentice Hall.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan menerangkan ciri-ciri bahan semikonduktor dan kepentingannya dalam proses fabrikasi; konsep bilik-bersih; pencemaran dan kontaminasi; aspek keselamatan dan protokol. *Ability to explain the characteristics of semiconductor materials and its importance in fabrication processes; cleanroom facility; pollution and contaminant; safety aspect and protocol.*
2	Berkebolehan menghubungkaitkan proses-proses fabrikasi; dan menilai proses/peralatan yang sesuai bagi fabrikasi peranti semikonduktor. *Ability to relate the fabrication processes; and to examine suitable processes/instruments for the fabrication of semiconductor devices.*
3	Berkebolehan merekabentuk carta aliran proses bagi fabrikasi peranti semikonduktor peranti seperti diod PN dan transistor CMOS. *Ability to design a process flow for the fabrication of semiconductor devices such as PN junction diodes and CMOS transistors.*
4	Berkebolehan untuk menerangkan proses-proses fabrikasi peranti semikonduktor dengan menggunakan perisian permodelan komputer. *Ability to explain the fabrication processes of semiconductor devices using computer modelling software.*

KKKT4053   Organisasi dan Senibina Sistem Komputer
Computer System Architecture and Organization

Kursus ini meliputi rekabentuk pemproses dan rekabentuk kawalan dalam sistem computer. Organisasi ingatan, I/O, penalian paip serta pemprosesan selari juga akan diketengahkan. Teknologi komputer masa kini dan yang sedang muncul juga akan diketengahkan sebagai kajian kes.

This course covers processor design and control design in computer systems. The organisation of memory, I/O, pipelining and parallel processing will also be featured. Current and emerging computing technologies will also be featured as case studies.

Pra-Keperluan (jika ada):
KKKL3293   Mikroprosessor dan Mikrokomputer

Pre-Requisite (if any):
KKKL3293   Microprocessor and Microcomputer

Bacaan Asas:
*References***:**

Tanenbaum, A. S. 2016. *Structured Computer Organization, 6/e. Prentice Hall.*
Stallings, W. 2015.*Computer Organization and Architecture, 10/e. Prentice Hall.*
Harris, S, and Harris, D. 2015. *Digital Design and Computer Architecture: ARM Edition, 1/e. Morgan Kaufmann.*
Bryant, R.E. & O'Hallaron, D.R., 2015. *Computer Systems: A Programmer's Perspective, 3rd Ed., Pearson.*
Null, L. & Lobur, J. 2015. *The Essentials of Computer Organization and Architecture, 4th Ed., Jones & Bartlett*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menerangkan rekabentuk pemproses dan kawalannya. *Ability to explain the design of the processor and its control.*
2	Berkebolehan untuk menerangkan konsep penalian paip dan pemprosesan selari serta teknologi komputer terkini. *Ability to explain the concepts of pipelining and parallel processing as well as current computing technology.*
3	Berkebolehan untuk menerangkan bagaimana rekabentuk sistem komputer mempengaruhi prestasi. *Ability to explain how computer system design affects performance.*
4	Kebolehan untuk membandingkan operasi sistem ingatan utama, maya dan cache. *The ability to compare the operation of the main memory, virtual memory and cache memory systems.*

KKKT4113   Sistem Multimedia
         Multimedia Systems

Kursus ini adalah sambungan kepada kursus Pemprosesan Isyarat Digit dan dimulakan dengan pengenalan kepada pelbagai data multimedia yakni audio, imej dan video. Pemampatan signal audio dan percakapan diperkenalkan, diikuti oleh teori sistem linear 2D bagi media visual. Kaitan media visual dan sistem penglihatan manusia diketengahkan dan diaplikasi kepada pemampatan imej dan video. Penstriman multimedia atas rangkaian kemudiannya diperihalkan, bersama dengan perkakasan yang termasuk sistem terkomputer. Pada akhir kursus, teknologi multimedia masa kini dan sedang muncul disentuh dan ditutup dengan kajian kes sistem tersebut.

This course is a continuation of the Digital Signal Processing course and begins with an introduction to various multimedia data namely audio, images and video. Speech and audio compression are introduced followed by 2D linear systems theory for visual media. The relation of visual media and the human visual system is made and applied to image and video compression. Multimedia streaming over networks is then described, along with hardware which includes computerised systems. Finally current and emerging multimedia technologies are touched upon, culminating in case studies of these systems.

Pra-Keperluan (jika ada):
KKKL2123 Isyarat dan Sistem

Pre-Requisite (if any):
KKKL2123 Signal and System

Bacaan Asas:
References:

Gonzalez, R. C. & Woods, R. E. 2017. *Digital Image Processing. 4th Edition. Addison-Wesley.*
Beach, A. 2018. *Video Compression Handbook. 2nd Edition. Peachpit Press.*
Weynand, D. & Piccin, V. 2015. *How Video Works: From Broadcast to the Cloud. Routledge.*
Z., Drew, M.S., & Liu, J. 2014. *Fundamentals of Multimedia. 2nd Edition. Springer.*
Ozer, J. L. 2016. *Video Encoding by the Numbers: Eliminate the Guesswork from your Streaming Video. Doceo Publishing.*

Hasil Pembelajaran/
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus/ *Course Outcomes (CO)*
1	Kebolehan untuk memahami dan memerihalkan pelbagai sistem multimedia. *Ability to describe the various multimedia systems*
2	Kebolehan untuk memerihal kaedah-kaedah pemampatan serta manipulasi data multimedia. *Ability to explain different multimedia data compression and manipulation techniques.*
3	Kebolehan untuk membandingkan jenis aplikasi multimedia berbeza bagi pelbagai kegunaan. *Ability to compare different types of available multimedia applications for various uses*
4	Kebolehan untuk mengadaptasi pengetahuan bidang utama yang berkaitan dengan multimedia, yakni audio, imej dan video dan memanupulasi data multimedia. *Ability to adapt knowledge of the main areas associated with multimedia i.e. audio, image and video and manipulate multimedia data.*

KKKT4133   Komunikasi Data dan Rangkaian Komputer
Data Communication and Computer Networks

Kursus ini mengambilkira rangkaian komunikasi komputer yang berstruktur lapisan. Ia meliputi senibina, protokol dan model komunikasi yang digunakan dalam Model Rujukan OSI. Masalah kawalan aliran dan ralat dan penyelesaiannya dibincangkan. Skim kawalan capaian medium (MAC) dan kawalan pautan data (DLC) diperkenalkan. Skim pencegahan perlanggaran MAC tanpa wayar juga turut dipersembahkan. Kemudian, teknik pensuisan litar & paket (litar maya & datagram) dibincangkan dengan algoritma penghalaan (laluan singkat). Setelah mengambil kursus ini, pelajar akan berupaya untuk merekabentuk rangkaian setempat (LAN) sendiri dan hubungan dengan LAN yang lain melalui rangkaian luas (WAN). Pelajar juga akan memahami tentang operasi protokol ini yang luas penggunaannya dalam penyediaan hubungan Internet dan Intranet.

This course considers computer communication network and structural layers. It covers communication models, architecture and protocols which are considered in OSI Reference Model. Flow and error control problems and their solutions are then discussed. Medium access control (MAC) and Data Link Control (DLC) schemes are introduced. Wireless MAC collision prevention schemes are also presented. Then, circuit & packet (virtual circuit & datagram) switching techniques are discussed with routing algorithms (shortest path). After completing this course, the student will be able to design a Local Area Network (LAN) and connection of LAN with wide area network (WAN). The students will also be able to understand the operational protocol with usage of Internet and Intranet.

Pra-Keperluan (*jika ada*):   Tiada
***Pre-Requisite (if any)*:**   *None*

Bacaan Asas:
***References*:**

Ibe, O. 2017. *Fundamentals of Data Communication Networks. 1st Edition. Wiley.*
Comer, D. 2018. *Computer Networks and Internets. 6th Edition. Pearson.*
Kurose, J.F. & Ross, K.W. 2017. *Computer Networking: A Top-down Approach. 7th Edition. Pearson.*
Stallings, W. 2014. *Data and Computer Communications. 10th Edition. Prentice Hall.*
Forouzan, B.A. 2012. *Data Communications and Networking. 5th Edition. McGraw Hill.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Kebolehan dalam mengenalpasti dan menganalisa teknik-teknik asas komunikasi data, kekangan dan kelebihannya. *Ability to identify and analyse the main data communication techniques, their limitations and advantages.*
2	Kebolehan dalam menganalisa prestasi penggunaan talian komunikasi dan mekanisma kawalan ralat. *Ability to analyse the performance of a communication link and error control mechanisms.*
3	Kebolehan dalam mengaplikasikan pengetahuan dalam sistem pensuisan asas dan topologi rangkaian. *Ability to apply the knowledge of main switching systems and network topologies.*
4	Kebolehan menerangkan kemajuan rangkaian dan kekangannya. *Ability to explain the network progress and its constraint.*

KKKT4143 Rekabentuk VLSI
VLSI Design

Kursus ini bertujuan untuk menerangkan asas dan kaedah merekabentuk litar bersepadu VLSI (Very Large Scale Integration). Kursus ini memberi tumpuan khusus kepada rekabentuk digit di samping menyentuh litar analog. Kuliah akan bertumpu kepada analisa sistematik dan asas rekabentuk litar bersepadu.Pelajar juga akan didedahkan kepada kemahiran perisian komputer yang berkaitan dengan rekabentuk VLSI yang mana pada masa yang sama akan meningkatkan kreativiti yang diperlukan untuk diaplikasikan di dalam bidang Kejuruteraan Elektronik.

The aim of this course is to provide some background and useful methods in designing VLSI (Very Large Scale Integration) integrated circuits. This course will give more emphasis on the digital design with some exposure on analog design. Teaching will focus on the systematic analysis and design of basic integrated circuits. Students will also be exposed to computer skills related to VLSI design which will simultaneously assist them in increasing the creative skills needed to be applied in the field of Electronic Engineering.

Pra-Keperluan (*jika ada*): Tiada
Pre-Requisite (if any): *None*

Bacaan Asas:
References:

Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic. 2016. Digital Integrated Circuits: A Design Perspective. 2nd edition, Pearson Education India.
Wayne Wolf. 2015. Modern VLSI Design. 4th edition, Pearson Education India.
Behzad Razavi. 2016. Design of Analog CMOS Integrated Circuits. 2nd edition, McGraw Hill Education.
Sung-Mo Kang, Yusuf Leblebici, Chulwoo Kim. 2014. CMOS Digital Integrated Circuits Analysis & Design. 4th edition, McGraw-Hill Education.
Neil H.E. Weste, David Harris. 2010. CMOS VLSI Design: A Circuits and Systems Perspective. 4th Edition. USA: Pearson Education.

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk membina litar VLSI menggunakan perisian EDA. *Ability to construct VLSI circuits using EDA tools.*
2	Berkebolehan untuk menggunakan litar VLSI untuk menyelesaikan masalah kejuruteraan. *Ability to use VLSI circuits to solve engineering problems.*
3	Berkebolehan untuk mengenalpasti dan menganalisa masalah/kekangan di dalam litar. *Ability to identify and analyze problems/disturbance in circuits*
4	Berkebolehan untuk mengaplikasi teknik pengoptimuman litar untuk mencapai objektif tertentu. *Ability to apply circuit optimization techniques to achieve the required objectives.*

KKKT4153   Kejuruteraan Elektromagnet
Electromagnetic Engineering

Merupakan kursus lanjutan selepas kursus Medan dan Gelombang Elektromagnet yang memberi penekanan kepada medium penghantaran dan gelombang mikro. Kursus dimulai dengan talian penghantaran dan kaedah penyelesaiannya. Seterusnya perambatan gelombang satah, penghantaran dan pemantulan gelombang, kaedah pemadanan galangan dan Carta Smith diperkenalkan. Kursus ini di akhiri dengan pengenalan kepada pandu gelombang mikro, rangkaian gelombang mikro, antena dan perambatan gelombang dan aplikasi dan pengukuran gelombang mikro. Objektif utama kursus ini adalah untuk memperkenalkan pelajar kepada unsur-unsur penting dalam bidang kejuruteraan elektromagnet seperti konsep talian penghantaran, fenomena perambatan gelombang dan aplikasi gelombang mikro dalam kejuruteraan.

