



FACULTY OF ENGINEERING



ACADEMIC SESSION 2021/2022

POSTGRADUATE HANDBOOK

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ABOUT US

Faculty of Engineering (FE) was formed on 1st July 2018, by merging 6 big faculties into one. With the transformation, Faculty of Engineering now comprises six schools namely School of Biomedical Engineering and Health Sciences, School of Chemical and Energy Engineering, School of Civil Engineering, School of Computing and School of Electrical Engineering. This transformation strengthens the collaboration of expertise with different engineering backgrounds within the faculty.

VISION

To be a premier global faculty in engineering and technology

MISSION

Synergizing academic capacity to nurture holistic talents and lead in innovative technologies.

MOTTO

Nurturing Talents. Delivering Excellence.

UNIVERSITI RANKING

UTM is now ranked at #191 Globally : QS World University **Rankings 2021**. **Universiti Teknologi** Malaysia continues soaring high internationally when its performance improved to Top 15% in the Quacquarely Symonds (QS) World University **Rankings 2021**, recently.



EDUCATIONAL GOALS

Bil.	Matlamat Pendidikan UTM
1	<p><i>Demonstrate knowledge and competency in various field of study, appropriate research and professional practices, and the processes of critical thinking, creative thinking, and problem solving for universal well-being and prosperity</i> <i>Mempamerkan pengetahuan dan kemahiran dalam pelbagai bidang pengajian, amalan penyelidikan dan profesional yang bersesuaian serta proses-proses pemikiran kritis, pemikiran kreatif dan penyelesaian masalah untuk kemakmuran dan kesejahteraan sejagat.</i></p>
2	<p><i>Demonstrate high standard of ethical conduct, positive character, and societal responsibilities</i> <i>Mempamerkan taraf etika yang tinggi, watak positif, dan tanggungjawab sosial</i></p>
3	<p><i>Appreciate and always be guided by the Universiti Teknologi Malaysia core values of Integrity, Synergy, Excellence and Sustainability</i> <i>Menghayati dan sentiasa berpandukan nilai-nilai teras Universiti Teknologi Malaysia iaitu integriti, sinergi, kecemerlangan dan kelestarian</i></p>
4	<p><i>Communicate and collaborate effectively with other professionals, and the society</i> <i>Berkomunikasi dan bekerjasama secara berkesan dengan ahli profesional yang lain serta masyarakat</i></p>
5	<p><i>Demonstrate the ability to learn and grow profesionally and further contribute to the development of science, technology and engineering</i> <i>Menunjukkan keupayaan untuk belajar dan meningkat secara profesional dan seterusnya menyumbang kepada pembangunan sains, teknologi dan kejuruteraan</i></p>

MESSAGE FROM THE DEAN



Faculty of Engineering (FE), also known as UTM Engineering is currently accommodating more than 10,000 undergraduate and postgraduate students, and therefore has become one of renowned institutions in Malaysia to provide professional and engineering workforce to the market, making UTM proud to be the premier engineering university.

Faculty of Engineering has more than 700 engineering specialists in various engineering fields of Civil, Electrical, Chemical, Mechanical, Biomedical and Computing. With this broad expertise, FE aims to build a borderless future particularly in providing knowledge across multi-disciplines to address contemporary global challenges.

With this strength, FE is determined to continue to be a leading academic excellence institution based on the mission and vision of the faculty along with the slogan of “Nurturing Talent, Delivering Excellence”.

As well all know, the presence of unexpected Covid-19 pandemic has contributed to disruptive life-changing situation, particularly in the delivery of our teaching and learning since 2020. During this uncertainty period, FE is managing with our best mechanisms to continually provide teaching and learning activities through multiple learning platforms and pedagogies to accommodate with the new normal.

Finally, let us engineer the future through meaningful collaboration together for the benefit of our nation.

Professor Ts. Dr. Ruzairi bin Abdul Rahim
Dean, Faculty of Engineering,
Universiti Teknologi Malaysia

ORGANISATION STRUCTURE



POSTGRADUATE STUDY

Doctor of Philosophy

Doctor of Philosophy (PhD) is a research-only qualification designed for students who intend to pursue an academic or research career. The degree is awarded on the basis of the submission of a thesis which should give evidence of the candidate's ability to carry out research, evidence that the candidate has shown originality and independence, and that the candidate has made a significant contribution to knowledge in a particular field.

Research Masters Degrees

The Master by research is supervised by a graduate faculty (or a panel of graduate faculty members). The directed research work introduces candidates to the processes by which new knowledge is developed and applied accordingly

Mixed Mode Masters Degrees

Student must complete a minimum of 21 credits of courses and an equivalent of 21-credit research component, and must obtain a final academic grade of at least 3.0 CGPA.

Coursework Masters Degrees

Student must complete a minimum of 40 credits, and must obtain a final academic grade of at least 3.0 out of 4.0 CGPA. Minimum 40-credit consists of several subject modules including faculty compulsory, faculty electives, a university elective module and a Master's project.

ENTRY REQUIREMENTS

Doctor of Philosophy

- A Master's Degree from Universiti Teknologi Malaysia or any other Institutions of higher learning recognised by the Senate; Universiti Teknologi Malaysia, and approved by the Graduate Studies Committee of the respective faculty and the Senate.
- Other qualifications equivalent to a Master's degree and experience in the relevant field recognised by the Senate; or
- Candidates who are currently registered in a Master's Degree programme at Universiti Teknologi Malaysia, and approved by the Graduate Studies Committee of the respective faculty and the Senate.

Master's Degree

- A Bachelor's Degree with good honours from Universiti Teknologi Malaysia or any other institution of higher learning recognised by the Senate; or
- A qualification equivalent to a Bachelor's Degree and experience in the relevant field recognised by the Senate.

UTM Entry Requirement to Master by Research and Mixed mode Programme						
Obtained Bachelor degree with the following grade						Working Experience
Degree Class	CPA Scale of 4	CPA Scale of 5	CPA Scale of 20	Percentage	1000 Marks	
First Class	2.75 or higher	3.38 or higher	13.75 and higher	68.75% or higher	687.5 or higher	No Working Experience Needed
Second Class Upper						
Excellent Pass						
Second Class Lower	2.50 <CPA < 2.75	3.13 <CPA < 3.43	12.5 <CPA < 13.75	62.5% <CPA < 68.75%	625 <CPA < 687.5	Subject to rigorous internal assessment
Very Good Pass						
Second Class Lower	2.00 <CPA < 2.50	2.50 <CPA < 3.13	10 < CPA < 12.5	50% < CPA < 62.5%	500 <CPA < 625	5 years working experience in the related field
Good Pass						

UTM Entry Requirement to Master by Coursework Programme						
Obtained Bachelor degree with the following grade						Working Experience
Degree Class	CPA Scale of 4	CPA Scale of 5	CPA Scale of 20	Percentage	1000 Marks	
First Class	2.50 or higher	3.13 or higher	12.5 and higher	62.5% or higher	625 or higher	No Working Experience Needed
Second Class Upper						
Excellent Pass						
Second Class Lower	2.00 ≤CPA < 2.50	2.50 ≤CPA < 3.13	10 ≤ CPA < 12.5	50% ≤CPA < 62.5%	500 ≤CPA < 625	5 year working experience in the related field
Very Good Pass						

English Language Requirement for International Students

If English is not your native language and you are attending a school where English is not the language of instruction, you must take the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System Academic (IELTS Academic)

Applicants who do not meet the English proficiency requirements of their chosen programme at Universiti Teknologi Malaysia (UTM) can improve their English at Intensive English Programme (IEP) at Language Academy, UTM or CIEP at ELS Language Centers in Malaysia. UTM accepts IELTS Level 5.5 and above upon completion of IEP conducted by Language Academy, UTM or ELS English Certificate (level 107) as an ENGLISH LANGUAGE ENTRY REQUIREMENTS FOR INTERNATIONAL STUDENTS. Students who choose to attend IEP (Language Academy, UTM) must attain IELTS 5.5 or attend ELS and must pass the required English course(s) before starting their programmes in UTM

COURSE REGISTRATION

It is mandatory for all students who have registered for a programme – a full time or external candidate – to register every course that will be taken for the semester. Students who did not enroll in the programme will not be allowed to register for any course.

Students can only register for courses that are offered for a particular semester based on the regulations set by the student's faculty. Students cannot register for any course that is not offered in the semester.

Student can withdraw (TD) any course registered for the semester. Application to withdraw must be made by using the Course Withdrawal Form (UTM.E/3-2).

If student fails to do the registration or does not do the registration of courses within the specified duration as mentioned above, unless valid reasons are given, he or she will be dismissed from the University.

ACADEMIC TRANSCRIPT

Applications will be charged a fee of RM25.00 for each Master and PhD. Transcripts released in English and student were enrolled on year 2000 onwards.

AWARD REQUIREMENTS

Doctor of Philosophy

1. Application is open to all students who have submitted their hard bound thesis/graduating students.
2. Student are NOT charged with any disciplinary action by University.
3. Student with outstanding fees WILL NOT be considered.
4. Student who apply for early certificate and academic transcript WILL NOT be considered.
5. Duration of study:
 - Full time student MUST have completed their study within 30 months until 48 Months.
6. Student MUST obtained grade of A or B1 for their viva voce.
(B2 result will be considered if the correction after viva is submitted within (3) months)
7. PUBLICATION
 - Student MUST be the first student author for all publications. Otherwise, the publication WILL NOT be counted.
 - Publications without the name of Main/ Co-Supervisor WILL NOT be considered.
 - Only publication with UTM affiliation will be considered.
 - Publications MUST be related to the discipline of study.
 - Every publication MUST be verified by the supervisor on the first page of the article.
 - Indexed journal (Q1, Q2, Q3, Q4, WOS, SCOPUS/ ERA), non-indexed journal, book chapter MUST be published during the duration of study
 - Proofs of evidence for indexed publication MUST be attached and fulfill the following condition. Examples are as follows:
 - Proof of SCOPUS/ ERA/ Web of Science.
 - Proof of Impact Factor (if any).
 - Verification of supervisor on the first page of the article.
8. CONFERENCE
 - Student MUST have participated in international or national conference during their study as the presenter.
 - Student who have received best paper or oral presenter during conference.
 - Student MUST upload the certificate of attendance for the conference as the presenter.
9. RECOGNITION
 - Student MUST have received an award in an International, National or University level.
10. INTELLECTUAL PROPERTY / COMMERCIALIZATION
 - Student who have received Intellectual Property and commercialization.
11. STUDENT ACTIVITIES
 - Certificate of activities is compulsory to be uploaded.
12. All information for the application is based on the current programme of studies only.
13. Only application which is recommended by supervisor and endorsed by faculty/ school will be considered.
14. After online submission, the applicant is required to follow up with the supervisor to verify his/her application.
15. Result of application is strictly final and no appeal will be entertained.