This course is the extension of Electromagnetic Field and Waves which gives emphasis on transmission medium and microwaves. The course begins with transmission lines and its solutions methods and followed by plane wave propagation, waves transmission and reflection, impedance matching and Smith Charts. This course will be ended by the introduction to the microwaves guides, microwave network, antenna and wave propagation and microwaves measurement. The main objective is to introduce the students to the important elements in electromagnetic waves concepts e.g. transmission line concept, waves propagation phenomena and the application of microwaves in engineering.

Pra-Keperluan (*jika ada*):
KKKL2133   Medan & Gelombang Elektromagnet

Pre-Requisite (if any):
KKKL2133   Electromagnetic Field and Waves

Bacaan Asas:
*References***:**

Matthew, N.O. Sadiku. 2018. *Element of Electromagnetic, 7/e. Oxford University Press.*
Chaturvedi, P. K. 2018. *Microwave, Radar & RF Engineering: with Laboratory Manual, 1/e. Springer.*
Hayt, W. 2018. *Engineering Electromagnetics, 9/e, McGraw-Hill.*
Pozar, D. M. 2011. *Microwave Engineering, 4/e. Addison-Wesley.*
Khan, A.S., 2014, *Microwave Engineering: Concepts and Fundamentals, 1/e, CRC Press.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan merekabentuk talian penghantaran sepadan menggunakan teknik pemadanan dan menerangkan prestasi rekabentuk tersebut. *Ability to design a matched transmission line using impedance matching techniques and to explain the performance of the design..*
2	Berkebolehan menyelesaikan masalah-masalah kejuruteraan dengan mengaplikasikan prinsip-prinsip gelombang elektromagnet. *Ability to solve related engineering problems by applying the electromagnetic waves principles.*
3	Berkebolehan menganalisis dan mengkategorikan pandu gelombang elektromagnet berdasarkan parameter gelombang. *Ability to analyse and categorize the electromagnetic waveguide based on its parameters.*
4	Berkebolehan menilai secara teori dan amali prestasi sistem antenna dan litar frekuensi radio dalam pelbagai aplikasi *Ability to verify theoretically and experimentally the performance of antenna and RF system in various applications.*

KKKT4162　Projek Ilmiah I
Project I

Satu kajian ilmiah yang berkaitan dengan bidang kajian/pengkhususan di Jabatan Kejuruteraan Elektrik, Elektronik dan Sistem yang mesti disediakan oleh setiap pelajar tahun akhir sebagai memenuhi syarat bagi penganugerahan Ijazah Sarjanana Muda Kejuruteraan. Projek ini berbentuk penyelidikan yang merangkumi penganalisian data, pembangunan perisian atau perkakasan. Setiap pelajar dikehendaki menyediakan satu laporan lengkap yang sekurang-kurangnya mengandungi pengenalan, objektif kajian, kajian kepustakaan, metodologi kajian, jadual kerja dan senarai rujukan. Pelajar juga perlu menunjukkan keputusan awal penyelidikan. Projek ini akan diteruskan dalam kursus KKKT4164 pada semester berikutnya.

An academic research that related to research field/ specialisation at Department of Electrical, Electronic and Systems Engineering that must be prepared by all final year students as to fulfil the requirements for bachelor degree of engineering awarded. This project is a type of research that involves data analysis, software or hardware development. Each student are expected to prepare a complete report that at least contains introduction, objectives, literature review, research methodology, project schedule planning and references. The students also are required to attach the research preliminary status. This project will be continued in KKKT4164 in the subsequent semester.

Pra-Keperluan (*jika ada*):   Tiada
***Pre-Requisite (if any)*:**   *None*

Bacaan Asas:
***References*:**

Pusat Pengurusan Siswazah. 2015. Panduan Penulisan Tesis Gaya UKM. Edisi ke-3. Penerbit UKM.

Friedland, A.J., Folt, C.L. & Mercer, J.L. 2018. *Writing Succesful Science Proposals. 3rd Edition. Yale University Press.*

Eco, U. 2015. *How to Write a Thesis. Massachusetts Institute of Technology (MIT) Press.*

Irish, R., Poe, M. & Deans, T. 2016. *Writing in Engineering: A Brief Guide. Oxford University Press.*

Heard, S.B. 2016. *The Scientist's Guide to Writing: How to Write More Easily and Effectively throughout Your Scientific Career. Princeton University Press.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan mengaplikasikan pengetahuan dan kemahiran kejuruteraan dalam menangani suatu masalah kejuruteraan yang siginifikan. *Ability to apply engineering knowledge and skills in handling any significant engineering problem.*
2	Berkebolehan menakrif penyataan masalah kejuruteraan dan mengenalpasti kaedah penyelesaian *Ability to define engineering problem statement and identify suitable solutions.*
3	*Berkebolehan menilai hasil kerja/kertas kerja penyelidikan terdahulu yang berkaitan dengan projek.* *Ability to assess previous research work/proposal related to project.*
4	Berkebolehan merekabentuk dan melaksanakan penyelesaian yang sesuai untuk sesuatu masalah kejuruteraan. *Ability to design and execute solutions suitable for any certain engineering problem.*
5	Berkebolehan merancang dan menguruskan satu projek penyelidikan dengan jayanya. *Ability to plan and manage a research project successfully.*

KKKT4163   Teknologi Fotonik
             Photonics Technology

Matlamat kursus ini ialah untuk menyampaikan pengetahuan tentang penggunaan teknologi fotonik dalam berbagai bidang terutamanya komunikasi gentian optik (analog dan digital), sistem penghantaran dan penerimaan isyarat optik, pemprosesan isyarat, industri berkaitan fotonik, pengukuran dan penderiaan berdasarkan prinsip-prinsip optik geometri, sinar, gelombang dan optik kuantum. Pengenalan kepada teknologi laser dan juga peranti seperti diod pengesan cahaya, pengganding optik, pemodulat optik dan sebagainya juga diterapkan. Selain itu, proses fabrikasi peranti-peranti tersebut berdasarkan gentian dan teknologi planar juga disentuh. Pelajar juga akan didedahkan tentang pengendalian peralatan optik seperti OTDR, mesin penyambat gentian optik, penganalisis spektrum optik (OSA) dan sebagainya yang terdapat di Makmal Teknologi Fotonik UKM.

The aim of this course is to convey knowledge about the use of photonics technology in various fields especially optical fiber communications (analog and digital), optical transmitter and receiver systems, signal processing, photonic industry, measurement and sensing system based on principles of geometric optics, light, wave and quantum optics. An introduction on laser technology and optical devices such as photodiode, optical coupler, optical modulator etc is also included. In addition, the fabrication process of these devices based on fiber and planar technologies is also discussed. The students are also exposed to the handling of optical equipment that are provided at the UKM Photonic Laboratory such as OTDR, optical splicer machine, optical spectrum analyzer (OSA) etc.

Pra-Keperluan (*jika ada*): Tiada
Pre-Requisite (if any): *None*

Bacaan Asas:
***References*:**

Saleh, B.E.A. & Teich, M.C. 2019. *Fundamentals of Photonics. 3/e. Wiley*
Eugene H. 2016. Optics, 5/e. *Addison-Wesley*
Reider, G. A., 2016, *Photonics, Springer.*
Keiser, G. 2014. *Optical Fiber Communications, 5/e. Mc Graw Hill Education.*
Kasap, S. O., 2013, *Optoelectronics & Photonics: Principles & Practices, 2/e. Prentice Hall.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan merekabentuk komponen dan sistem optik berdasarkan pengetahuan teknologi optik. *Ability to design component and optical system based on optical technology knowledge.*
2	Berkebolehan memasang peralatan dan komponen untuk ujikaji yang berkaitan dengan teknologi fotonik. *Ability to assemble equipment and components for experiment related to photonic technology.*
3	Berkebolehan menyelesaikan masalah yang berkaitan dengan teknologi fotonik pada masa kini. *Ability to solve problems associated with the current photonics technology.*
4	Berkebolehan mencadangkan penyelesaian masalah yang berkaitan bidang teknologi fotonik. *Ability to propose solution for problems in areas related to photonics technology.*

KKKT4164   Projek Ilmiah II
Project II

Kursus ini merupakan sambungan kepada projek ilmiah KKKT4162. Hasil kerja projek bersama-sama dengan kerja yang dilakukan dalam projek ilmiah I perlu dilaporkan dalam satu laporan akhir berbentuk disertasi. Format penulisan perlu mengikut format dalam panduan menulis tesis Gaya UKM. Projek ini akan dinilai oleh penyelia dan ahli jawatankuasa dalam bentuk pemeriksaan tesis, laporan teknikal dan lisan pada penghujung semester berkenaan.

This course is a continuation of Project I KKKT4162. Project results together with the work done in Project I have to be documented in a final report in a form of dissertation. The writing format has to follow specifications in the writing guidelines for thesis writing using the UKM style. This project will be evaluated by the supervisor and another assessor in the form of a thesis, technical report and oral assessment at the end of the semester.

Pra-Keperluan (*jika ada*)
KKKT4162   Projek Ilmiah I

Pre-Requisite (if any):
KKKT4162   Project I

Bacaan Asas:
*References***:**

Pusat   Pengurusan   Siswazah.   2015.   Panduan   Penulisan
        Tesis   Gaya   UKM.   Edisi   ke-3.   Penerbit   UKM.

Friedland, A.J., Folt, C.L. & Mercer, J.L. 2018. *Writing Succesful Science Proposals. 3rd Edition. Yale University Press.*

Eco, U. 2015. *How to Write a Thesis. Massachusetts Institute of Technology (MIT) Press.*

Irish, R., Poe, M. & Deans, T. 2016. *Writing in Engineering: A Brief Guide. Oxford University Press.*

Heard, S.B. 2016. *The Scientist's Guide to Writing: How to Write More Easily and Effectively throughout Your Scientific Career. Princeton University Press.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan mencipta penyelesaian yang sesuai untuk sesuatu masalah kejuruteraan. *Ability to create solutions suitable for any certain engineering problem.*
2	Berkebolehan mengatur satu projek penyelidikan dengan jayanya. *Ability to organize a research project successfully.*
3	Berkebolehan merumuskan data/hasil dari eksperimen/projek. *Ability to formulate data/outcomes from experiment/project.*
4	Berkebolehan melaporkan hasil projek dengan berkesan. *Ability to report project output effectively.*

KKKT4173   Rangkaian dan Keselamatan
Network and Security

Kursus ini merupakan kursus pelengkap kepada beberapa kursus komunikasi seperti Komunikasi Data dan Telekomunikasi. Berpandukan kepada model 7 lapisan OSI, kursus ini akan lebih menumpukan kepada lapisan rangkaian dan ke atas. Pada lapisan rangkaian ini, kaedah pengalamatan IP dan cara membuat sub-rangkaian akan diperkenalkan. Di samping lPv4, pengalamatan lPv6 juga akan diterangkan. Lapisan berikutnya adalah lapisan pengangkutan yang menghubungkan lapisan rangkaian kepada lapisan applikasi. Keselamatan rangkaian akan diterangkan pada keperluan keselamatan setiap lapisan. Ini termasuklah teknik-teknik kriptografi, IPSec, tembok api, keselematan e-mel dan lapisan soket selamat (SSL). Jenis-jenis ancaman keselamatan rangkaian dan kaedah untuk mengatasinya juga akan diterangkan.

This course is a complement course to some communication courses such as Data Communication and Telecommunication. Based on the OSI 7 layer model,

this course will give more emphasis on the network layer and the layers above it. In the network layer, methods of IP addressing and subnetwork creation will be introduced for both IPv4 and IPv6. The next layer is the transport layer, which connects the network layer to the application layer. Network security for the requirements of each layer will be discussed. This includes cryptography techniques, IPSec, firewall, e-mail security and Secure Socket Layer (SSL). Types of threats in networking security and methods to overcome them will also be described.

Pra-Keperluan (jika ada):
KKKT4133   Komunikasi Data dan Rangkaian Komputer

Pre-Requisite (if any):
KKKT4133   *Data Communication and Computer Network*

Bacaan Asas:
*References***:**

Stallings, W., 2016, *Cryptography and Network Security: Principles and Practice, 7th Edition, Pearson.*
Stallings, W., 2017, *Computer Security: Principles and Practice, 4th Edition, Pearson.*
Comer, D., 2018, *Computer Networks and Internets, 6th Edition, Pearson.*
Stallings, W., 2014, *Data and Computer Communications, 10th Edition, Prentice Hall.*
Forouzan, B.A. and Fegan, S.C., 2012, *Data communication and networking, 5th Edition, McGraw-Hill.*
Tanenbaum, A.M., 2010, *Computer Networks, 5th edition, New Jersey, Prentice Hall.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Kebolehan untuk menerangkan rangkaian data komunikasi menggunakan pengetahuan tentang komponen rangkaian dan mengunakan teknologi terkini berdasarkan IPv4 dan IPv6. *Ability to describe a data communication network using knowledge of standard network components and current technology based on IPv4 and IPv6.*

2	Kebolehan untuk menganalisa masalah dalam sistem rangkaian dan mengenalpasti penyelesaian untuk mengatasi masalah ini. *Ability to analyse the problems in a network and identify solutions to overcome these problems.*
3	Kebolehan untuk menerangkan prestasi dan kekangan rangkaian yang sedia ada. *Ability to describe the performance and constraints of the existing network.*
4	Kebolehan untuk mengenalpasti ancaman dan membincangkan teknik untuk rangkaian yang selamat dengan menggunakan teknologi keselamatan terkini. *Able to identify threats and discuss techniques for a secure network using the latest security technology.*

KKKT4183   Teknologi Peranti Termaju
Advanced Devices Technology

Matlamat kursus ini adalah untuk memperkenalkan kepada para pelajar elemen-elemen asas teknologi peranti termaju. Tajuk-tajuk yang dibincangkan adalah kesan elektron panas, peranti gelombang mikro, peranti-peranti frekuensi tinggi, dan lain-lain. Selain itu, teknologi MOSFET submikron, peranti masa transit, peranti paparan, CCD, dan peranti cas magnetik turut dibincangkan.

This course aims at introducing to the students the basic elements of advanced devices technology. The topics covered are hot electron effects, microwave devices, high frequency devices, etc. In addition, technologies on submicron MOSFETs, transit time devices, display devices, CCD, and magnetic charged devices are also discussed.

Pra-Keperluan (jika ada):
KKKT3253   Mikroelektronik

Pre-Requisite (if any):
KKKT3253   Microelectronics

Bacaan Asas:
References:

Grundmann M., 2016. *The Physics of Semiconductors: An Introduction Including Nanophysics and Applications, 3rd edition, Springer.*
Bolívar N., 2017. *Modern Semiconductor Device Physics, Arcler Press.*
Sze S.M., 2015. *Semiconductor Devices: Physics And Technology, 2nd edition, Wiley India.*
Rudan, M., 2017, *Physics of Semiconductor Devices, 2nd edition, Springer.*
Neaman, D., 2011, *Semiconductor Physics And Devices, 4th edition, McGraw-Hill.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menunjukkan prinsip asas peranti semikonduktor termaju serta penyelesaian analitik dan hadnya. *Ability to describe the basic principles of advanced semiconductor devices as well as analytical solutions and the limitation.*
2	Berkebolehan untuk menerangkan kesan sifat bahan dan suhu ke atas prestasi peranti. *Ability to explain the effect of temperature on material properties and devices performance.*
3	Berkebolehan untuk mengenalpasti teori asas semikonduktor dengan penekanan kepada angkutan pembawa dan kelincahan elektron dalam pelbagai aplikasi. *Ability identify basic theory of semiconductors with emphasis on carrier transport and mobility of electrons in numerous applications.*
4	Berkebolehan untuk memberi pendapat tentang penyelidikan terkini dalam teknologi peranti termaju. *Ability to give opinion on the latest research in advanced device technologies.*

KKKT4193   Komunikasi Radio dan Satelit
Radio and Satellite Communication

Kursus ini akan mengkaji dua sistem komunikasi iaitu sistem komunikasi radio khususnya radio selular dan peribadi serta sistem komunikasi satelit. Bermula dengan sejarah, perkembangan dan piawaian, seterusnya prinsip asas mengenai sistem tersebut akan diterangkan. Kursus ini juga melibatkan kajian kesan perambatan dan pemudaran, perancangan sel, belanjawan pautan dan trafik, skema capaian dan modulatan serta rekabentuk sistem. Beberapa aplikasi komunikasi radio dan satelit turut dibincangkan.

This course explores two communication systems i.e. radio communication, specifically radio and personal cellular, as well as satellite communication system. This course begins with the history, development and standard; after that, basic principles on the system will be discussed. This course also involves the study on the effects of propagation and fading, cell planning, link budget and traffic, modulation and access scheme as well as system design. The applications of radio and satellite communication are also discussed.

Pra-Keperluan (*jika ada*):   Tiada
Pre-Requisite (if any):   *None*

Bacaan Asas:
*References***:**

Beard & Stallings. 2015. *Wireless Communication Network and Systems, 1/e.* Pearson

Timothy, P. & Jeremy, E. A. 2019. *Satellite Communications, 3/e.* Wiley and Sons

Louis, J.I. 2017. *Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance , 2/e.* Wiley and Sons.

Randy, L.H. 2019. *Introduction to Wireless Communications Systems, 1/e.* Wiley and Sons

Alejandro Aragón-Zavala. 2017. *Indoor Wireless Communications: From Theory to Implementation, 1/e.* Wiley and Sons.

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Kebolehan untuk membezakan piawai dan migrasi sistem komunikasi tanpa wayar selular dan satelit dan menerangkan prinsip-prinsip asas radio selular berdasarkan gangguan sistem. *Ability to distinguish the migration and standard of a communication system for wireless cellular and satellite and explain the principle of basic cellular radio based on system interference.*
2	Kebolehan untuk menjangka tujuan belanjawan pautan dan jangkaan liputan menggunakan kesan perambatan terhadap rekabentuk sistem komunikasi radio dan satelit dan model kehilangan laluan. *Capability to predict the link budget purpose and the coverage prediction by using propagation effects towards radio and satellite communication system design and path loss model*
3	Kebolehan untuk mengaplikasikan teknik perancangan saluran, gred perkhidmatan, penambahbaikan kapasiti dan kecekapan spektrum. *Ability to apply channel planning technique, service grade, capacity enhancement and spectrum efficiency.*
4	Kebolehan untuk memanipulasi peralatan dan perisian bagi memantau liputan rangkaian berdasarkan kedudukan. *Ability to manipulate the instruments and software for network coverage monitoring based on location..*

KKKT4203   Rangkaian Telekomunikasi
Telecommunication Networks

Kursus ini merangkumi pengenalan kepada: Sejarah telekomunikasi; reka bentuk rangkaian, prestasi dan pengurusan. Melangkah pendahuluan sedikit

dengan memperkenalkan asas-asas sains rangkaian dan analisis. Ditambah dengan pengenalan kepada teori queing salah satu teknik analisis rangkaian yang umumn. Objektifnya adalah untuk menyediakan pelajar dengan pemahaman asas rangkaian digital dan keupayaan menggunakan pengetahuan ini untuk aplikasi. Penilaian objektif pengetahuan akan dijalankan melalui pemeriksaan; dan aplikasi (iaitu, pemilihan dan pengurusan) dengan objektif penggredan projek individu dan kumpulan dan kajian kes. Sesi seminar dari Industri berkaitan akan diatur untuk memperkenalkan keperluan semasa industri telekomunikasi dan penyelidikan. Kursus ini adalah mengenai teknologi digital dan bagaimana ia berfungsi, ia bukan kursus praktikal, atau kursus latihan untuk melatih peralatan tertentu dan / atau aplikasi. Walaubagaimanapun akan ada demonstrasi teknologi yang berkaitan, kursus ini bukan intensif peralatan dan tidak akan melibatkan keperluan teknologi khas luar biasa selain daripada akses kepada komputer dan Internet.

The course includes an introduction to: telecommunications history; network design, performanace and management. Moving a little advance by introdusing the basics of network science and analysis. Added with an introduction to queing theory one of the most common network peformance analysis technique. Its objective is to provide the students with a basic understanding of the working of digital networks and the ability to apply this knowledge to specific applications and situations. Evaluation of knowledge objectives will be by examination; and of application (i.e., selection and management) objectives by grading of group and individual projects and case studies. Industry related seminar sessions will be arranged to introduce the current needs of telecommunication industries and related researches.While the course is about digital technology and how it works, it is not a "hands on" course, or a training course in particular equipment and/ or applications. While there will be demonstrations of relevant technologies, the course is not equipment-intensive and will not involve special technology needs beyond the normal access to computing and the Internet.

Pra-Keperluan (jika ada): Tiada
Pre-Requisite (if any): None

Bacaan Asas:
*References***:**

Valdar, A., 2017, Understanding Telecommunications Networks, 2nd Edition, The Institution of Engineering and Technology.

Viswanathan T., Bhatnagar M. 2015. Telecommunication Switching Systems and Networks, 2nd Edition, Prentice-Hall.
A. Ghosh & S. Chatterjee, 2015, Telecommunication Switching System. USP/Laxmi Publications.
Flood, J.E. 2013, Telecommunication Networks 2nd Edition, The Institution of Engineering and Technology Telecommunication Series.
Roger L. Freeman, 2013, Fundamentals of Telecommunications, 2nd Edition, Wiley-IEEE Press.
Forouzan, B.A. 2012, Data Communications and Networking, 5th Edition, McGraw-Hill.

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menegenalpasti perkhidmatan telekomunikasi terkini dan masa hadapan, serta piawaian dan badan organisasi yang berkaitan. *Ability to classify the current and future telecommunication services, as well as standards and the related organization.*
2	Berkebolehan menyusun ciri-ciri dan rekabentuk rangkaian telekomunikasi. *Ability to arrange the characteristics and designs of telecommunication networks*
3	Berkebolehan membina pelbagai sistem telekomunikasi jalur lebar. *Ability to construct various broadband telecommunication systems*
4	Berkebolehan menghuraikan kebersesuaian sesuatu sistem telekomunikasi yang memenuhi spesifikasi tertentu. *Ability to explain the suitability of a telecommunication system to suit a given set of specification*
5	Berkebolehan menghitung masalah baris-gilir (queue) dan kehilangan dalam kejuruteraan teletrafik. *Ability to compute problems related to queue and losses in teletraffic engineering.*

KKKT4213   Kejuruteraan Perisian
Software Engineering

Kursus ini adalah sambungan kepada kursus Bahasa Pengatucaraan Tahun 1. Dalam kursus ini, pelajar akan mempelajari proses teknikal dan pengurusan bagi merekabentuk sistem perisian mengunakan pengetahuan yang telah dipelajari pada tahun satu. Konsep kejuruteraan perisian yang akan diketengahkan adalah meluas, merangkumi konsep aplikasi berorientasikan objek kepada penggunaan komponen rekabentuk arkitektur hingga pembinaan sistem perisian yang besar.

This course is a continuation of the programming language course in Year 1. In this course, students will learn the technical and management processes for the design of software systems, using knowledge learned in year one. Software engineering concepts to be highlighted are extensive, covering the concept of object-oriented applications to using architectural design components to building a large software system.

Pra-Keperluan (jika ada): Tiada
Pre-Requisite (if any): None

Bacaan Asas:
*References***:**

Sommerville, I. 2018. Software Engineering. 10th Edition, Pearson.
Pressman, R. S. 2016, Software Engineering, A Practitioner's Approach. 8th Edition, McGraw Hill.
Deitel, H. M. & Deitel P. J. 2016. C: How to Program, Global Edition. Prentice-Hall.
Booch, G., Rumbaugh, J., & Jacobson, I., 2005. The Unified Modeling Language User Guide, 2nd Edition. Addison-Wesley.
Gamma, E., Helm, R., Johnson, R., & Vlissides, J. 2002. Design Patterns: Elements of Reusable Object Oriented Software. Addison-Wesley.