16. The application can only be submitted once and no resubmission is allowed.

Master by Research

1. Application is open to all student who have submitted their hard bound thesis/graduating students.
2. Students are NOT charged with any disciplinary action by the University.
3. Student with outstanding fees WILL NOT be considered.
4. Students who apply for early certificate and academic transcript WILL NOT be considered.
5. Duration of study:
 - Full time student MUST complete study within 15 months until 27 months.
6. Student MUST obtained grade of A or B1 for their viva voce.
(B2 result will be considered if the correction after viva is submitted within one (1) month)
7. PUBLICATION / BOOK CHAPTER
 - Student MUST be the first student author for all publications. Otherwise, the publication will not be counted.
 - Participated in International and National conference during the study.
 - Only publication with UTM affiliation will be considered.
 - Publications MUST be related to the discipline of study.
 - Every publication MUST be verified by the supervisor on the first page of the article.
 - Indexed journal (Q1, Q2, Q3, Q4, WOS, SCOPUS / ERA), journal non-indexed, book chapter MUST be published during the duration of study.
 - Proofs of evidence for indexed publication MUST be attached and fulfill the following condition. Examples are as follows:
 - Proof of SCOPUS indexing (SCOPUS website)
 - Proof of Quartile (if any)
 - Verification of supervisor on the first page of the article.
8. CONFERENCE
 - Students MUST have participated in international or national conference during their study as the presenter.
 - Students who have received best paper or oral presenter during conference.
 - Students MUST upload the certificate of attendance for the conference as the presenter.
9. RECOGNITION
 - Students MUST have received an award in an International, National or University level.
10. IP/ COMMERCIALIZATION
 - Students who have received Intellectual Property and commercialization.
11. STUDENT ACTIVITIES
 - Students who have participated in a student activity,
 - Certificate of activities is compulsory to be uploaded.
 - Student activities MUST be related with academic matters.
12. All information for the application is based on the current programme of studies only.
13. Only application which is recommended by supervisor and endorsed by faculty/ school

will be considered.

14. After online submission, the applicant is required to follow up with the supervisor to verify his/her application.
15. Result of application is strictly final and no appeal will be entertained.

Master by Coursework and Research (Mixed Mode)

1. Application is open to all students who have submitted their hard bound thesis/graduating students.
 2. Students are NOT charged with any disciplinary action by the University.
 3. Students with outstanding fees will NOT be considered.
 4. Students who apply for early certificate and academic transcript WILL NOT be considered.
 5. Duration of study:
 - Full time student MUST complete study within 15 months until 27 months.
 6. Student MUST obtained A, B1 or B2 grade for master dissertation / master project and CPA 3.75 or above.
 7. PUBLICATION / BOOK CHAPTER
 8. - Student MUST be the first student author for all publications. Otherwise, the publication will not be counted.
 - Publications without the name of Main/Co-Supervisor will not be considered
 - Only publication with UTM affiliation will be considered
 - Publications MUST be related to the discipline of study
 - Every publication MUST be verified by the supervisor on the first page of the article.
 - Indexed journal (Q1, Q2, Q3, Q4, WOS, SCOPUS / ERA), journal non-indexed, book chapter MUST be published during the duration of study
 - Proofs of evidence for indexed publication MUST be attached and fulfill the following condition. Examples are as follows:
 - Proof of SCOPUS indexing (SCOPUS website)
 - Proof of Quartile (if any)
 - Verification of supervisor on the first page of the article.
 9. CONFERENCE
 - Students MUST have participated in international or national conference during their study as the presenter.
 - Students who have received best paper or oral presenter during conference.
 - Students MUST upload the certificate of attendance for the conference as the presenter.
 10. RECOGNITION
 - Students MUST have received an award in an International, National or University level.
 11. IP/ COMMERCIALIZATION
 - Students who have received Intellectual Property and commercialization.
- STUDENT ACTIVITIES**
- Students who have participated in a student activity,
 - Certificate of activities is compulsory to be uploaded.
 - Student activities MUST be related with academic matters.

12. All information for the application is based on the current programme of studies only.
13. Only application which is recommended by supervisor and endorsed by faculty/ school will be considered.
14. After online submission, the applicant is required to follow up with the supervisor to verify his/her application.
15. Result of application is strictly final and no appeal will be entertained

Master by Coursework

1. Open for all graduating students.
2. Students are NOT charged with any disciplinary action by the University.
3. Students with outstanding fees WILL NOT be considered.
4. Students who apply for early certificate and academic transcript WILL NOT be considered.
5. Duration of study:
 - Full time student MUST complete study within 4 semesters or below.
6. Student MUST obtained A+, A or A- grade for master dissertation / master project and CPA 3.70 or above.
7. PUBLICATION / BOOK CHAPTER
 - Student MUST be the first student author for all publications. Otherwise, the publication will not be counted.
 - Publications without the name of Main/Co-Supervisor will not be considered.
 - Only publication with UTM affiliation will be considered
 - Publications MUST be related to the discipline of study
 - Every publication MUST be verified by the supervisor on the first page of the article.
 - Indexed journal (Q1, Q2, Q3, Q4, WOS, SCOPUS / ERA), journal non-indexed, book chapter MUST be published during the duration of study
 - Proofs of evidence for indexed publication MUST be attached and fulfill the following condition. Examples are as follows:
 - Proof of SCOPUS indexing (SCOPUS website)
 - Verification of supervisor on the first page of the article.
 - Publications MUST be related to the discipline of study
8. CONFERENCE
 - Students MUST have participated in international or national conference during their study as the presenter.
 - Students who have received best paper or oral presenter during conference.
 - Students MUST upload the certificate of attendance for the conference as the presenter.
9. RECOGNITION
 - Students MUST have received an award in an International, National or University level.
10. IP/ COMMERCIALIZATION
 - Students who have received Intellectual Property and commercialization.
11. STUDENT ACTIVITIES
 - Students who have participated in a student activity,
 - Certificate of activities is compulsory to be uploaded.

- Student activities MUST be related with academic matters
- 12. All information for the application is based on the current programme of studies only.
- 13. Only application which is recommended by supervisor and endorsed by faculty/ school will be considered.
- 14. After online submission, the applicant is required to follow up with the supervisor to verify his/her application.
- 15. All Result of application is strictly final and no appeal will be entertained

EXPLORE POSTGRADUATE PROGRAMMES

Faculty of Engineering: Engineering Education and Generic Programme		
Research	Mixed Mode	Taught Courses
i. Doctor of Philosophy (Engineering Education) ii. Doctor of Philosophy iii. Master of Philosophy		
Field of Research		
Engineering Education: <ul style="list-style-type: none"> • Engineering Learning Approaches <ul style="list-style-type: none"> - <i>Research on engineering learner's developing knowledge and competencies in context</i> • Engineering Teaching Strategies <ul style="list-style-type: none"> - <i>Research on the instructional design and teaching methods</i> • Assessment in Engineering Education <ul style="list-style-type: none"> - <i>Research on assessment methods, instruments and measurements to inform engineering education practice</i> • Engineering Epistemologies <ul style="list-style-type: none"> - <i>Research on what constitutes engineering thinking and knowledge within a particular context</i> • Future Ready Engineering Educators 	Generic Programme: Any research related to engineering that incorporates, <ul style="list-style-type: none"> • Inter-disciplinary fields, or • Broad fields 	

<ul style="list-style-type: none"> - <i>Research on developing and supporting Engineering Educators on educating engineers of the future</i> • <i>STEM Education Research</i> - <i>Research on Science, Technology, Engineering and Mathematics (STEM) education in school and university setting as the talent pipeline for developing engineers of the twenty-first century</i> 		
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School of Biomedical Engineering & Health Sciences (SKBSK)		
Research	Mixed Mode	Taught Courses
<ul style="list-style-type: none"> i. Doctor of Philosophy, Field of Research : Health Science ii. Doctor of Philosophy, Field of Research : Biomedical Engineering iii. Doctor of Philosophy, Field of Research Biomedical Engineering – Double Degree iv. Master of Philosophy, Field of Research : Rehabilitation Technology v. Master of Philosophy, Field of Research : Biomedical Engineering vi. Master of Philosophy, Field of Research : Biomedical Engineering-Double Degree 		<ul style="list-style-type: none"> i. Master of Science (Biomedical Engineering)

Field of Research		
<p>Biomedical:</p> <ul style="list-style-type: none"> • Biomaterials • Biomechantronics • Biomedical Imaging • Biomedical Instrumentation • Biosignal Processing • Clinical Engineering • Health Care Management System • Medical Computing • Prosthetics & Orthotics • Rehabilitation Engineering • Tissue Engineering • Medical Imaging • Bioinformatics 	<p>Health Science :</p> <ul style="list-style-type: none"> • Sport Science • Physiotherapy • Healthcare Management • Psychological Science • Animal Science • Alternative Medicine 	

School of Chemical & Energy Engineering (SKT)		
Research	Mixed Mode	Taught Courses
i. Doctor of Philosophy Field of Research: Bioprocess Engineering	i. Doctor of Engineering in Process Plant Management	i. Master of Petroleum Engineering
ii. Doctor of Philosophy Field of Research: Chemical Engineering	ii. Master of Engineering Specialization: Bioprocess	ii. Master of Science (Herbal Technology)
iii. Doctor of Philosophy Field of Research: Environmental Engineering	iii. Master of Engineering Specialization: Chemical	iii. Master of Gas Engineering and Management
iv. Doctor of Philosophy Field of Research: Gas Engineering	iv. Master of Environmental Engineering	iv. Master of Science (Energy Management)
v. Doctor of Philosophy Field of Research: Petroleum Engineering	v. Master of Science Specialization: Polymer Technology	v. Master of Science (Process Plant Management)
vi. Doctor of Philosophy Field of Research: Polymer Engineering		vi. Master of Science (Safety, Health & Environment)
vii. Master of Philosophy Field of Research: Bioprocess Engineering		