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Kebolehan untuk menguruskan pembangunan perisian. *Ability to manage software development.*
2	Kebolehan untuk menggunakan kelas dan objek di dalam perisian dan perkakas rekabentuk formal. *Ability to use classes and objects in software and formal design tools.*
3	Kebolehan untuk mengaplikasi sesetengah corak rekabentuk lazim di dalam perisian berorientasikan objek. *Ability to apply some common design patterns in object-oriented software.*
4	Kebolehan untuk mengubah reka bentuk penyelesaian perisian sistem komputer yang penting berdasarkan masalah dan keperluan fungsian sistem. *Ability to alter the design of significant computer systems software solution based on the problems and functionality requirements of the system.*

KKKT4223   Keboleharapan dan Pencirian Litar Bersepadu
Reliability and Characterization of Integrated Circuit

Matlamat kursus ini ialah memberikan pengetahuan, kefahaman dan konsep dalam bidang kejuruteraan keboleharapan dan peranti litar bersepadu. Kursus ini merupakan kursus pengenalan kepada konsep keboleharapan dan pengenalan kepada kaedah pencirian litar bersepadu. Pelajar-pelajar mengaplikasi ilmu matematik dan kejuruteraan terutama dalam bidang kebarangkalian dan statistik. Mereka juga dikehendaki merekabentuk satu sistem, menggunakan komponen atau proses dengan mengambilkira konsep keboleharapan, seterusnya melakukan kerja, menulis laporan dalam kumpulan. Dengan ini juga mereka dapat memahami, mengecam, serta menyelesaikan masalah berkaitan dengan keboleharapan serta pencirian litar bersepadu. Membuat lawatan industry sekurang-kurangnya 3 jam untuk meninjau amalan di dalam industri.

The aim of this course is to give knowledge, understanding and concept in the field of reliability and integrated circuit characterization. This course is an introductory course to the concept of reliability and characterization method in integrated circuit. Students are to apply mathematics and engineering knowledge especially in the area of probability and statistics. Students should be able to translate the given data using statistics. They are also required to design a system using component or process with the inclusion of reliability concept and then analyze the design and write group report. With this, they should be able to understand, identify and solve problems related to the reliability and integrated circuit characterization. This course will also include at least 3 hours of industrial visit to observe the practice in industry.

Pra-Keperluan (jika ada): Tiada
Pre-Requisite (if any): None

Bacaan Asas:
References:

Modarres, M.; Kaminskiy, M. and Krivtsov, V. 2016. Reliability and Risk Analysis – A Practical Guide, 3/e, CRC Press.
Rykov, V., 2016, Reliability of Engineering Systems and Technological Risk, ISTE.
Tortorella, M., 2015, Reliability, Maintainability, and Supportability: Best Practices for Systems Engineers, 1/e, Wiley-Blackwell.

Enrico Zio. 2007. An Introduction to the basics of Reliability and Risk Analysis. World Scientific Publishing.
Ebeling, C. E. 2009. Reliability and Maintainability Engineering, McGraw Hill.
Stark,H. and Woods, J. W. 2002. Probability, Random Processes and Estimation Theory for Engineers, 3/e, Prentice Hall

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menterjemahkan konsep kualiti, keboleharapan dan keselamatan dalam industry *Ability to describe the concept of quality, reliability and safety in industry.*
2	Berkebolehan merumuskan konsep kadar kegagalan tetap bagi model komponen / sistem *Ability to formulate the concept of fixed failure rate model of a component / system.*
3	Berkebolehan menterjemahkan keboleharapan peringkat sistem. *Ability to describe a system level reliability.*
4	Berkebolehan untuk membina kerja penyiasatan secara bersepadu bagi mengenapasti punca kegagalan; iaitu dengan kaedah analisis berkesan mod kegagalan (FMEA) dan analisis pokok kegagalan (FTA) *Ability to construct integrated investigation work for identification on the source of failure i.e. with failure mode effective analysis method (FMEA) and failure tree analysis (FTA)*

KKKT4233   Optoelektronik
Optoelectronics

Matlamat kursus ini ialah untuk menerapkan kefahaman teknologi optoelektronik dalam dunia aplikasi fotonik hari ini. Kursus ini dimulai dengan memperkenalkan lebih mendalam mengenai peranti optoelektronik, seperti konsep laser, penguat optik dan komponen-komponen pasif. Asas-asas dan hukum-hukum cahaya seperti persamaan Maxwell, persamaan Fresnel, hukum snell, pantulan dalam penuh diulangkaji semula berdasarkan gelombang semula jadi cahaya di dalam pandu gelombang dielektrik dan gentian optik. Bab-bab seterusnya merangkumi polarisasi cahaya, modulasi cahaya, konsep pemultipleksan panjang gelombang (WDM) dan komponen-komponen yang terlibat. Trend teknologi optoelektronik yang terkini akan dibincangkan khususnya dari aspek sistem telekomunikasi, pengesan, pengimejan dan paparan. Kursus ini juga akan memberikan pendedahan makmal terhadap aktiviti pengukuran dan pencirian peralatan dan komponen optoelektronik. Para pelajar juga didedahkan kepada pengenalan penggunaan perisian simulasi bagi merekabentuk komponen optoelektronik.

The goal of this course is to apply the understanding of optoelectronic technology in the world's today photonic applications. This course begins by introducing in greater depth of optoelectronic devices, such as the concept of lasing, optical amplification and working concept of passive components. Fundamental principles and laws of light, such as Maxwell's equations, Fresnel equation, snell law, total internal reflection will be revisited, based on the phenomenon of wave nature of light in dielectric waveguides and optical fibers. Subsequent chapters include light polarization, modulation of light, wavelength division multiplexing (WDM) concepts and components that involved. The current trends of optoelectronic technology will be discussed from the aspect of telecommunications systems, sensors, imaging and display. This course will provide laboratory exposure to the measurement and characterization equipment and optoelectronic components. The students are also exposed to the introduction of the use of simulation software for the design of optoelectronic components.

Pra-Keperluan (*jika ada*) : Tiada
Pre-Requisite (if any): *None*

Bacaan Asas:
***References*:**

Saleh, B.E.A. & Teich, M.C. 2019. *Fundamentals of Photonics. 3/e. Wiley.*
Eugene H. 2016. *Optics, 5/e. Addison-Wesley*
Reider, G. A., 2016, *Photonics, Springer.*
Keiser, G. 2014. *Optical Fiber Communications, 5/e. Mc Graw Hill Education.*
Kasap, S. O., 2013, *Optoelectronics & Photonics: Principles & Practices, 2/e. Prentice Hall.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan merekabentuk komponen dan sistem aktif berdasarkan pengetahuan teknologi opto-elektronik. *Ability to design an active component and system based on knowledge of optoelectronic technology.*
2	Berkebolehan memasang dan mengukur peranti optik dan sistem menggunakan perisian pemodelan dan alat optik. *Ability to assemble and measure optical device and system using modelling software and optical tools.*

3	Berkebolehan menyelesaikan masalah yang berkaitan dengan teknologi opto-elektronik pada masa kini. *Ability to solve problems associated with the optoelectronic technology today.*
4	Berkebolehan merekabentuk dan membentangkan penyelesaian kepada masalah yang berkait dengan teknologi opto-elektronik. *Ability to design and propose solution to problems related to optoelectronic technology.*

KKKT4243   Sistem Komunikasi Optik
Optical Communication Systems

Kursus ini meliputi topik-topik berikut: Sejarah dan latarbelakang komunikasi optik, Gentian optik dan kabel-kabel, sumber-sumber dan pengesan-pengesan, Hubungan gentian titik ke titik, Peranti-peranti komunikasi optik, Pemultipleks pembahagi   panjang gelombang (WDM), Peranti-peranti WDM, CWDM dan penghantaran jarak jauh, Pengulang dan penguat optik, Gentian optik dalam WAN, metropolitan dan rangkaian agihan, Peranti tambah/gugur dan sambung silang optik, Suis-suis optik, Rangkaian-rangkaian pelanggan dan teknologi FTTH, FTTH dan WDM, PON dan CWDM, CDMA optik, serta Sistem optik tanpa wayar.

This course covers the following topics: History and background of optical communication. Optical fiber and cables, sources and sensors, Point-to-point fiber connection, Optical communication devices, Wavelength division multiplexing (WDM), WDM devices, CWDM and long distance transmission, Repeater and optical amplifier, Optical fiber in WAN, metropolitan and distribution networks, Optical add / drop devices and optical cross-links. Optical switches, FTTH's customers and technology networks, FTTH and WDM, PON and CWDM, CDMA optics, as well as Wireless optical system.

Pra-Keperluan (jika ada): Tiada
Pre-Requisite (if any): None

Bacaan Asas:
***References*:**

Murat Uysal et. al. 2016. Optical Wireless Communications. Springer.
Eugene H. 2015. Optics, 5/e. Addison-Wesley.
Fedor M., 2016. Fiber Optics: Physics and Technology. 2/e. Springer
Keiser, G. 2013. Optical Fiber Communications. 5/e. McGraw-Hill, Toronto.
Agrawal, G. P. 2011. Lightwave Technology: Telecommunication Systems. John Wiley & Sons, New Jersey.
Shiva K. & Jamal, M.D. 2014. Fiber Optic Communications: Fundamentals and Applications. 1/e. John Wiley & Sons.

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menganalisis komponen dan aplikasi dalam sistem komunikasi optik. *To be able to analyse component and application in System of Communication Optic.*
2	Berkebolehan untuk mereka bentuk sistem komunikasi optik menggunakan perisian atau secara experimen. *To be able to design System of Communication Optic using software or by experiment.*
3	Berkebolehan untuk membincangkan teknologi dan isu-isu terkini yang berkaitan dengan sistem komunikasi optik. *To be able to discuss current technology and issues that are related to System of Communication Optic.*

KKKT4253   Antena dan Litar Berfrekuensi Tinggi
Antenna and High Frequency Circuits

Matlamat kursus ini ialah memberikan pengetahuan, kefahaman dan keutamaan merekabentuk antenna dan litar berfrekuensi tinggi. Kursus ini memberi penekanan terhadap analisis talian penghantaran dengan penekanan diberikan kepada talian mikrostrip, analisis rangkaian pengkalan tunggal dan berbilang terutamanya parameter-S dan rajah aliran, rekabentuk penuras RF, teknik-teknik pemadanan impedans, analisis dan rekabentuk guat transistor serta beberapa litar RF lain. Kursus ini juga memberikan penekanan terhada pteori, permodelan, analisis, dan rekabentuk antenna dan terhadap kelakuan fizikal dan permodelan perambatan gelombang radio dalam apliaksi bidang telekomunikasi. Pakej berbantukan computer seperti IE3D, Sonnet dan HFSS diperkenalkan bagi membantu pelajar merekabentuk litar berfrekuensi tinggi. Pelajar juga akan didedahkan kepada penggunaan alatan RF dan gelombang mikro seperti penjana isyarat, penganalisa isyarat, meter kuasa dan penganalisa rangkaian untuk tujuan pengujian litar.

The aim of this course is to import knowledge, understanding and ability of the student to design antenna and high frequency circuits. This course focuses on the transmission line analysis with emphasis on microstrip line, the analysis of single and multi-terminal networks, especially the S-parameter and flow diagrams, design of RF filter, impedance matching techniques, analysis and design of transistor amplifiers as well as some other RF circuits. This course focuses on the theory, modelling, analysis and design of antenna and the physical behaviours of radio wave propagation modelling in the telecommunication field. Computer-aided software package such as IE3D, Sonnet and HFSS will be

introduced to help students to design high frequency circuits. Students are also introduced with the basic antenna measurement tools such as RF and microwave signal generator, signal analyser, power meter and network analyser circuit for testing purposes.

Pra-Keperluan (jika ada): Tiada
Pre-Requisite (if any): None

Bacaan Asas:
References:

Balanis, C. A. 2016. Antenna Theory: Analysis and Design, 4/e. Wiley-Interscience.
Grebennikov A. 2015. RF and Microwave Power Amplifier Design, 2/e. McGraw-Hill.
Chaturvedi, P.K., 2018, Microwave, Radar & RF Engineering, 1/e, Springer.
Boris, L. 2017. Antenna Engineering: Theory and Problems, CRC Press
Pozar, D. M. 2011. Microwave Engineering, 4/e. Addison-Wesley.
Yikai C., & Chao-Fu W. 2015. Characteristic Modes: Theory and Applications in Antenna Engineering, 1/e, Wiley

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk mengenalpasti dan menganalisa berbagai jenis komponen litar RF dan memahami spesifikasi elektrikal litar. *Ability to identify and analyse various components of the RF circuit and understanding the electrical specifications of the circuit.*
2	Berkebolehan untuk merekabentuk litar-litar penuras, penguat, pengayun dan pemisah serta menyelesaikan masalah berkaitan dengan rekabentuk. *Ability to design circuits, filters, amplifiers, oscillators, separator, and solving problems related to the antenna design.*
3	Berkebolehan untuk menggunakan pakej berbantukan komputer untuk merekabentuk antenna dan litar HF dan menggunakan alatan RF dan gelombang mikro untuk pengujian litar. *Ability to use computer-aided package for design of HF antennas and circuits, and uses RF and microwave devices for circuit testing.*
4	Berkebolehan untuk menilai prestasi parameter antenna bagi sesuatu keadaan khusus yang diberikan. *Ability to evaluate the performance of the antenna parameters for a specific environment.*

KKKT4263   Sistem Pengoperasian
Operating Systems

Matlamat kursus ini ialah memberikan pengetahuan dan kefahaman konsep asas sistem pengoperasian, jenis-jenis dan khidmat sistem pengoperasian, proses-proses dan komunikasi antara-proses, perjadualan proses dan kebuntuan, sistem masukan dan keluaran, pengurusan ingatan dan sistem fail.

The course objective is to impart knowledge and understanding on the fundamental concepts of operating systems, their types and services, processes and interprocess communication, process scheduling and deadlocks, input and output systems, memory management and file systems.

Pra-Keperluan (jika ada): Tiada
Pre-Requisite (if any): None

Bacaan Asas:
References:

Stallings W., 2017. *Operating Systems: Internals and Design Principles, 9th Edition, Pearson, USA.*

Silberschatz A. et al., 2018. *Operating System Concepts, 10th Edition. Wiley, USA.*

Barnes, R. (Editor). 2017. *Operating Systems: Principles and Practice, Larsen and Keller Education.*

Anderson, A., Dahlin, M., 2014. *Operating Systems: Principles and Practice. 2nd Edition, Recursive Books.*

Tanenbaum A. S. & Woodhull A.S. 2006. *Operating Systems: Design and Implementation.   3rd   Edition.   USA: Prentice   Hall.*

Davis W.D. dan Rajkumar T.M. 2004.*Operating System a Systematic Review. 6th Edition. Addison Wesley, USA.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menganalisis permasaalahan dalam pengurusan proses, pengurusan ingatan dan pengurusan storan. *Ability to analyse problems in process, memory, file and I/O management.*
2	Berkebolehan membandingkan pelbagai teknik dalam sistem pengurusan ingatan. *Ability to compare different techniques in memory management systems.*

3	Kebolehan mensistesis dan menilai masalah dalam pengurusan proses. *Ability to synthesise and evaluate problems in process management.*
4	Kebolehan menggunakan simulasi komputer secara berkumpulan untuk menganalisa pelbagai jenis sistem pengurusan ingatan dan proses. *Ability to work in a group to implement computer simulations for analysing various types of memory and process management systems.*

KKKT4273   Teknologi Laser
Laser Technology

Matlamat kursus ini adalah untuk memberi pengetahuan dan pemahaman asas laser dan aplikasinya. Kursus ini menekankan konsep interaksi foton dan atom, penguat laser dan pengempaman optik, optik resonan, jenis-jenis laser dan kegunaannya dalam pelbagai bidang. Rekabentuk laser akan ditekankan berdasarkan jenis-jenis laser yang popular termasuk laser berkuasa tinggi dan rendah termasuk laser semikonduktor dan gentian. Berdasarkan ciri-ciri sinar laser yang unik, berbagai penggunaan laser dalam berbagai bidang akan dibincangkan.

The aim of this course is to give knowledge and basic understanding of laser and its applications. Emphasize on concept of photon and atom interaction, laser amplification and optical pump, optic resonance, types of lasers and usage in various field. Laser design will focus on the popular types of lasers which include high and low power lasers such as semiconductor lasers and fiber laser. Based on the characteristics of a unique laser beams, multiple use of lasers in various fileds will be discussed.

Pra-Keperluan (jika ada): Tiada
Pre-Requisite (if any): None

Bacaan Asas:
References:

Eugene H. 2015. Optics, 5/e. Addison-Wesley

Fedor M., 2016, *Fiber Optics: Physics and Technology 2nd ed. 2016 Edition, Springer.*

Reider, G. A., 2016, *Photonics, Springer.*

Kasap, S. O. 2012. *Optoelectronics and Photonics, 2nd Edition. Prentice Hall*

Saleh, B.E.A., Teich, M.C. 2007. *Fundamentals of Photonics. Wiley*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menghuraikan prinsip asas teori laser dan mampu menerangkan mekanisma-mekanisma yang berlaku dalam aplikasi teknologi laser *Ability to describe the basic principles of laser theory and could explain the mechanisms that occur in the application of laser technology.*
2	Berkebolehan menyelesaikan masalah yang berkaitan dengan teknologi laser pada masa kini. *Ability to solve problems associated with current laser technology.*
3	Berkebolehan merekabentuk laser berdasarkan pengetahuan dalam prinsip-prinsip asas bahan, fizik dan kejuruteraan laser termasuk pancaran stimulasi. *Ability to design laser based on knowledge in the basic principles of materials, laser physics and engineering, including the emission of stimulation.*
4	Berkebolehan menulis laporan mengenai penyelidikan terkini dalam teknologi laser. *Ability to write reports about the latest research in laser technology.*

KKKT4283 Rekabentuk Litar Analog CMOS/
CMOS Analog IC Design

Kursus ini membincangkan aspek rekabentuk litar analog yang berasaskan pemprosesan teknologi CMOS. Pemahaman konsep asas dan pembangunan model litar analog akan ditekankan untuk mengenalpasti beberapa parameter yang penting bagi sesuatu litar. Beberapa litar asas analog akan dianalisa seperti litar arus tingkap, litar rujukan dan juga litar penguat. Berasaskan kepada pemahaman konsep ini, kursus ini akan diakhiri dengan satu rekabentuk keseluruhan litar analog.

This course discusses aspects of analogue circuits based on CMOS process technology. Emphasis will be given to the fundamental understanding and models development for analogue circuit. Several basic analogue circuits will be analysed such as current mirrors, reference circtuis and analogue amplifiers. Based on this, the course will be directed towards the design and simulation of a complete analogue circuit.

Pra-Keperluan (jika ada):
KKKL2173   Elektronik Analog

Pre-Requisite (if any):
KKKL2173   Analog Electronics

Bacaan Asas:
*References***:**

Cilingiroglu, U. 2019. *Analog Integrated Circuit Design by Simulation: Techniques, Tools, and Methods. McGraw-Hill Education.*
Razavi B., 2016. *Design of Analog CMOS Integrated Circuits. 2nd Edition. McGraw-Hill.*
Rincon-Mora G., 2015. *Analog IC Design with Low-Dropout Regulators, 2nd Edition. McGraw-Hill Professional.*
Sedra, A.S., Smith, K.C., 2014, *Microelectronic Circuits, 7th edition, Oxford University Press.*
Carusone T.C., Johns D. and Martin K., 2011. *Analog Integrated Circuit Design. Wiley*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menerangkan konsep rekabentuk litar analog berasaskan CMOS *Able to explain the concept of analogue IC design using CMOS processes*
2	Mempunyai kebolehan untuk menerangkan model-model yang berkaitan dengan litar analog *Able to explain the models related to analog circuit.*
3	Berkebolehan untuk menganalisa litar-litar analog. *Able to analyse analog circuits.*
4	Berkebolehan untuk menganalisa prestasi litar penguat *Able to analyse analogue amplifer circuits*
5	Berkebolehan untuk merekabentuk keseluruhan litar analog *Able to design a complete analogue circuit*

KKKT4293 Pengenalan Teknologi MEMS
Introduction to MEMs Technology

Tujuan kursus ini adalah untuk memberi pengetahuan, kefahaman dan kebolehan kepada pelajar untuk merekabentuk peranti berasaskan teknologi MEMS. Kursus ini dimulakan dengan pengenalan kepada teori asas struktur peranti MEMS , bahan dan aplikasinya. Rekabentuk dan fabrikasi proses diperkenalkan termasuk proses pemesinan mikro/nano. Pelbagai kaedah sensor dan aktuator diperkenalkan dan dianalisis. Pelajar juga didedahkan kepada reka bentuk asas sensor MEMS dan peranti termaju seperti sensor bioperubatan.

The aim of this course is to provide students with knowledge, comprehension and ability to design devices using MEMS technology. This course begins with the introduction to basic theory of MEMS device structure, materials and applications. The design and fabrication processes are introduced which includes micro/nano machining process. Various sensing and actuation methods are introduced and analyzed. Students are also exposed to basic and advanced design of MEMS sensors such as biomedical sensors.

Pra-Keperluan (jika ada):Tiada
Pre-Requisite (if any): None

Bacaan Asas
*References***:**

Nihtianov, S. & Luque, A., 2018. *Smart Sensors and MEMS: Intelligent Sensing Devices and Microsystems for Industrial Applications International Edition. 2nd Ed. Duxford: Woodhead.*
Lee, Y.C., Cheng, Y. T.& Ramadoss, R., 2018. *MEMS Packaging. World Scientific Publishing.*
Castañer, L., 2015, *Understanding MEMS: Principles and Applications, 1st Edition. Wiley.*
Liu, C. 2014. *Foundations of MEMS: International Edition. 2nd Ed. Edinburgh: Pearson.*
Maluf, N & Williams, K., 2014. *An Introduction to Microelectromechanical Systems Engineering. 2nd Ed. Boston: Artech House.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk memerihalkan teori-teori asas dalam teknologi MEMS, termasuk asas struktur, bahan dan aplikasi. *Ability to demonstrate basic theories in MEMS technology, including basic structures, materials and applications.*
2	Berkebolehan untuk mengenal-pasti dan mengkelaskan setiap teknik pemesinan mikro dalam proses fabrikasi peranti MEMS. *Ability to distinguish and categorize each micro-machining techniques in MEMS fabrication process.*
3	Berkebolehan untuk mengusulkan proses asas mikrofabrikasi untuk membangunkan peranti MEMS. *Ability to propose basic microfabrication process to develop MEMS devices.*

4	Berkebolehan untuk mengintegrasi pengetahuan teknologi MEMS dalam penghasilan peranti-peranti termaju. *Ability to integrate knowledge of MEMS technology in producing advanced devices.*

KKKZ3073   Mesin Elektrik
Electrical Machines

Matlamat kursus ini ialah untuk memberikan pengetahuan dan kefahaman asas mesin elektrik yang memberi penekanan kepada topik-topik seperti litar magnet dan analog elektrik. Pengubah: Litar setara, kecekapan, jenisnya. Mesin AT: pembentukan, belitan, litar-magnet, tindakbalas angker, penukartertiban, pengekelasan motor AT dan penjana AT, ciri penjana AT, ciri penjana dan motor, kecekapan. Mesin AU: pembentukan, belitan, penghasilan medan magnet berputar, ciri pengulangalik dan motor sinkroni. Motor taruhan satu fasa dan tiga fasa, pembentukan pemutar, konsep gelincir dan operasiannya. Kawalan motor AT dan motor AU.

The aim for this course is to give knowledge and understanding on electrical machine fundamental which emphasize on chapters including magnetic circuit and electrical analogue. Transformer: Equivalent circuit, efficiency, classification, DC Machine: construction, winding, magnetic circuit, armature reaction, commutator, DC motor and DC generator classification, characteristic of generator and motor, efficiency, AC Motor: construction, winding, rotating magnetic field, characteristics of alternators and synchronous motor, single-phase and three-phase Induction motor, rotor construction, slip concept and operational. DC motor and AC motor control.