<p>viii. Master of Philosophy Field of Research: Chemical Engineering</p> <p>ix. Master of Philosophy Field of Research: Environmental Engineering</p> <p>x. Master of Philosophy Field of Research: Gas Engineering</p> <p>xi. Master of Philosophy Field of Research: Petroleum Engineering</p> <p>xii. Master of Philosophy Field of Research: Polymer Engineering</p>		
Field of Research		
<p>Bioprocess Engineering:</p> <ul style="list-style-type: none"> • Biopharmaceuticals • Biotechnology • Biotransformation • Bioinformatics • Bioseparation • Cell Cultures • Fermentation • Food and Biomaterial Engineering • Genetic Engineering • Membrane Technology • Nanotechnology • Tissue Engineering • Bioproduct processing and development <p>Petroleum Engineering:</p> <ul style="list-style-type: none"> • Cementing • Corrosion • Cuttings Transport • Drilling Engineering • Formation Damage • Geostatistics and Geoscience Engineering • Improved and Enhanced Oil 	<p>Gas Engineering:</p> <ul style="list-style-type: none"> • Advanced Material for Energy Application • Burner Conversion • Catalytic Combustion • Corrosion Engineering • Fire and Explosion • Gas Adsorbent Development • Gas Metering and Calibration • Gas Transportation and Storage • Membrane Science & Technology • NGV Conversion System • Renewable Energy <p>Environmental Engineering:</p> <ul style="list-style-type: none"> • Environmental System Modelling • Groundwater Contamination • Industrial Waste Treatment 	<p>Chemical Engineering:</p> <ul style="list-style-type: none"> • Catalysis and Reaction Engineering • Membrane Separation • Process Control and Safety • Process Modelling and Simulation • Biodiesel Production • Process Plant Management • Separation Technology • Sustainable Energy Management System • Sustainable Product and Process Design • Water Minimization • Process Optimization • Advanced Materials • Nanotechnology <p>Polymer Engineering:</p> <ul style="list-style-type: none"> • Biopolymers • Fibre-Reinforced Composite • Microwave Processing Of Polymers • Modification Of Polymer • Plastic-Rubber Blend

<p>Recovery</p> <ul style="list-style-type: none"> • Petroleum Geology • Production Engineering • Rock Mechanics • Rock-Fluid Interactions • Sand Control • Flow Assurance • Separation Of Oil-Water Emulsion • Shale Problems • Water Flooding • Well Bore Stability • Scale Problem Prevention 	<ul style="list-style-type: none"> • Solid and Hazardous Waste Management • Wastewater • Water and Air Pollution 	<ul style="list-style-type: none"> • Polymer Additive and Adhesive • Polymer Nanocomposites • Polymer Synthesis And Characterisation • PVC Technology • Recycling Of Plastics Waste • Rheology Of Polymer Melts
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School of Civil Engineering (SKA)		
Research	Mixed Mode	Taught Courses
i. Doctor of Philosophy Specialization: Civil Engineering	i. Engineering Doctorate Specialization: Construction Technology and Management	i. Master of Engineering (Civil)
ii. Master of Philosophy Field of Research: Transportation		ii. Master of Engineering (Structure)
iii. Master of Philosophy Field of Research: Coastal and Maritime		iii. Master of Engineering (Hydraulic & Hydrology)
iv. Master of Philosophy Field of Research: Materials		iv. Master of Engineering (Geotechnics)
v. Master of Philosophy Field of Research: Construction		v. Master of Engineering (Environmental Management)
vi. Master of Philosophy Field of Research: Highway and Traffics		vi. Master of Engineering (Construction Management)
vii. Master of Philosophy Field of Research: Structures and Materials		vii. Master of Engineering (Transportation)
viii. Master of Philosophy Field of Research: Hydraulics		viii. Master of Forensic Engineering
ix. Master of Philosophy Field of Research: Environmental		ix. Master of Project Management
x. Master of Philosophy		

xi. Field of Research: Geotechnics Master of Philosophy Field of Research: Structures xii. Master of Philosophy Field of Research: Hydrology and Water Resources xiii. Master of Philosophy Field of Research: Hydraulics and Hydrology		
Field of Research		
<ul style="list-style-type: none"> • Civil Engineering • Highway & Transportation • Structures & Materials • Geotechnics • Forensic Engineering • Environmental Engineering and Management • Hydraulic & Hydrology • Construction Management & Project Management • Hydrology and Water Resources • Coastal & Maritime 	<ul style="list-style-type: none"> • Highway & Transportation • Hydraulics & Hydrology • Project Management • Structures & Materials 	<ul style="list-style-type: none"> • Civil Engineering • Highway & Transportation • Structures & Materials • Geotechnics • Forensic Engineering • Environmental Engineering and Management • Hydraulic & Hydrology • Construction Management & Project Management

School of Computing (SC)		
Research	Mixed Mode	Taught Courses
i. Doctor of Philosophy (Computer Science) ii. Doctor of Philosophy (Software Engineering) iii. Doctor of Philosophy (Informatics Engineering) iv. Master of Philosophy (Software	i. Master of Computer Science	i. Master of Science (Data Science) ii. Master of Science (Cyber Security)

v. Engineering) Master of Philosophy (Computer Science)		
Field of Research		
<ul style="list-style-type: none"> • Software Engineering • Computer Vision • Computer Graphics and Multimedia • Artificial Intelligence • Data Science • Data Mining and Knowledge Discovery • Text and Web Mining • Business Intelligence • Information Systems Adoption • Bioinformatics • Operational Research • Information Science • Natural Language Processing • Internet of Things (IoT) • Body Sensor Network • Mobile Ad Hoc Network • Cloud Computing & Security • Network & Security • Computer/Network Forensic • Information System Security • Blockchain • Wireless Sensor Network • Pervasive Computing • Vehicular Ad Hoc Network • Wireless Mesh Network • Underwater Sensor Network 	<ul style="list-style-type: none"> • Data Science • Cloud Computing & Security • Network & Security • Computer/Network Forensic • Information System Security 	

School of Electrical Engineering (SKE)		
Research	Mixed Mode	Taught Courses
i. Doctor of Philosophy (Electrical Engineering) ii. Master of Philosophy (Electrical Engineering)		i. Master of Engineering (Computer & Microelectronic Systems) ii. Master of Engineering (Mechatronics & Automatic Control) iii. Master of Engineering (Wireless Communication)

		and Network) iv. Master of Engineering (Electrical Power)
Field of Research		
<p>Power Engineering</p> <ul style="list-style-type: none"> • Power Electronic and electrical machine drive • Renewable energy and energy storage system: PV solar, wind energy, battery and supercapacitor • Electric and hybrid vehicle system • Power System • Power System Optimization • Smart Grid • Power System Protection • Power System Stability • Power System Security Assessment • Lightning Monitoring and Protection Systems • Overvoltage Protection System and Insulation Coordination • Electrical Discharge Detection and Monitoring • Nanocomposite Insulating Materials • Deregulated Electricity Market • Electrical Energy Management • Power Quality • Alternative energy management • Renewable energy system sizing and 	<p>Electronics and Computer Engineering</p> <ul style="list-style-type: none"> • VLSI & Embedded Computing Architecture Design • Computational Nanoelectronics • Digital Signal and Image Processing • Bio-medical & Instrumentation Electronics • Microelectronics • Computer Engineering <p>Control and Mechatronics Engineering</p> <ul style="list-style-type: none"> • Computer Control Systems • Design of embedded systems • Real-time Software Engineering for Mechatronics systems • Design of robots and robotics work cells • Application of advanced control in robotics • Multi-agent intelligent mobile robots • Internet-based tele robotics • Micro-electromechanical System (MEMS) • Industrial automation 	<p>Communication Engineering</p> <ul style="list-style-type: none"> • Next Generation Broadband Network – 5G and Beyond 5G Technologies • Wireless Communication System • Satellite Communication System • Sonar and Acoustic Engineering • Radar Technology • Radio Wave Propagation • Antenna and Microwave/Millimetre wave • Optical Communication Systems and Networks • Internet-of-Everything (IoE) Solutions • Electromagnetic Compatibility and Interference • Pervasive networks and networks computing and security

<p>optimization</p> <ul style="list-style-type: none"> • Lightning measurement and characterisation • Domestic electrical safety and energy efficiency. • High Voltage Instrumentation • Grounding System • Electromagnetic Field Interferences <p>High Voltage Simulation and Modelling</p>	<p>and computer integrated manufacturing</p> <ul style="list-style-type: none"> • Advanced Control strategies in Industrial Processes • Identification and Control of Industrial Processes • Intelligent Plant Interface • Advanced Transducer Application • Sensor technology • Process Tomography for flow measurement • Vision Systems • Neural Network, Fuzzy Logic and Genetic Algorithms • Intelligent Control Systems • Artificial Intelligence applications • Robust Control and Uncertain System • Smart sensors & Actuators • Real-time control system • Nanotechnology-based mechatronics and robotics 	
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School of Mechanical Engineering (SKM)		
Research	Mixed Mode	Taught Courses
i. Doctor of Philosophy (Mechanical Engineering) ii. Master of Philosophy (Mechanical Engineering) iii. Master of Philosophy (Marine Technology)		i. Master of Science (Industrial Engineering) ii. Master of Science (Mechanical Engineering)
Field of Research		
<i>Applied Mechanics & Design:</i> <ul style="list-style-type: none"> • Adaptive Control and Intelligent System • Computational Solid Mechanics • Mechatronics & Instrumentation • Artificial Intelligence • Elasticity & Plasticity • Automatic Control & System Engineering • Fatigue and Fracture Mechanics • Biomechanics & Biomedical Engineering • Finite Element Method • Functional Control Systems • CAD & Virtual Reality • Guided Wave & Acoustic • Composite Structure & Ballistic Impact • Structural Dynamic & mechanics • Structural Impact & Crashworthiness • Thin-Walled and Polymeric Materials • Tissue Engineering Scaffolds • Porous Structures 	<i>Materials, Manufacturing & Industry:</i> <ul style="list-style-type: none"> • Advanced Manufacturing Process • Advanced Materials • Automation in Manufacturing • CAD/CAPP/CAM/CNC • Carbon Nanomaterials • Ceramics and Composites • Ceramics Coating • Ferrous metallurgy • Solder Metallurgy Technology • Solid State Kinetics • Surface Coating • Surface Treatment & Industrial Engineering • Surface Engineering & Composites Machining • Sustainable Product Design • System Dynamic Modelling • Virtual Manufacturing Work Design • Quality improvement and design of experiment • Operations management research • Life cycle assessment • Supply chain management 	<i>Automotive, Aeronautic & Offshore:</i> <ul style="list-style-type: none"> • Advanced Ice-Ship • Aerodynamics • Airspace Safety Monitoring System • Automotive Tribology • Avionics and Antennae • Biofuel and Multiphase Flow • Brake Design & Safety • CFD & Combustion Technology • Computer Vision • Contact Mechanics • Electric and Hybrid Vehicles • Engine Air Management • Ethnographic Factors in Fishing Boat Design • FEM & Model Updating • Flight Guidance and Control • Flight Simulation • Helicopter Technology • Aircraft Structures • Drone Technology • Rocket Propulsion • Tunnel Testing • Turbo machinery & Aero acoustics • Unsteady Aerodynamics • Vehicle Powertrain • Vehicle Stability and Control Wind