Pra-Keperluan (jika ada) : Tiada
Pre-Requisite (if any) : None

 Bacaan Asas:
*References***:**

Ramamoorty, M. & Sekhar, O. C. 2018. *Electrical Machines. Eastern Economy Edition. PHI Learning Private Limited.*
Gieras, J. F. 2016. *Electrical Machines: Fundamentals of Electromechanical Energy Conversion. International Standard Book. CRC Press.*
Bhattacharyya, M. 2016. *Electrical Machines: Modelling and Analysis. Eastern Economy Edition. PHI Learning Pvt. Ltd.*

Ryan, W.T. 2016. *Design of Electrical Machinery: A Manual for the Use, Primarily, of Students in Electrical Engineering Courses. Bibliolife DBA of Bibilio Bazaar II LLC.*

Walker, M. 2016. *Specification and Design of Dynamo-Electric Machinery. Classic Reprint. Fb&c Limited.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk menerangkan prinsip operasian, pembinaan dan penggunaan berbagai jenis mesin elektrik seperti pengubah, motor AT dan AU, penjana AU dan AT. *The ability to explain the operational principles, construction and use of various types of electric machines such as transformers, AC and DC motors, AC and DC generators.*
2	Berkebolehan untuk mengenalpasti dan membezakan berbagai jenis mesin elektrik. *The ability to identify and distinguish various types of electric machines.*
3	Berkebolehan untuk menganalisa pengaturan voltan, pengaturan kelajuan dan kecekapan bagi setiap mesin. *The ability to analyze voltage regulation, speed regulation and the efficiency of each machine.*
4	Berkebolehan untuk mentafsirkan model dan litar setara bagi motor dan penjana AT, penjana AU, dan Teknologi Motor Terkini. *The ability to interpret the model and equivalent circuit for DC motors and generators, AC generators and Recent Motor Technology*

KKKZ3123   Kejuruteraan Kawalan
Control Engineering

Matlamat kursus ini ialah memberikan pengetahuan dan kefahaman asas dalam bidang sistem kawalan. Ia merupakan kursus yang memberi penekanan terhadap kaedah analisis sistem kawalan yang meliputi topik teknik kawalan, pengkelasan teknik kawalan, sistem suap balik, sistem gelung terbuka, permodelan fizikal sistem dinamik, model fungsi pindah, graf aliran isyarat, sambutan fana sistem, kestabilan, tatasusun Routh, indek prestasi, teknik punca londar, kaedah sambutan frekuensi, plot Bode, kriteria Nyquist.

The objective of this course is to equip students with the knowledge and basic understanding of control system. Students will learn about analysis methods in control system such as classification of control techniques, feedback system, open loop system, physical modeling of dynamic system, transfer function model, signal flow graph, transient response, stability, Routh array, performance index, root locus technique, frequency response methods, Bode plot and Nyquist criterion

Pra-Keperluan (jika ada) :
KKKL2123   Isyarat dan Sistem

Pre-Requisite (if any):
KKKL2123   Signal and System

Bacaan Asas
References:

Nice, N.S.. 2015. *Control Systems Engineering. 7th Edition. John Wiley & Sons Inc.*
Ogata, K. 2013. *Modern Control Engineering. 5th   Edition. Pearson.*
Dorf, R.C. & Bishop, R.H. 2016. *Modern Control Systems. 13th Edition. Pearson.*
De   Oliveira,   M.C.   2017.   *Fundamentals   of   Linear   Control:*
    A   Concise   Approach.   Cambridge   University   Press.
Franklin,   G.F.,   Powell,   J.D.   &   Emami-Naeini,   A.   2014.
    Feedback   Control   of   Dynamic   Systems.   7th   Edition.   Pearson.
Golnaraghi,   F.   &   Kuo,   B.C.   2017.   *Automatic*
    Control   Systems.   10th   Edition.   Mc-Graw   Hill.

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Kebolehan untuk menerangkan konsep asas sistem kawalan dan mendapatkan fungsi pindah melalui konsep pemodelan. *Ability to describe basic concepts of a control system and determine its transfer functions through modelling concept.*
2	Kebolehan untuk mensintesis sambutan sistem kawalan dalam domain masa dan domain frekuensi. *Ability to synthesize system response in time domain and frequency domain.*
3	Kebolehan untuk mensintesis dan menerangkan kestabilan sesuatu sistem kawalan. *Ability to synthesize and tell the stability of a given control system.*
4	Kebolehan untuk menggunakan teori system kawalan di dalam permasalahan sebenar. *Ability to use control system theories in real problems.*

KKKZ3143 Kejuruteraan Kuasa
Power Engineering

Matlamat kursus ini adalah untuk memberikan pengetahuan dan kefahaman tentang kejuruteraan kuasa. Penekanan diberikan kepada pelbagai cabang komponen dalam penjanaan, penghantaran dan agihan kuasa. Antara tajuk yang dirangkumi adalah struktur sistem kuasa, komponen sistem kuasa, konsep asas kuasa, faktor kuasa, sistem tiga fasa, sistem per unit, parameter talian penghantaran, permodelan talian pendek, sederhana dan panjang, pendedahan asas voltan tinggi dalam sistem kuasa, komponen-komponen voltan tinggi dalam sistem pengagihan kuasa, penjanaan voltan tinggi, runtuhan dalam dielectric pejal dan gas, pengukuran voltan tinggi dan koordinasi penebat.

The course aims to provide knowledge and comprehension on power engineering. Emphasis is given to various components in power generation, power transmission and power distribution. Among the topics covered are power system structure, power system components, basic concept of power, power factor, 3-phase system, per unit system, transmission line parameters, modelling of short, medium and long transmission lines, basic introduction of high voltage engineering in power system, high voltage components in power distribution systems, high voltage generation, breakdown in solid, gases and liquid dielectric, high voltage measurement, and insulation coordination.

Pra-Keperluan (jika ada) :
KKKL1123 Teori Litar II

Pre-Requisite (if any) :
KKKL1123 Circuit Theory II

Bacaan Asas:
*References***:**

Ahmad, M. 2018. *Operation and Control of Renewable Energy Systems. 1st Edition. John Wiley & Sons. Ltd*
Fan, L. 2017. *Control and Dynamics in Power Systems and Microgrids. CRC Press.*
Bevrani, H. & Hiyama, T. 2017. *Intelligent Automatic Generation Control. CRC Press.*
Glover J. D. Sarma, M. S. & Overbye, T. J. 2016. *Power System Analysis and Design. 6th Edition. Cengage Learning.*
Kuffel, P., Zaengl, W.S. & Hammond, P. 2013. *High Voltage Engineering: Fundamentals. Pergamon Press.*
Saadat, H. 2010. *Power System Analysis. 3rd Edition. Mc Graw Hill.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan untuk membezakan penjanaan, penghantaran dan agihan kuasa serta mengaplikasikan teori tiga fasa dan sistem per unit untuk menganalisa talian penghantaran. *Ability to distinguish power generation, transmission and distribution; apply the three phase theory and per unit system to analyse transmission lines.*
2	Berkebolehan untuk menganalisa dan mensintesis model talian penghantaran jarak pendek, sederhana dan panjang. *Ability to analyze and synthesis short, medium and long transmission line models.*
3	Berkebolehan untuk menerangkan dan membezakan pelbagai jenis pengalir voltan tinggi dan kabel voltan tinggi *Ability to explain and distinguish various types of high voltage power conductors and cables.*
4	Berkebolehan untuk menyiasat perbagai komponen voltan tinggi di sistem pengagihan kuasa. *Ability to examine the various high voltage components in power distribution systems.*

KKKZ4013   Bioisyarat dan Sistem
Biosignal and System

Prinsip instrumentasi perubatan telah diberikan dengan penekanan yang khusus terhadap peralatan elektronik. Secara amnya, kursus ini memberi penekanan kepada topik-topik berikut: kekangan isyarat perubatan, pengaturan peranti perubatan, aktiviti elektrik terhadap sel-sel teruja, electroneurogram, electromyogram, electrocardiogram, electroencephalogram, pengkutuban elektrod dan elektrod model, antaramuka kulit elektrod, model litar mikroelektrod, keperluan penguat biopotensi, electrocardiograph, pemproses biopotensi dan jenisnya, kesan fisiologi terhadap arus elektrik, kejutan mikro dan kejutan makro, pencegahan bahaya, DSP untuk isyarat biologi dan akhir sekali kajian kes dalam isyarat biologi.

Principles of medical instrumentation are reviewed. Special emphasis is put on electronic apparatus. Generalized instrumentation systems. Medical signal constraints. Regulation of medical devices, Electrical activity of excitable cells, The electroneurogram, electromyogram, The electrocardiogram, the electroencephanogram, Polarization of electrodes and electrode models, Requirements of biopotential amplifiers, The electrocardiograph, Other types of biopotential processors. Physiological effects of electrical current, Microshock and Macroshock, Hazard prevention, DSP for biological signals. Case studies in biological signals.

Pra-Keperluan (jika ada) : Tiada
Pre-Requisite (if any) : None

Bacaan Asas:
References:

Kaniusas, E. 2015. *Biomedical Signals and Sensors II: Linking Acoustic and Optic Biosignals and Biomedical Sensors. Springer.*

Bronzino, J. D. & Peterson, D. R.. 2014. *Biomedical Engineering Fundamentals. CRC Press.*

Webster, J. G. & Eren, H. 2014. *Measurement, Instrumentation, and Sensors Handbook, Second Edition: Two-Volume Set. CRC Press.*

Sarpeshkar, R. 2010. *Ultra Low Power Bioelectronics: Fundamentals, Biomedical Applications, and Bio-Inspired Systems. Cambridge University Press (versi terkini).*

Webster, J.G. 2009. *Medical Instrumentation Application and Design, 4th Edition. John Wiley (versi terkini).*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan membuat kesimpulan spesifikasi sistem tertentu diperlukan berdasarkan permohonan tertentu dan asal biosignal dalam tubuh manusia. *Ability to infer specifications of particular system required based on the particular application and origin of the biosignal in the human body.*
2	Berkeupayaan untuk menilai kesan fisiologi dan had keselamatan arus elektrik pada tubuh manusia. *Ability to analyze the physiological effects and safety limits of electric currents on human body.*
3	Berkeupayaan untuk menggambarkan sumber gangguan utama dan menganalisis kesannya kepada kualiti rakaman isyarat biologi. *Ability to describe the main interference sources and analyze their effect on the quality of biological signal recording.*
4	Berkebolehan menyediakan sistem rakaman Bioelectrical. *Ability to prepare a bioelectrical recording system.*

KKKZ4023 Perlindungan dan Keselamatan Sistem Kuasa
Power System Protection and Safety

Matlamat kursus ini ialah untuk memberikan pengetahuan dan kefahaman tentang perlindungan sistem kuasa dan keselamatan elektrik. Ia memberi pengetahuan tentang peranti perlindungan sistem kuasa seperti pengubah

arus, pengubah voltan, geganti, fius, pemutus litar dan penutup semula. Jenis geganti seperti geganti IDMT, arus lebihan, geganti galangan, geganti jarak, geganti kebezaan. Perlindungan penjana, pengubah, basbar dan talian. Gegantian berkomputer. Penyelarasan geganti. Sistem pembumian. Kesan fisiologi terhadap renjatan elektrik. Akta Bekalan Elektrik 1990, Malaysia. Kod Keselamatan Elektrik Kebangsaan 1994, Malaysia.

The objective of this course is to give knowledge and understanding of power system protection and electrical safety. It gives knowledge about the devices of power system protection such as current transformer, voltage transformer, relay, fuse, circuit breaker and reclosure. Relay types such as IDMT relay, excessive current, impedance relay, distance relay and differential relay. Generator, transformer, busbar and line protection. Computerized relay. Relay coordination. Earthing system. Physiology effect towards electric shock. Electricity Supply Act 1990, Malaysia. National Electrical Safety Code 1994, Malaysia.

Pra-Keperluan (jika ada) : Tiada
Pre-Requisite (if any) :None

Bacaan Asas:
References:

Duncan, J. G., Sarma, M. S. & Overbye, T. J. 2016. *Power System Analysis and Design. Thomson Learning.*
Das, J. C. 2017. *Power System Protective Relaying. CRC Press.*
Cadick, J., Windfield, A. & Capelli-Schellpfeffer, M. 2018. *Electrical Safety Handbook. Mc Graw Hill.*
Cooper W. F. 2011. *Electrical Safety Engineering. UK. Butterworth Scientific.*
Wentz, C. A. 1999. *Safety, Health and Environmental Protection. McGraw Hill.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan menerangkan dan menyenarai pelbagai peranti perlindungan (geganti, pemutus litar, penutup semula, dll) yang digunakan dalam perlindungan system kuasa. *Ability to describe various protection devices (relays, circuit breakers, reclosers etc) used in power system protection.*

2	Berkebolehan memeriksa operasi geganti untuk perlindungan talian agihan, talian penghantaran, penjana, alatubah dan motor. *Ability to examine relay protection and operations for distribution line protection, transmission line, generator, transformer and motor.*
3	Berkebolehan menganalisa (kajian kes) kemalangan disebabkan oleh bahaya elektrik dan mencadangkan penyelesaiannya. *Ability to analyse (case studies) of accidents caused by electrical hazard and propose solutions.*
4	Berkebolehan merekabentuk dan menyelesaikan masalah pembumian, perlindungan litar pintas dan kilat dalam keselamatan elektrik. *Ability to design and solve problems related to earthing, short circuit and lightning protection as measures of electrical safety. (Design and conduct)*

KKKZ4033   Analisis Sistem Kuasa
Power System Analysis

Matlamat kursus ini ialah memberikan pengetahuan dan kefahaman tentang analisis aliran kuasa, analisis kerosakan atau litar pintas dan analisis kestabilan fana dalam sistem kuasa. Analisis aliran beban adalah dengan menggunakan teknik lelaran seperti teknik Newton Raphson, Gauss Seidel dan Fast Decoupled. Termasuk dalam kursus ini adalah analisis kerosakan seimbang dan tak seimbang yang merangkumi teori komponen simetri dan penggunaannya. Analisis kerosakan meliputi analisis terhadap berbagai jenis kerosakan seperti kerosakan satu-talian-ke-bumi, dua-talian-ke-bumi dan fasa tiga. Analisis kestabilan fana dalam sistem kuasa turut diajar dengan mengambilkira terbitan persamaan buai dan penggunaan kaedah kriteria luas sama bagi penilaian kestabilan. Simulasi sistem kuasa dilakukan dengan menggunakan perisian analisis sistem kuasa seperti Digsilent, PSS/E, PSAT, Power World Simulator dan Matpower untuk tujuan analisis aliran beban, kerosakan dan kestabilan.

The objective of this course is to provide knowledge and understanding on power flow analysis, fault analysis or short circuit and stability analysis in power system. Load flow analysis will be done by using iterative techniques such as the Newton Raphson, Gauss Seidel and Fast Decoupled techniques. Other topics include balanced and unbalanced fault analyses including symmetrical component theory and its application. Fault analyses include single-line to ground, double-line to ground and three phase faults. Transient stability analysis in power systems will be taught considering derivation of the swing equation and using the equal area criteria for stability assessment. Power system simulations will be carried out using softwares such as Digsilent, PSS/E, PSAT, Power World Simulator and Matpower for load flow, fault and stability analyses.

Pra-Keperluan (jika ada) : Tiada
Pre-Requisite (if any) : None

Bacaan Asas:
*References***:**

Glover J. D., Overbye, T. J. & Sarma, M. S. 2017. *Power System Analysis and Design. Cengage Learning.*
Grainger, J. J., Stevenson, W. D. & Chang, G. W. 2016. *Power System Analysis. McGraw Hill Higher Education.*
Murty, P. S. R. 2017. *Power System Analysis. Butterworth-Heinemann.*
Hadi Saadat. 2011. *Power System Analysis. 3rd Edition. PSA Publishing.*
Shertukde, H.M. 2019. *Power System Analysis Illustrated with MATLAB and ETAP. CRC Press.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan menjalankan kaedah Gauss Seidel, Newton Raphson dan Fast Decoupled untuk analisis aliran beban. *Ability to perform Gauss Seidel, Newton Raphson and Fast Decoupled techniques for power flow analysis*
2	Berkebolehan untuk menganalisa kerosakan seimbang dan tak seimbang menggunakan komponen simetri. *Ability to analyse balanced and unbalanced faults using symmetrical component.*
3	Berkebolehan untuk mengaplikasi kaedah kriteria luas sama untuk analisis kestabilan fana. *Ability to apply equal area criterion method for steady state stability analysis.*
4	Berkebolehan membangunkan model rangkaian kuasa dengan menggunakan perisian seperti Digsilent, Power World Simulator, Matpower dan PSAT. *Ability to construct power network models using software tools such as Digsilent, Power World Simulator, Matpower and PSAT.*

KKKZ4043   Kualiti Kuasa
Power Quality

Matlamat kursus ini ialah memberikan pengetahuan, kefahaman dan sintesis dalam bidang kualiti kuasa. Kursus ini merupakan kursus lanjutan yang memberi penekanan terhadap topik pengenalan kualiti kuasa, jenis gangguan kualiti kuasa, fana, lendut voltan, gelembung voltan, harmonik, voltan lebihan, voltan berkurangan, herotan bentuk gelombang, kaedah pemantauan kualiti kuasa, pemilihan peralatan dan tempat pengawasan,

punca lendut voltan, harmonik dan fana. Peralatan pembaikan kualiti kuasa seperti penapis harmonik, sistem bekalan kuasa tanpa gangguan, penyesuaian kuasa, pemampas statik, pemulih voltan dinamik turut diajar.

Objective of this course is to provide knowledge, understanding and synthesis in power quality study. This advance course gives emphasis on power quality introduction, types of power quality disturbance, transient, voltage sag, voltage swell, harmonic, over voltage, under voltage, waveform distortion, power quality monitoring technique, voltage sag source, instrument selection, monitoring area, PQ benchmarking, DG impacts on power quality. Rectification instrument for power quality such as harmonic filter, uninterrupted power supply system, power adjustment, static compensator and dynamic voltage restorer will also be taught in this course.

Pra-Keperluan (jika ada) : Tiada
Pre-Requisite (if any) : None

Bacaan Asas:
References:

Sankaran, C. 2017. *Power Quality.* CRC Press.
Donsion, M.P. & Buzdugan, M. I. 2017. *Power Quality.* Cambridge Scholars Publishing.
Singh, B. C. A. & Al-Haddad, K. 2015. *Power Quality: Problems and Mitigation Techniques. Wiley.*
Faisal, M.F. 2015. *Voltage Sag Solutions for Customers. Tenaga Nasional Berhad.*
Masoum, M.A.S. & Fuchs, E.F. 2015. *Power Quality in Power Systems and Electrical Machines. Academic Press.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan mengenalpasti dan menganalisis berbagai jenis gangguan kualiti kuasa, punca dan kesannya, serta pemiawaian kualiti kuasa. *Ability to identify and analyse various PQ disturbance types, sources, effect and power quality standardization, UPS, STATCOM, DVR, PQ Monitoring Devices to solve PQ problems.*
2	Berkebolehan menerangkan kesan alam sekitar dan impak ekonomi yang disebabkan oleh masalah gangguan kualiti kuasa. *Ability to explain environmental and economic impact caused by power quality disturbances.*

3	Berkebolehan untuk melaksanakan pengawasan data dan analisis data menggunakan peranti kualiti kuasa seperti meter perakam kuasa kawalan jauh. *Ability to perform data monitoring and data analysis using PQ device (e.g. remote power recording meter).*
4	Berkebolehan untuk melaksanakan pemodelan, simulasi dan analisa data kualiti dengan menggunakan perisian komputer (cth. dengan menggunakan MATLAB dan/atau PSCAD). *Ability to work on modeling, simulation and analysis of PQ data using computer software (e.g. using MATLAB and/or PSCAD).*

KKKZ4063   Sistem Kawalan Berkomputer
Computer Controlled Systems

Kursus ini membincangkan pelbagai aspek pengaplikasian komputer dalam sistem kawalan yang merangkumi aspek pemilihan dan konfigurasi alatan, simulasi, analisis sistem masa diskrit, penalaan pengawal diskrit dan permodelan sistem masa diskrit.

This course discusses variety aspects of computer application in control system, which covers aspect of instrument selection and configuration, simulation, discrete time system analysis, digital controller tuner and discrete time system modeling.

Pra-Keperluan (jika ada) : Tiada
Pre-Requisite (if any) : None

Bacaan Asas:
References:

Phillips, C.L., Nagle, T. & Chakrabortty, A. 2015. *Digital Control System Analysis and Design. 4th Edition. Pearson.*
Dorf, R.C. & Bishop, R.H. 2017. *Modern Control Systems. 13th Edition. Pearson.*
Nise, N.S. 2015. *Control Systems Engineering. 7th Edition. Wiley.*
Kang-Zhi Liu & Yu Yao. 2016. *Robust Control: Theory and Applications. 1st Edition. Wiley.*
Astrom & Wittenmark. 2011. *Computer Controlled System: Theory and Design. 3rd Edition. Prentice Hall.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomexs (CO)*
1	Berkebolehan untuk menerangkan elemen-elemen penting bagi sistem kawalan berkomputer daripada segi perkakasan dan perisian. *Ability to explain the important elements of computer control system from hardware and software point of view.*

2	Berkebolehan untuk menjelaskan konsep sistem masa diskrit dan menganalisa ciri-ciri sistem masa diskrit. *Ability to illustrate the concepts of discrete time systems and to analyse the characteristics of discrete time systems.*
3	Berkebolehan untuk merekabentuk pengawal digital asas dan merumuskan penalaan pengawal. *Ability to design basic digital control and formulate control tuning.*
4	Berkebolehan untuk membina program pemodelan dan simulasi. *Ability to build modeling and simulation program.*

KKKZ4113 Elektronik Kuasa
Power Electronics

Matlamat kursus ini ialah untuk memberikan pengetahuan, kefahaman dan kemahiran asas sistem elektronik kuasa. Antara isi kandungan kursus ialah pengenalan sistem elektronik kuasa, teknologi, aplikasi dan isu-isu semasa yang berkaitan. Ciri-ciri, penggunaan dan kawalan peranti kuasa dibincangkan. Litar penukar kuasa seperti litar penerus satu dan tiga fasa, litar pemotong serta litar penyongsang satu dan tiga fasa dipelajari. Teknik pensuisan modulasi lebar denyut (PWM) serta pemacuan motor arus terus dan motor aruhan diperkenalkan. Pemodelan litar elektronik kuasa menggunakan perisian MATLAB Simulink atau Pspice dilakukan. Latihan amali di makmal atau projek mini turut dilaksanakan.

The objective of this course is to give knowledge, comprehension and basic skills of power electronics system. The contents of the course include the introduction to power electronic systems, technology, application, and related current issues. The power devices characteristics, usage and control is discussed. Power converter circuits such as single and three phase rectifiers, choppers and inverters are studied. Pulse width modulation (PWM) switching technique, DC motor and induction motor drives are introduced. Power electronics circuit modelling using MATLAB Simulink or Pspice softwares is carried out. A practical experiment in the laboratory or mini project will also be conducted.