<ul style="list-style-type: none"> • Reliability & Engineering Design • Shells & Pressure Vessels • Structural Vibration and condition Monitoring <p>Thermofluids:</p> <ul style="list-style-type: none"> • Advanced Refrigeration and Air-Conditioning System • Combustion & heat transfer • Compressible Flow • Computational Fluid Dynamics • Fuel, biomass and energy • Heating & Ventilation • Micro-Cooling • Sustainable Energy Technology • Thermofluids Measurement and Diagnostics • Energy Management • Tribology & lubrication 	<ul style="list-style-type: none"> • Lean manufacturing • Facility design and management 	<ul style="list-style-type: none"> • Vehicle Dynamics and Control • Vortex Induced Vibration • Wave Structure Interaction • Hull-Riser-Mooring Coupled Dynamics • Hydromechanics • Low Emission Combustor • Marine Active Control • Marine Safety and Environment • Marine Transport and Management • Mega-Float Design & System Modelling • Ship Dynamics • Smart Offshore Structure • Stability & Design • Subsea & Offshore Engineering System Energy / Waste Heat Recovery
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PRE-MASTER AT FACULTY ENGINEERING

Information About Pre-Master at Faculty of Engineering

A pre-master is designed to bridge the gap between your current bachelor degree to your intended Master degree of your choice.

Undergraduate students of Engineering, Science and Technology who cannot be admitted directly to our Master programmes, could now gain entry through the Pre-Master.

Students who have passed the Pre-Master courses can continue and complete their Master courses

LIST OF PRE-MASTER COURSES AT FACULTY OF ENGINEERING

School Of Chemical and Energy Engineering (SKT)

Pre-Master Course (Undergraduate Core Course)	Master by Taught Course
1. SKTB 3213 - Biochemistry 2. SKTB 3113 - Bioseparation Technology 3. SKTB 3133 – Bioreactor Design & Analysis	Master of Science (Herbal Technology)
1. SKTB 3133 – Bioreactor Design & Analysis 2. SKTB 3173 – Engineering Economics and Project Management 3. SKTB 4133 – Quality Management in BioManufacturing	Master of Science (Process Plant Management)
Pre-Master Course (Undergraduate Core Course)	Master by Mixed Mode
1. SKTB 3213 – Biochemistry 2. SKTB 3113 – Bioseparation Technology 3. SKTB 3133 - Bioreactor Design & Analysis 4. SKTB 3223 - Chemical Reaction Engineering	Master of Engineering in Bioprocess
1. SKTK 3413 - Pollution Control Engineering 2. SKTK 4423 - Waste Management 3. SKTK 4433 - Environmental Sustainability	Master of Engineering in Environment
1. SKTK 4613 - Fundamental of polymer 2. SKTK 4623 - Polymer physics and properties 3. SKTK 4633 - Polymer rheology and processing	Master of Science in Polymer Technology

Pre-Master Course (Undergraduate Core Course) (at least 3 courses)	Master by Research
1. SKTK 1123 - Mass Balance 2. SKTK 2313 - Transport Processes 3. SKTK 2253 - Chemical Eng. Thermodynamic 4. SKTK 3263 - Chemical Reaction Engineering	Master of Philosophy in Chemical Engineering
1. SKTB 3213 – Biochemistry 2. SKTB 3113 - Bioprocess Technology 3. SKTB 3133 - Bioreactor Design & Analysis	Master of Philosophy in Bioprocess Engineering
1. SKTK 4613 - Fundamental of polymer 2. SKTK 4623 - Polymer physics and properties 3. SKTK 4633 - Polymer Rheology and Processing	Master of Philosophy in Polymer Engineering
1. SKTP 2213 - Basic Geosciences 2. SKTP 2313 - Reservoir Rock and Fluids Properties 3. SKTP 3413 - Drilling Engineering 4. SKTP 3513 - Petroleum Production Engineering	Master of Philosophy in Petroleum Engineering
1. SKTG 1333 – Thermodynamics 2. SKTG 2343 - Fluid Mechanics 3. SKTG 3213 - Gas Transmission and Distribution 4. SKTG 4223 - Gas Storage and Reticulation System	Master of Philosophy in Gas Engineering
1. SKTK 3413 - Pollution Control Engineering 2. SKTK 4423 - Waste Management 3. SKTK 4433 - Environmental Sustainability	Master of Philosophy in Environmental Engineering

School of Computing (SC)

Pre-Master Course (Undergraduate Core Course)	Master by Taught Course
1. SCSR3443 - Introduction to Cryptography 2. SCSR3413 - Computer Security 3. SCSR1213 - Network Communication	Master of Science (Information Security)
Pre-Master Course (Undergraduate Core Course)	Master by Mixed Mode
1. SCSJ3203 - Theory of Computer Science	Master of Computer Science

2. SCSJ2013 - Data Structure & algorithm 3. SCSR2033 - Computer Organization and Architecture	
Pre-Master Course (Undergraduate Core Course) (at least 3 courses)	Master by Research
1. SCSJ3323 - Software Engineering 2. SCSJ3343 - Software Testing 3. SCSJ2203 - Software Design & Architecture	Master of Philosophy in Software Engineering
1. SCSJ3203 – Theory of Computer Science 2. SCSJ2013 - Data Structure & algorithm 3. SCSR2033 - Computer Organization and Architecture	Master of Philosophy in Computer Science

School Of Biomedical Engineering and Health Science (SKBSK)

Pre-Master Course (Undergraduate Core Course)	Master by Taught Course
1. SMBE 1015 - Basic Anatomy & Physiology 2. SMBE 3043 - Instrumentation & Measurement for Biomedical	Master of Science (Biomedical Engineering) OR
Pre-Master Course (Undergraduate Core Course) (at least 3 courses)	Master by Research
1. SMBE 1015 - Basic Anatomy & Physiology 2. SMBE 3043 - Instrumentation & Measurement for Biomedical	Master of Philosophy in Biomedical Engineering OR
1. SMBE 1015 - Basic Anatomy & Physiology 2. SMBE 3043 - Instrumentation & Measurement for Biomedical	Master of Philosophy in Rehabilitation Technology

School of Electrical Engineering (SKE)

Pre-Master Course (Undergraduate Core Course)	Master by Taught Course
1. SKEE 2263 - Digital Systems 2. SKEE 3223 – Microprocessor 3. SKEL 4743 - Basic Digital VLSI Design	Master of Engineering (Computer & Microelectronic Systems)
1. SKEE 2263 - Digital Systems 2. SKEE 3223 - Microprocessor 3. SKEE 2073 - Signals and System 4. SKEE 3533 - Communication Principles	Master of Engineering (Electronic & Telecommunication)

1. SKEE 1013 - Electrical Circuit Analysis 2. SKEE 3133 - System Modeling & Analysis 3. SKEE 3143 - Control System Design	Master of Engineering (Mechatronic & Automatic Control)
1. SKEE 4423 - Power System Engineering 2. SKEE 4433 - Power Electronics and Drives 3. SKEE 4463 - High Voltage Technology	Master of Engineering (Electrical Power)
1. SKEE 2523 - Electromagnetic Field Theory 2. SKEE 2073 - Signals and System 3. SKEE 3533 - Communication Principles Programming Language	Master of Engineering (Wireless Communication and Network)

School Of Mechanical Engineering (SKM)

Pre-Master Course (Undergraduate Core Course)	Master by Taught Course
1. SEMM 1113 - Mechanics of Solids I 2. SEMM 2313 - Mechanics of Fluids I 3. SSCE 1793 - Differential Equations	Master of Science (Mechanical Engineering)
1. SEMM 3813 - Industrial Engineering 2. SSCE 2193 - Engineering Statistics 3. SEMI 4823 - Operations Research	Master of Science (Industrial Engineering)
1. SEMM 1513 - Introduction to Design 2. SEMM 2613 - Materials Science 3. SEMM 2713 - Manufacturing Process	Master of Science (Advanced Manufacturing Technology)
1. SEMM 2613 - Materials Science 2. SEMM 2713 - Manufacturing Process 3. SEMM 3623 - Materials Engineering	Master of Science (Materials Engineering)
1. SEMM 2313 - Mechanics of Fluids I 2. SSCE 1793 - Differential Equations 3. SEMT 3212 - Flight Mechanics	Master of Science (Aeronautical Engineering)
1. SEMM 1113 - Mechanics of Solids I 2. SEMM 2313 - Mechanics of Fluids I 3. SEMM 1213 – Dynamics	Master of Science (Ship and Offshore Engineering)
1. SEMV 3413 - Internal Combustion Engine 2. SEMV 4213 - Vehicle Dynamic 3. SEMV 4792 - Automotive Production Technology	Master of Science (Automotive Engineering)

School of Civil Engineering (SKA)