Pra-Keperluan (*jika ada*):   Tiada
Pre-Requisite (if any):   *None*

Bacaan Asas:
References:

Trzynadlowski, A.M. 2015. *Introduction to Modern Power Electronics.Wiley.*
Euzili, C. D. S. Jr. & Edison, R. C. D. S. 2015. *Advanced Power Electronics Converters. IEEE Press dan Wiley.*
Mahesh, P. & Pankaj, R. 2015. *Control Systems for Power Electronics: A Practical Guide. Springer India.*

Muhammad, H. R. 2014. *Power Electronics: Devices, Circuits, and Applications, International Edition. 4th Edition. Pearson Education Limited.*

Mohan, N., Undeland, T. M. & Robbins, W. P. 2003. *Power Electronics Converters, Applications and Designs. 3rd Edition. John Wiley & Sons, Inc (versi terkini).*

Hart, D. W. 2011. *Power Electronics. McGraw-Hill (versi terkini).*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan memahami sistem elektronik kuasa dan teknologinya. *Ability to comprehend power electronics and its application.*
2	Berkebolehan mengaplikasi dan mengoperasikan litar-litar penukar kuasa. *Ability to apply and operate power converter circuits.*
3	Berkebolehan menerangkan operasi pemacu motor. *Ability to describe the operation of motor drives.*
4	Berkebolehan memodel dan menyelaku litar penukar kuasa menggunakan alatan komputer. *Ability to model and simulate power converter circuits using computer tool.*

KKKZ4124   Rekabentuk Sistem Kawalan
Control System Design

Matlamat kursus ini ialah memberikan pengetahuan dan kefahaman dalam merekabentuk sistem kawalan. Ia merupakan lanjutan kepada kursus sistem kawalan yang memberi penekanan terhadap teknik-teknik rekabentuk sistem kawalan moden, kawalan klasik dan rekabentuk sistem kawalan lasak. Turut diajar dalam kursus adalah kaedah rekabentuk sistem kawalan berbantu komputer dengan memanfaatkan alat perisian seperti MATLAB dengan Simulink dan Kotak Alatan Sistem Kawalan.

The objective of this course is to give knowledge and understanding in designing a control system. It is an extension of control system course that emphasizes on the design of modern control system techniques, classical control and the design of robust control system. Design technique with computer assisted control system will also be taught in the course, with the help of commercial software tool like MATLAB with Simulink and Control System Toolbox.

Pra-Keperluan (jika ada) : Tiada
Pre-Requisite (if any) : None

Bacaan Asas:
References:

Nise, N. S. 2019. *Control Systems Engineering. 8th Edition. John Wiley & Sons Inc.*

Dorf, R. C. & Bishop, R. H. 2016. *Modern Control Systems. 13th Edition. Pearson Education.*

Clark, R. N. 2015. *Control Systems Dynamics. Cambridge University Press.*

Ogata, K. 2012. *Modern Control Engineering. 5th Edition. Pearson Education (versi terkini).*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkeupayaan menerangkan struktur serta teknik-teknik rekabentuk sistem kawalan secara berkumpulan. *Ability to describe the structure and techniques to design a control system in a group..*
2	Berkeupayaan mentafsir spesifikasi rekabentuk dan memanipulasi strategi sistem kawalan berasaskan objektif kawalan dalam domain masa dan frekuensi. *Ability to interpret design specifications and manipulate the control system strategy based on the control objectives in time domain and frequency domain.*
3	Berkeupayaan menilai dan mewajarkan sistem kawalan yang telah dibangunkan. *Ability to evaluate and justify the developed control system.*
4	Berkeupayaan merekabentuk suatu sistem kawalan lasak. *Ability to design a robust control system.*

KKKZ4133 Penjanaan Kuasa Elektrik dan Pertukaran Tenaga
Electrical Power Generation and Energy Conversion

Matlamat kursus ini ialah untuk memperkenalkan dan memberi kefahamam tentang konsep asas penjanaan dan pertukaran tenaga. Topik yang diperkenalkan termasuk prinsip dan kaedah penjanaan kuasa, loji terma, hidro, gas, dan sebagainya; pertukaran tenaga termoelektrik, ion haba, fotovoltan, hidrodinamik magnet, elektromekanikal, sel bahan api dan bateri; Penguja, pengatur voltan automatik, penguasa laju untuk kawalan frekuensi dan voltan; dan kawalan penjanaan dan permodelan bagi penjana, beban, penggerak utama, dan penguasa. Penghantaran beban ekonomik dan kaedah lelaran lambda, komitmen unit dan kaedah penyelesaiannya juga turut dibincangkan.

The objective of this course is to introduce and give understanding about the basic concept of electrical power generation and energy conversion. The topics that will be discussed include the principles and methods of power generation, thermal plant, hydro, gas, nuclear and so on; thermoelectric energy conversion, heat ion, photovoltaic, magnetic hydrodynamic, electromechanical, fuel cell and battery; exciter, automatic voltage regulator, speed governor for frequency and voltage controller, generation controller and generator modelling, load, prime mover, and governor. Economic load transmission and lambda iteration method, unit commitment and its solution will also be discussed.

Pra-Keperluan (jika ada) : Tiada
Pre-Requisite (if any) : None

Bacaan Asas:
References:

Breeze, P. 2019. *Power Generation Technologies. 3rd Edition. Newnes.*
Luo, F. L. & Ye H. 2017. *Renewable Energy Systems: Advanced Conversion Technologies and Applications, Reprint Edition. CRC Press, Taylor and Francis.*
Sopian K., Othman, M.Y.H. & Yatim, B. 2000. *Renewable Energy: Resources and Applications in Malaysia. 2nd Edition. Selangor: Pusat Tenaga Malaysia. (versi terkini).*
Glover, J. D., Sarma, M. S. & Overbye, T. J. 2017. *Power System Analysis and Design. 6th Edition. Cengage Learning.*
Tyagi, H., Agarwal, A.K., Chakraborty, P.R. & Powar, S. 2018. *Applications of Solar Energy. Springer.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkeupayaan melakar konsep asas penjanaan kuasa dan pertukaran tenaga konvensional dan bukan konvensional *Ability to sketch basic concept and characteristics of conventional and non-conventional energy conversion and generation.*
2	Berkebolehan memerihal, mengenalpasti dan memanggil semula maklumat serta menyelesaikan masalah asas dalam pertukaran tenaga. *Ability to describe, identify and recall information as well as solve basic energy conversion problems.*

3	Berkebolehan memperihal teknik-teknik pengawalan frekuensi dan voltan yang diaplikasikan dalam loji kuasa dan sistem kuasa. *Ability to explain frequency and voltage control techniques applied in power plants and in power systems.*
4	Berkebolehan mencadangkan ciri-ciri loji kuasa berdasarkan masalah penghantaran beban ekonomik dan komitmen unit. *Ability to propose power plant characteristics based on economic dispatch and unit commitment problems.*

KKKZ4162   Projek Ilmiah I
Project I

Satu kajian ilmiah yang berkaitan dengan bidang kajian/pengkhususan di Program Kejuruteraan Elektrik dan Elektronik (PKE) yang mesti disediakan oleh setiap pelajar tahun akhir sebagai memenuhi syarat bagi penganugerahan Ijazah Sarjanamuda Kejuruteraan. Projek ini berbentuk penyelidikan yang merangkumi penganalisian data, pembangunan perisian atau perkakasan. Setiap pelajar dikehendaki menyediakan satu laporan lengkap yang sekurang-kurangnya mengandungi pengenalan, objektif kajian, kajian kepustakaan, metodologi kajian, jadual kerja dan senarai rujukan. Pelajar juga perlu menunjukkan keputusan awal penyelidikan. Projek ini akan diteruskan dalam kursus KKKZ4164 pada semester berikutnya.

An academic research that related to research field/ specialisation at the Program of Electrical and Electronic Engineering (PKE) that must be prepared by all final year students to fulfil the requirements for bachelor degree of engineering awarded. This project is a type of research that involves data analysis, software or hardware development. Each student is expected to prepare a complete report that at least contains introduction, objectives, literature review, research methodology, project schedule planning and references. The students also are required to attach the research preliminary status. This project will be continued in KKKZ4164 in the subsequent semester.

Pra-Keperluan (*jika ada*):   Tiada
Pre-requisite (if any):   *None*

Bacaan Asas/ *References:*

Pusat Pengurusan Siswazah. 2015. *Panduan Penulisan Tesis Gaya UKM. Edisi ke-3. Penerbit UKM.*
Friedland, A.J., Folt, C.L. & Mercer, J.L. 2018. *Writing Succesful Science Proposals. 3rd Edition. Yale University Press.*
Eco, U. 2015. *How to Write a Thesis. Massachusetts Institute of Technology (MIT) Press.*

Irish, R., Poe, M. & Deans, T. 2016. *Writing in Engineering: A Brief Guide. Oxford University Press.*
Heard, S.B. 2016. *The Scientist's Guide to Writing: How to Write More Easily and Effectively throughout Your Scientific Career. Princeton University Press.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan memilih pengetahuan dan kemahiran kejuruteraan yang bersesuaian dalam menangani suatu masalah kejuruteraan yang signifikan. *Ability to select suitable engineering knowledge and skills in handling any significant engineering problem.*
2	Berkebolehan mengkategorikan penyataan masalah kejuruteraan *Ability to categorize engineering problem statement.*
3	*Berkebolehan menerangkan hasil kerja/kertas kerja penyelidikan terdahulu yang berkaitan dengan projek.* *Ability to describe previous research work/proposal related to project.*
4	Berkebolehan merekabentuk penyelesaian yang sesuai untuk sesuatu masalah kejuruteraan. *Ability to identify solutions suitable for any certain engineering problem.*
5	Berkebolehan melaksanakan aktiviti projek dengan menyeluruh. *Ability to perform project activities comprehensively.*

KKKZ4164   Projek Ilmiah II
Project II

Kursus ini merupakan sambungan kepada projek ilmiah KKKZ4162. Hasil kerja projek bersama-sama dengan kerja yang dilakukan dalam projek ilmiah I perlu dilaporkan dalam satu laporan akhir berbentuk disertasi. Format penulisan perlu mengikut format dalam panduan menulis tesis Gaya UKM. Projek ini akan dinilai oleh penyelia dan ahli jawatankuasa dalam bentuk pemeriksaan tesis, laporan teknikal dan lisan pada penghujung semester berkenaan.

This course is a continuation of Project I KKKZ4162. Project results together with the work done in Project I have to be documented in a final report in a form of dissertation. The writing format has to follow specifications in the writing guidelines for thesis writing using the UKM style. This project will be evaluated by the supervisor and another assessor in the form of a thesis, technical report and oral assessment at the end of the semester.

Pra-Keperluan (jika ada) :
KKKZ4162   Projek Ilmiah I

Pre-requisite (if any):
KKKZ4162   Project I

Bacaan Asas:
References:

Pusat   Pengurusan   Siswazah.   2015.   *Panduan   Penulisan Tesis   Gaya   UKM.   Edisi   ke-3.   Penerbit   UKM.*
Friedland,   A.J.,   Folt,   C.L.   &   Mercer,   J.L.   2018.   *Writing Succesful   Science   Proposals.   3rd   Edition.   Yale   University   Press.*
Eco,   U.   2015.   *How   to   Write   a   Thesis. Massachusetts   Institute   of   Technology   (MIT)   Press.*
Irish,   R.,   Poe,   M.   &   Deans,   T.   2016.   *Writing   in Engineering: A   Brief   Guide.   Oxford   University   Press.*
Heard, S.B. 2016. *The Scientist's Guide to Writing: How to Write More Easily and Effectively throughout Your Scientific Career. Princeton University Press.*

Hasil Pembelajaran
Course Outcomes

Bil No.	Hasil Pembelajaran Kursus *Course Outcomes (CO)*
1	Berkebolehan menakrif penyataan masalah kejuruteraan dan mengenalpasti kaedah penyelesaian sesuai. *Ability to define engineering problem statement and identify suitable solutions.*
2	Berkebolehan menilai hasil kerja/kertas kerja penyelidikan terdahulu yang berkaitan dengan projek. *Ability to assess previous research work/proposal related to project.*
3	Berkebolehan merekabentuk dan melaksanakan penyelesaian yang sesuai untuk sesuatu masalah kejuruteraan *Ability to design and execute solutions suitable for any certain engineering problem.*
4	Berkebolehan merancang dan menguruskan satu projek penyelidikan dengan jayanya *Ability to plan and manage a research project successfully.*
5	Berkebolehan menganalisa dan mentafsirkan data/hasil dari eksperimen/projek. *Ability to analyse and interpret data/outcomes from experiment/project.*