Pre-Master Course (Undergraduate Core Course)	Master by Taught Course
<ol style="list-style-type: none"> 1. SKAB3712 – Geotechnics II 2. SKAB2223 – Mechanics of Materials & Structure 3. SKAB2513 – Hydraulics 4. SKAB3123 – Construction Technology, Estimating & Contract 	<p>Master of Engineering (Civil)</p>
<ol style="list-style-type: none"> 1. SKAA4223 – Structural Analysis 2. SKAA4333 – Reinforced Concrete Design I 3. SKAA3352 – Reinforced Concrete Design II 4. SKAA3233 – Steel Design & Timber 5. SKAB211 – Civil Engineering Materials 	<p>Master of Engineering (Structure)</p>
<ol style="list-style-type: none"> 1. SKAB4113 – Construction & Project Management 2. SKAB3123 – Construction Technology, Estimating & Contract 3. SKAB4143 – Construction Plants & Equipment 4. SKAB4133 – Construction Law & Contract 	<p>Master of Engineering (Construction Management)</p>
<ol style="list-style-type: none"> 1. SKAB1713 – Soil Mechanics 2. SKAB2722 – Geotechnics I 3. SKAB3712 – Geotechnics II 4. SKAB2712 – Eng. Geology & Rock Mechanics 	<p>Master of Engineering (Geotechnics)</p>
<ol style="list-style-type: none"> 1. SKAB2832 – Highway Engineering 2. SKAB3842 – Traffic Engineering 3. SKAB1713 – Soil Mechanics 	<p>Master of Engineering (Transportation)</p>
<ol style="list-style-type: none"> 1. SKAB1513 – Fluid Mechanics 2. SKAB2513 – Hydraulics 3. SKAB3613 – Hydrology & Water Resources 	<p>Master of Engineering (Hydraulics & Hydrology)</p>
<ol style="list-style-type: none"> 1. SKAB2912 – Water Treatment 2. SKAB2922 – Wastewater Engineering 3. SKAB3913 – Environmental Management 	<p>Master of Engineering (Environment)</p>



**ENGINEERING EDUCATION AND
GENERIC PROGRAMME**

ENGINEERING EDUCATION AND GENERIC PROGRAMME

MASTER OF PHILOSOPHY

FIELD OF RESEARCH:

1. ENGINEERING EDUCATION

Engineering Learning Approaches, Assessment in Engineering Education, Engineering Epistemologies, Future Ready Engineering Educators and STEM Education Research.

2. GENERIC

Generic is the term use to describe any field of research under broad Engineering and engineering trades without specializing in any of the detailed fields. The generic programme covers a wide range of research fields. Also, the generic research study could comprise works of various disciplines within the engineering schools.

PROGRAMME SPECIFICATIONS

The Master of Philosophy (MLPG) is offered on a full-time basis. The duration of study is in between minimum of one (1) year to a maximum of four (4) years.

The aim of the programme is to produce postgraduates in Doctor of Philosophy in line with the inspirations of UTM which are innovative, entrepreneurial, and global in the area related to engineering, technology, and management of technology. In order to satisfy this aim, PEO has been formulated based on the visions and missions of UTM and SPS.

Generic programme has collaboration with research centre in UTM as list below:

- i. Center of Engineering Education (CEE), UTM
- ii. Advanced Membrane Technology Research Centre (AMTEC), UTM

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia		
2. Teaching Institution	Universiti Teknologi Malaysia		
3. Programme Name	Master of Philosophy Field of Research: - Engineering Education - Engineering and Engineering Trades (Broad Programmes)		
4. Final Award	Master of Philosophy		
5. Programme Code	MLPG (Starting from 2014) MLG (Before 2014)		
6. Professional or Statutory Body of Accreditation	MQA/SWA0810		
7. Language(s) of Instruction	English		
8. Mode of Study (Conventional, distance learning, etc)	Research		
9. Mode of operation (Franchise, self-govern, etc)	Self-governing		
10. Study Scheme (Full Time/Part Time)	Full Time		
11. Study Duration	Minimum : 1 year Maximum : 4 years		
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	2	8	14
Short	-		-

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 2 semesters)	0	
iv	Thesis	0	
	Total	3	

Engineering Education

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to generate in-depth relevant knowledge in professional practices for the benefits of both national and international communities.
PEO2	Graduates are able to maintain conducive working environment qualities through effective leadership, complex problem solving and high order thinking skills.
PEO3	Graduates are able to advocate relevant knowledge and expertise through effective oral and written communications.
PEO4	Graduates are able to facilitate discovery to contribute towards the generation of new knowledge.
PEO5	Graduates are able to nurture, promote professional and ethical responsibilities including contemporary issues and environmental awareness.

Program Outcome (PO)

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to integrate and generate in-depth relevant knowledge in professional practices for the benefit of the field of engineering education.
PLO2	Ability to formulate hypothesis, carry out research scientifically to solve and explained observed phenomena in engineering education.
PLO3	Ability to critically analyse and evaluate situations to synthesis findings and their implications into new ideas in engineering education.
PLO4	Ability to independently conduct engineering education research in a professional and ethical manner.

PLO5	Ability to communicate effectively in oral and written form the findings, knowledge, recommendations and rationale to experts, peers and the community in engineering education.
PLO6	Ability to continuously update professional knowledge and skills.

Engineering and Engineering Trades (Broad Programmes)

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Generate in-depth, relevant and cutting-edge knowledge through original, ethical and scholarly research.
PEO2	Utilized the research knowledge for the benefit of communities, society, nation and humanities.
PEO3	Advocate relevant knowledge and expertise through effective oral and written communications.
PEO4	Pursue lifelong learning, such as graduate work and other professional education.
PEO5	Become effective collaborators and innovators, leading or participating in efforts to address social, technical and business challenges

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Show a systematic comprehension and in depth understanding of a discipline and mastery of skills and research methods related to the field of study.
PLO2	Show capabilities to generate, design, implement and adopt the integral part of research process with scholarly strength and ethics.
PLO3	Contribute to the original research by making critical analysis, evaluation and synthesis of new and complex ideas that broadened the boundary of knowledge.
PLO4	Practice research ethics and conduct responsible research.
PLO5	Communicate with peers, scholarly community and society at large concerning the field of expertise.
PLO6	Promote technological, social and cultural progress in a knowledge-based society in the academic and professional context
PLO7	Demonstrate sensitivity to social needs and readiness to apply relevant knowledge to fulfilling them
PLO8	Demonstrate the awareness of effective team-working conducting research
PLO9	Demonstrate leadership capability and the ability to effectively deliver knowledge, scientific findings, recommendations and rationale to peers and experts.
PLO10	Ability to gather, organize, adapt contemporary knowledge effectively and capable of utilizing appropriate computational tools independently.

PLO11	Demonstrate the ability of managing and conducting research or other activities, and display the awareness of the need to exploit all possible resources and opportunities which include personal, institutional or business linkages and collaboration
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GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
FACULTY OF ENGINEERING (ENGINEERING EDUCATION) COURSES					
1	Uxxx xxx3	University General Course (choose 1 course) UHAP6013 (Seminar on Global Development, Economic and Social Issues) – Faculty of Management (FM) UICW6023 (Philosophy of Science and Civilization) – Faculty of Islamic Civilization (FTI) UCSM1263 (IT Project Management) – Faculty of Computing (FC) UPPF6033 (Dynamics of Leadership) – Faculty of Education (FP)			
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology <i>*For Engineering Education</i>			
	UKKP0010	School of Chemical and Energy Engineering			
	UKMP0010	School of Mechanical Engineering			
	UMBP0010	School of Biomedical Engineering and Health Sciences			
	UKEP0010	School of Electrical Engineering			
	UAPA0010	School of Civil Engineering			
3	MLPG XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) publication from journal article or conference proceeding or book chapter)			

COURSE SYNOPSIS

Research Methodology

In this course, students were taught how to conduct research. Start from how to get problem statement, find objectives and scope, conduct literature review, experiment, survey, and analysis, and finally make conclusions. A few tricks and tips on writing thesis and viva also explained.

Besides those two courses, all doctoral/master full research programmes require students to complete a doctoral/master thesis.

There is no course offered in the programme, however students can join other courses conducted by any faculty.

DOCTOR OF PHILOSOPHY

FIELD OF RESEARCH: ENGINEERING EDUCATION

PROGRAMME SPECIFICATIONS

The Doctor of Philosophy Field of Research: Engineering Education (PLPE) is offered on a full-time basis. The duration of study is in between minimum of three (3) years to a maximum of eight (8) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Doctor of Philosophy	
4. Final Award		Doctor of Philosophy Field of research: Engineering Education	
5. Programme Code		PLPE	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/Part Time)		Full Time	
11. Study Duration		Minimum : 3 years Maximum : 8 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Mi n	Ma x	
Normal	6	16	14
Short	-		-

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University General Course (1 course)	3	
ii.	Program Core (5 courses not counted into the overall credits)	HW	
iii.	Research (Minimum 6 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to generate in-depth relevant knowledge in professional practices for the benefits of both national and international communities.
PEO2	Graduates are able to maintain conducive working environment qualities through effective leadership, complex problem solving and high order thinking skills.
PEO3	Graduates are able to advocate relevant knowledge and expertise through effective oral and written communications.
PEO4	Graduates are able to facilitate discovery to contribute towards the generation of new knowledge.
PEO5	Graduates are able to nurture, promote professional and ethical responsibilities including contemporary issues and environmental awareness.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to integrate and generate in-depth relevant knowledge in professional practices for the benefit of the field of engineering education.
PLO2	Ability to formulate hypothesis, carry out research scientifically to solve and explained observed phenomena in engineering education.
PLO3	Ability to critically analyse and evaluate situations to synthesis findings and their implications into new ideas in engineering education.
PLO4	Ability to independently conduct engineering education research in a professional and ethical manner.
PLO5	Ability to communicate effectively in oral and written form the findings, knowledge, recommendations and rationale to experts, peers and the community in engineering education.
PLO6	Ability to continuously update professional knowledge and skills.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF ENGINEERING (ENGINEERING EDUCATION) COURSES					
1	Uxxx xxx3	University General Course (1 course)			
2		Program Core (5 courses not counted into the overall credits)			
	PLPT 6113	Fundamentals of Engineering Education			
	PLPT 6123	Research Methodology in Engineering Education			
	PLPT 6133	Data Analysis Techniques			
	PLPT 6140	Seminar in Engineering Education			
	PLPT 6143	Issues in Engineering Education			
3	PLPT XX00	Research (Minimum 2 semesters)			
4	PLPT xxx0	Thesis			
5		Publication (minimum one (1) refereed article or two (2) indexed conference proceedings accepted as published in SCOPUS/ERA/WOS)			

COURSE SYNOPSIS

CORE COURSES

PLPT 6113 - Fundamentals of Engineering Education

This course introduces students to the basics of engineering education which include pedagogy, learning approaches, and teaching strategies. Students are also familiarized with topics related to curriculum design, teaching materials (such as applications of ICT, software, etc.), assessment and evaluation methods, as well as enhancement of generic skills through teaching practice.

PLPT 6123 - Research Methodology in Engineering Education

This course aims to introduce the rigorous research methodology in engineering education from both the quantitative and qualitative approaches. The topics include epistemological assumptions of research, research methodology, research design, data collection techniques, sampling and instrumentation, validity and reliability, trustworthiness and introduction to data analysis.

PLPT 6133 - Data Analysis Techniques

This is the continuation of PTL6123 to guide students in analyzing data. The topics which are covered in this course draw from both quantitative and qualitative data analysis techniques such as descriptive statistics, inferential statistics, coding techniques, document analysis, thematic analysis and constant comparisons method. The inferential statistics includes some statistical tests of correlation analysis, t-test, one-, two-, three-way ANOVA, factor analysis, regression and structural equation modeling (SEM), while the coding techniques comprise of open coding, axial coding and selective coding.

PLPT 6140 - Seminar in Engineering Education

This course provides the platform for students to develop and enhance their competency and confidence as independent researchers in the area of engineering education. Students are trained to effectively present and communicate their research ideas, both in the verbal and written forms. Through this course, they are also expected to instill the awareness of the importance of becoming critically reflective and reflexive researchers throughout their intellectual journey.

PLPT 6143 - Issues in Engineering Education

This course compliments PLT 6113 in which students are introduced to the history and philosophy of engineering education. Discussions on this particular topic help to strengthen students' knowledge on their respective research areas. Such knowledge further facilitates students to identify the relevancies of their research projects within the twenty-first century engineering education scenario. Among the issues included in the discussions are active learning approaches for engineering students, effective teaching strategies for engineering educators, outcome-based approach for curriculum development, as well as its relevant assessment and evaluation methods.

DOCTOR OF PHILOSOPHY

GENERIC

Generic is the term use to describe any field of research under broad Engineering and engineering trades without specializing in any of the detailed fields. The generic programme covers a wide range of research fields. Also, the generic research study could comprise works of various disciplines within the engineering schools.

The Doctor of Philosophy (PLPG) is offered on a full-time basis. The duration of study is in between minimum of three (3) years to a maximum of eight (8) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Doctor of Philosophy Field of research: -	
4. Final Award		Doctor of Philosophy	
5. Programme Code		PLPG (Starting from 2014) PLG (Before 2014)	
6. Professional or Statutory Body of Accreditation		MQA/SWA0809	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/Part Time)		Full Time	
11. Study Duration		Minimum : 3 years Maximum : 8 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	6	16	14
Short	-		-

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University General Course (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 6 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Generate in-depth, relevant and cutting-edge knowledge through original, ethical and scholarly research.
PEO2	Utilized the research knowledge for the benefit of communities, society, nation and humanities.
PEO3	Advocate relevant knowledge and expertise through effective oral and written communications.
PEO4	Pursue lifelong learning, such as graduate work or other professional education.
PEO5	Become effective collaborators and innovators, leading or participating in efforts to address social, technical and business challenges.

Programme Learning Outcomes (PLO)

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

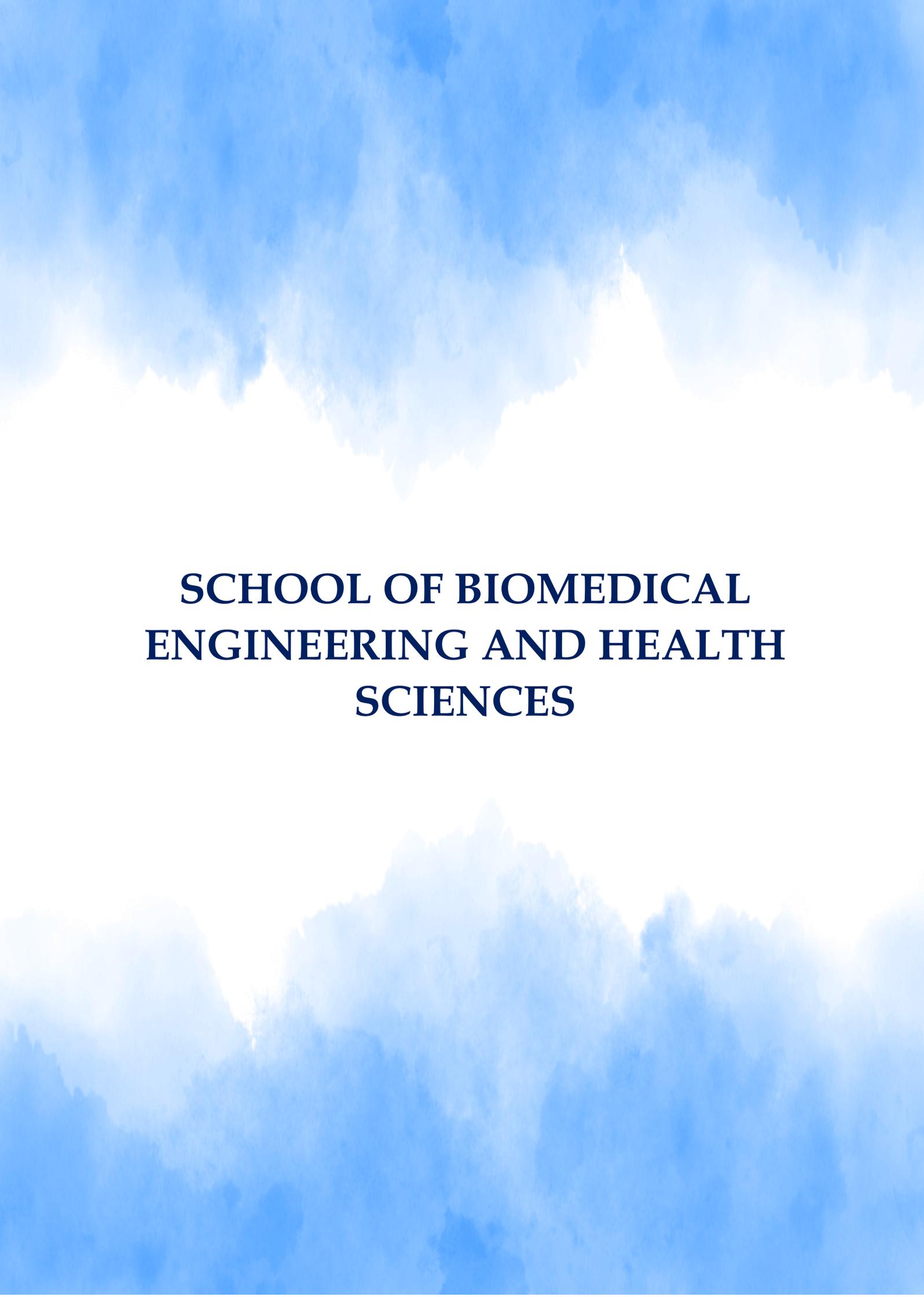
Code	Intended Learning Outcomes
PLO1	Show a systematic comprehension and in-depth understanding of a discipline and mastery of skills and research methods related to the field of study.
PLO2	Show capabilities to generate, design, implement and adopt the integral part of research process with scholarly strength and ethics.
PLO3	Contribute to the original research by making critical analysis, evaluation and synthesis of new and complex ideas that broadened the boundary of knowledge.
PLO4	Practice research ethics and conduct responsible research.
PLO5	Communicate with peers, scholarly community and society at large concerning the field of expertise.
PLO6	Promote technological, social and cultural progress in a knowledge-based society in the academic and professional context
PLO7	Demonstrate sensitivity to social needs and readiness to apply relevant knowledge to fulfilling them
PLO8	Demonstrate the awareness of effective team-working conducting research
PLO9	Demonstrate leadership capability and the ability to effectively deliver knowledge, scientific findings, recommendations and rationale to peers and

	experts.
PLO10	Ability to gather, organize, adapt contemporary knowledge effectively and capable of utilizing appropriate computational tools independently.
PLO11	Demonstrate the ability of managing and conducting research or other activities, and display the awareness of the need to exploit all possible resources and opportunities which include personal, institutional or business linkages and collaboration

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE		CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
FACULTY OF ENGINEERING COURSES					
1	Uxxx xxx3	University General Course (choose 1 course) UHAP6013 (Seminar on Global Development, Economic and Social Issues) – Faculty of Management (FM) UICW6023 (Philosophy of Science and Civilization) – Faculty of Islamic Civilization (FTI) UCSM1263 (IT Project Management) – Faculty of Computing (FC) UPPF6033 (Dynamics of Leadership) – Faculty of Education (FP)			
2		Research Methodology :			
	UKKP0010	School of Chemical and Energy Engineering			
	UKMP0010	School of Mechanical Engineering			
	UMBP0010	School of Biomedical Engineering and Health Sciences			
	UKEP0010	School of Electrical Engineering			
	UAPA0010	School of Civil Engineering			
3	PLPG XX00	Research (Minimum 5 Semester)			
4		Thesis			
5		Publication (minimum one (1) refereed article or two (2) indexed conference proceedings accepted as published in SCOPUS/ERA/WOS)			



**SCHOOL OF BIOMEDICAL
ENGINEERING AND HEALTH
SCIENCES**

PROGRAMMES OFFERED

The School of Biomedical Engineering and Health Sciences (SBEHS) offers five (5) postgraduate programmes that lead to the award of postgraduate degrees (Master or Doctor of Philosophy) in the areas of Biomedical Engineering, Rehabilitation Technology and Health Sciences. Students may register for the programme by one of the modes of study offered, namely course work (master's degree only) and research. For full-time Master and Doctor of Philosophy programmes, the normal study durations are 3 to 8 semesters (1.5 - 4 years) and 6 to 16 semesters (3 - 8 years) respectively.

Additional Requirements

Each programme requires the student to take at least one University compulsory course from (but not limited to) the following options:

- UANP 6013 Informatics in Society
- UBSS 6013 Organization Behaviour and Development
- UBSS 6023 Business Ethics, Responsibility and Sustainability
- UECS 6013 IT Project Management
- UHPS 6013 Dynamics of Leadership
- UHSM 6013 Seminar on Global Development, Economic and Social Issues
- URSP 6023 ICT Ethics and Society
- URTS 6013 Environmental Ethics

Whereas international students are required to take at least one University compulsory course from (but not limited to) the following options:

- UHLM 6013 Malay Language for Postgraduates
- UHMZ 6023 Malaysian Society and Culture

International students are required to register for courses that have been labelled as “*For International Students*” since some of the other courses are conducted in the Malay language. For the full list of University compulsory courses, students may visit the School of Graduate Studies’ website at <https://sps.utm.my/academic-related-resources/> .

Apart from the above requirements, all research students must register and attend for the Research Methodology course (Compulsory attendance):

- UMBP 0010 Research Methodology

The Research Methodology course is offered as an intensive course during the mid-semester break and must be completed prior to the proposal defence.

Master Degree Programmes

Programmes	Code	Mode*	Research Field**
Master of Science (Biomedical Engineering)	MEBC	1	A
Master of Philosophy, Field of Research: Biomedical Engineering	MMBE	2	A
Master of Philosophy, Field of Research: Biomedical Engineering-Double Degree	MMBE	2	A
Master of Philosophy, Field of Research: Rehabilitation Technology	MMBR	2	B

Doctoral Degree Programmes

Programmes	Code	Mode*	Research Field**
Doctor of Philosophy, Field of Research: Biomedical Engineering	PMBE	2	A
Doctor of Philosophy, Field of Research: Biomedical Engineering-Double Degree	PMBE	2	A
Doctor of Philosophy, Field of Research: Health Science	PMBH	2	C

***Mode:**

1 = Course work, 2 = Research

**** Research Field:**

A= Biomedical Engineering

B= Rehabilitation and Health Sciences Technology

C= Health Sciences

DOCTOR OF PHILOSOPHY

Programme Specifications

The School of Biomedical Engineering and Health Sciences (SBEHS) offers the three following Doctor of Philosophy programmes by research:

1. Doctor of Philosophy, Field of Research: Biomedical Engineering
2. Doctor of Philosophy, Field of Research: Health Science
3. Doctor of Philosophy, Field of Research: Biomedical Engineering - Double Degree
Universiti Teknologi Malaysia (UTM) and Technical University Ilmenau (TUIL) Germany have collaborated to offer an International Double Degree programme in Biomedical Engineering. This doctorate double degree programme enables student to be awarded with 2 certificates, which are Doctor of Philosophy (PhD) degree in Biomedical Engineering from UTM and Doctor in Computer Science and Automation (Dr.-Ing) from Technical University Ilmenau, Germany (TUIL). Students are required to spend at least nine (9) months at the partner university.

Programme Features

The three Doctor of Philosophy by research programmes above are offered full-time. A student will carry out research in any one of the research areas chosen. Each research project is supervised by a lecturer of the Graduate Faculty. A Graduate Faculty member is an academic staff who has a doctoral degree qualification or an academic staff who holds an academic post of at least associate professor and is involved directly or indirectly in the post-graduate programmes. Co-supervisor(s) should be appointed from among Graduate Faculty members or may also come from a related industry.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia
2. Teaching Institution	Universiti Teknologi Malaysia
3. Programme Name	Doctor of Philosophy, Field of Research: Biomedical Engineering Doctor of Philosophy, Field of Research: Health Sciences Doctor of Philosophy, Field of Research: Biomedical Engineering - Double Degree
4. Final Award	Doctor of Philosophy, Field of Research: Biomedical Engineering Doctor of Philosophy, Field of Research: Health Sciences Doctor of Philosophy, Field of Research: Biomedical Engineering - Double Degree

5. Programme Code	PMBE PMBH PMBE
6. Professional or Statutory Body of Accreditation	Malaysia Qualification Agency
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional (Research)
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Scheme (Full Time/Part Time)	Full Time
11. Study Duration	Minimum: 3 years (6 semesters) Maximum: 8 years (16 semesters)

Course Menu

Doctor of Philosophy, Field of Research: Biomedical Engineering

Year	Code	Description	Credit
1	PMBE 1100	Research	0
	PMBE 1200	Research	0
2	PMBE 2100	Research	0
	PMBE 2200	Research	0
3	PMBE 3100	Research	0
	PMBE 3200	Research	0
4	PMBE 4100	Research	0
	PMBE 4200	Research	0
5	PMBE 5100	Research	0
	PMBE 5200	Research	0
6	PMBE 6100	Research	0
	PMBE 6200	Research	0
7	PMBE 7100	Research	0
	PMBE 7200	Research	0
8	PMBE 8100	Research	0
	PMBE 8200	Research	0

Doctor of Philosophy, Field of Research: Health Science

Year	Code	Description	Credit
1	PMBH 1100	Research	0
	PMBH 1200	Research	0
2	PMBH 2100	Research	0
	PMBH 2200	Research	0
3	PMBH 3100	Research	0
	PMBH 3200	Research	0
4	PMBH 4100	Research	0
	PMBH 4200	Research	0
5	PMBH 5100	Research	0
	PMBH 5200	Research	0
6	PMBH 6100	Research	0
	PMBH 6200	Research	0
7	PMBH 7100	Research	0
	PMBH 7200	Research	0
8	PMBH 8100	Research	0
	PMBH 8200	Research	0

General Elective University Course (Compulsory) - Applicable for both PMBE and PMBH

Code	Course	Credit
UMBP 0010	Research Methodology	HW
U*** **3	General Elective University Course	3

MASTER OF PHILOSOPHY

Programme Specifications

School of Biomedical Engineering and Health Sciences (SBEHS) offers the following three master programmes by research mode:

1. Master of Philosophy, Field of Research: Biomedical Engineering
2. Master of Philosophy, Field of Research: Rehabilitation Technology
3. Master of Philosophy, Field of Research: Biomedical Engineering - Double Degree
Universiti Teknologi Malaysia (UTM) and Technical University Ilmenau (TUIL) Germany have collaborated to offer an International Double Degree programme in Biomedical Engineering. The student will be awarded with 2 certificates, which are Master in Engineering (Biomedical) from UTM and/or Master in Biomedical Engineering (MSc) from TUIL. The students are required to spend at least 7 months at the partner university. *Limited scholarships from German's government are available for selected students.*

Programme Features

The three Master by research programmes above are offered full-time. A student will carry out research in any one of the research areas chosen. Each research project is supervised by a lecturer of the Graduate Faculty. A Graduate Faculty member is an academic staff who has a doctoral degree qualification or an academic staff who holds an academic post of at least associate professor and is involved directly or indirectly in the post-graduate programmes. Co-supervisor(s) should be appointed from among Graduate Faculty members or may also come from a related industry.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia
2. Teaching Institution	Universiti Teknologi Malaysia
3. Programme Name	Master of Philosophy, Field of Research: Biomedical Engineering Master of Philosophy, Field of Research: Rehabilitation Technology Master of Philosophy, Field of Research: Biomedical Engineering - Double Degree
4. Final Award	Master of Philosophy, Field of Research: Biomedical Engineering Master of Philosophy, Field of Research: Rehabilitation Technology Master of Philosophy Double-Degree, Field of Research: Biomedical Engineering, UTM + MSc Computer Engineering, Ilmenau, Germany

5. Programme Code	MMBE MMBE MMBR
6. Professional or Statutory Body of Accreditation	Malaysia Qualification Agency
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional (Research)
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Scheme (Full Time/Part Time)	Full Time
11. Study Duration	Minimum: 1.5 years (3 semesters) Maximum: 4 years (8 semesters)

Course Menu

Master of Philosophy, Field of Research: Biomedical Engineering

Year	Code	Description	Credit
1	MMBE 1100	Research	0
	MMBE 1200	Research	0
2	MMBE 2100	Research	0
	MMBE 2200	Research	0
3	MMBE 3100	Research	0
	MMBE 3200	Research	0
4	MMBE 4100	Research	0
	MMBE 4200	Research	0

Master of Philosophy, Field of Research: Rehabilitation Technology

Year	Full-Time	Description	Credit
1	MMBR 1100	Research	0
	MMBR 1200	Research	0
2	MMBR 2100	Research	0
	MMBR 2200	Research	0
3	MMBR 3100	Research	0
	MMBR 3200	Research	0
4	MMBR 4100	Research	0
	MMBR 4200	Research	0

General Elective University Course (Compulsory) - Applicable for both MMBE and MMBR

Code	Course	Credit
UMBP 0010	Research Methodology	HW
U*** **3	General Elective University Course	3

MASTER OF SCIENCE (BIOMEDICAL ENGINEERING)

Programme Specifications

SBEHS offers the MSc (Biomedical Engineering) programme by course work mode offered in full-time. The MSc (Biomedical Engineering) can be completed within three semesters (1½ years).

General Information

1. Awarding Institution	Universiti Teknologi Malaysia
2. Teaching Institution	Universiti Teknologi Malaysia
3. Programme Name	Master of Science (Biomedical Engineering)
4. Final Award	Master of Science (Biomedical Engineering)
5. Programme Code	MEBC
6. Professional or Statutory Body of Accreditation	MQA
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional (Taught Courses)
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Scheme (Full Time/Part Time)	Full Time
11. Study Duration	Minimum :1.5 years Maximum : 3 years

Students are required to successfully complete a minimum of 45 credits which include at least:

Classification	Credit
University General Elective Courses (U**S 6**3) (to choose from the list given by School of Graduate Studies)	3
Programme Core Courses	
Biomedical Measurement Technique	3
Diagnostic and Therapeutic Technology	3
Advanced Biomedical Engineering	3
Medical Informatics	3
Biomechanics	3
Research Methodology for Biomedical Engineering	3
Programme Elective Courses	

Anatomy and Physiology for Engineers	3
Biomedical Fluid Mechanics	3
Biostatistics	3
Medical Imaging and Image Processing	3
Health Care Technology Management	3
Neuroscience	3
Pathophysiology	3
Advance Biosignal Processing	3
Rehabilitation Engineering	3
Tissue Engineering	3
Ultrasound and Electromagnetic in Medicine	3
Choose 4 courses only	12
Master Project	
Master Project 1	4
Master Project 2	8
Total Credit	45

Course Classification

No.	Classification	Credit Hours	Percentage
i.	Faculty Core Courses	18	39.9%
ii.	Faculty Elective Course	12	26.7%
iii.	Master Project	12	26.7%
iv.	University General Elective Course	3	6.7%
Total		45	100

Regulation of Assessment

Marks	Grade	Evaluation Point	Interpretation
90-100	A+	4.00	Excellent Pass
80-89	A	4.00	
75-79	A-	3.67	
70.74	B+	3.33	Good Pass
65-69	B	3.00	
60-64	B-	2.67	Pass
55-59	C+	2.33	Fail
50-54	C	2.00	
45-49	C-	1.67	
40-44	D+	1.33	
35-39	D	1.00	
30-34	D-	0.67	
00-29	E	0.00	

Course Menu

JULY INTAKE

YEAR 1: SEMESTER 1			
Code	Course	Credit	Pre-requisite
MEBC 1003	Biomedical Measurement Technique	3	
MEBC 1013	Diagnostic and Therapeutic Technology	3	
MEBC 1023	Advanced Biomedical Engineering	3	
MEBC 1**3	Elective 1	3	
U**S 6**3	University General Course	3	
MEBC 0013	Research Methodology for Biomedical Engineering	3	
Total Credit		18	
Cumulative Credits		18	

YEAR 1: SEMESTER 2			
Code	Course	Credit	Pre-requisite
MEBC 1033	Medical Informatics	3	
MEBC 1043	Biomechanics	3	
MEBC 1184	Master Project 1	4	
MEBC 1**3	Elective 2	3	
MEBC 1**3	Elective 3	3	
Total Credit		16	
Cumulative Credits		34	

YEAR 2: SEMESTER 1			
Code	Course	Credit	Pre-requisite
MEBC 1198	Master Project 2	8	
MEBC 1**3	Elective 4	3	
Total Credit		11	
Cumulative Credits		45	

FEBRUARY INTAKE

YEAR 1: SEMESTER 1			
Code	Course	Credit	Pre-requisite
MEBC 1033	Medical Informatics	3	
MEBC 1043	Biomechanics	3	
MEBC 1**3	Elective 1	3	
MEBC 1**3	Elective 2	3	
U**S 6**3	University General Elective Course	3	
MEBC 0013	Research Methodology in Biomedical Engineering	3	
Total Credit		18	
Cumulative Credits		18	
YEAR 1: SEMESTER 2			
Code	Course	Credit	Pre-requisite
MEBC 1003	Biomedical Measurement Technique	3	
MEBC 1013	Diagnostic and Therapeutic Technology	3	
MEBC 1023	Advanced Biomedical Engineering	3	
MEBC 1**3	Elective 3	3	
MEBC 1184	Master Project 1	4	
Total Credit		16	
Cumulative Credits		34	

YEAR 2: SEMESTER 1			
Code	Course	Credit	Pre-requisite
MEBC 1198	Master Project 2	8	
MEBC 1**3	Elective 4	3	

Total Credit	11	
Cumulative Credits	45	

Elective Course	
Code	Course
MEBC 1053	Anatomy and Physiology for Engineers
MEBC 1063	Biomedical Fluid Mechanics
MEBC 1073	Introduction to Biostatistics
MEBC 1083	Healthcare Technology Management
MEBC 1093	Medical Imaging and Image Processing
MEBC 1103	Neuroscience
MEBC 1113	Pathophysiology
MEBC 1123	Advance Biosignal Processing
MEBC 1143	Rehabilitation Engineering
MEBC 1153	Cardiovascular Engineering
MEBC 1173	Biomedical Electronic System Design
MEBC 1183	Bio-Material Characterization and Analysis
MEBC 1193	Genetic Engineering
University Elective Course	
U**S 6**3	University Elective

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of Biomedical Engineering field.
PEO2	Practice professionalism and high standards of ethical conducts within organization and society.
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Attain new frontiers of knowledge in the field of Biomedical Engineering.
PLO2	Solve complex problems critically and integratively using systematic approaches.
PLO3	Apply practical skills to solve problems in the field of Biomedical Engineering.
PLO4	Demonstrate effective collaboration with stakeholders professionally.
PLO5	Communicate effectively the knowledge, skills, and ideas using appropriate methods to peers, experts and communities.
PLO6	Use digital technologies and appropriate softwares competently to enhance study and practice.

PLO7	Evaluate numerical and graphical data critically using quantitative or qualitative tools in solving problems.
PLO8	Demonstrate leadership, autonomy and responsibility in managing resources.
PLO9	Engage self-advancement through continuous learning or professional development.
PLO10	Initiate entrepreneurial projects supported by relevant knowledge and skills.
PLO11	Demonstrate respectable ethical conducts and professionalism skills in an organization and society.

Graduation Checklist

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

No.	Code	Course	Credit Earned (Jkd)	Credit Count-Ed (Jkk)	Tick (✓) If Passed
Engineering Courses					
1	MEBC 1003	Biomedical Measurement Technique	3	3	
2	MEBC 1013	Diagnostic and Therapeutic Technology	3	3	
3	MEBC 1023	Advanced Biomedical Engineering	3	3	
4	MEBC 1**3	Elective 1	3	3	
5	MEBC 1033	Medical Informatics	3	3	
6	MEBC 1043	Biomechanics	3	3	
7	MEBC 1184	Master Project 1	4	4	
8	MEBC 1**3	Elective 2	3	3	
9	MEBC 1**3	Elective 3	3	3	
10	MEBC 1198	Master Project 2	8	8	
11	MEBC 1**3	Elective 4	3	3	
12	MEBC 0013	Research Methodology for Biomedical Engineering	3	3	
Total Credit			42	42	
University General Courses					
Kluster 1: Penghayatan Falsafah, Nilai & Sejarah (Faculty of Social Sciences and Humanities)					
1	U**S 6**3	University General Course	3	3	
Total Credit			45	45	

COURSE SYNOPSIS

MEBC 1003 - Biomedical Measurement Technique

Objectives

Identify and explain the basic and advanced concept of biomedical instrumentation and measurement

Analyse physiological properties and design suitable instrumentation for specific purpose to solve biomedical engineering problems.

Synopsis

This course provides the students a complete exposure of various recording mechanism and biomedical parameters measured for diagnostic application. Also introduces students to design biomedical measurement systems and biomedical instrumentation. The architecture of electronic instruments used to measure physiological parameters is addressed, as well as the analysis of major process functions integrated in these instruments.

References

Leslie Cromwell (1997). Biomedical Instrumentation and measurement. Prentice Hall, India, New Delhi.

John G. Webster (1998). Medical Instrumentation, Application and Design (3rd Ed). John Wiley.

Khandpur R.S (1997). Handbook of Biomedical Instrumentation Tata McGraw-Hill, New Delhi.

Joseph J.Carr and John M. Brown (1997). Introduction to Biomedical Equipment Technology. John Wiley and sons, NewYork.

Geoddes and L.E. Baker (1975).Principles of Applied Biomedical Instrumentation. John Wiley, L.A.

R.S. Khandpur (2003). Hand-book of Biomedical Instrumentation, TMH, 2nd Ed.

Mackay, Stuart R (1968). Biomedical Telemetry. John Wiley

MEBC 1013 - Diagnostic and Therapeutic

Objectives

Explain knowledge in advanced diagnostic and therapeutic technology in the clinical and hospital environment

Analyze and categorize scientific and technical knowledge for research in advanced diagnostic and therapeutic technology.

Synopsis

This course is designed to introduce students on how the bio-signal is measured, recorded and monitored and details on the broad collection of diagnostic and therapeutic equipments. At the end of the course, student will be able to learn various techniques that have been used in healthcare environment, clinical or research.

References

Alan K. David, Scott A. Fields, D. Melessa Phillips, Joseph EScherger and Robert B. Taylor (2008). Taylor's Diagnostic and Therapeutic Challenges: A Handbook. Springer.

Dyro, J. F. (2004). *Clinical Engineering Handbook*. Elsevier.

Geddes, L. A., Baker, L. E. (1989). *Principles of Applied Biomedical Instrumentation*. Wiley Interscience.

Khandpur (2003). *Handbook of Biomedical Instrumentation*. McGraw Hill.

Stephen McPhee, Maxine Papadakis and Michael W. Rabow (2011). *Current Medical Diagnosis and Treatment*. McGraw Hill

Related journal papers

MEBC 1023 - Advanced Biomedical Engineering

Explain advanced technology and knowledge used in medical devices to diagnose and treat patients by applying the electronics, signal processing, biomechanics medical and therapy knowledges.

Objectives

Design device used in diagnosis and clinical treatment by combining biological and medical science

Synopsis

This course provides the students with the introduction to advanced technologies of biomedical engineering in the field of bioinstrumentation, biophysics, biomaterials and biomechanics. The impact of technologies on clinical research, rehabilitation engineering, and patient care will be dealt along with professional ethics. The course explores techniques for assessing current information practices, determining the information needs of health care providers and patients, developing interventions using biomedical technology, and evaluating the impact of those interventions.

References

Joesph D. Bronzino (2000). *The Biomedical Engineering Handbook*. CRC Press LLC.

Dyro, J. F. (2004). *Clinical Engineering Handbook*.

Geddes, L. A. and Baker, L.E. (1989). *Principles of AppliedJ. F. (2004). Biomedical Instrumentation*. Wiley Interscience.

Khandpur (2003). *Handbook of Biomedical Instrumentation*. McGraw Hill

MEBC 1033 - Medical Informatics

Objectives

Apply medical informatics knowledge to improve the quality of health care, reduce cost, provide better education for providers and patients.

Synopsis

This course provides students with the organization of medical information, the effective management of information using computer technology, and the impact of such technology on medical research, education, and patient care. The course explores techniques for assessing current information practices, determining the information needs of health care providers and patients, developing interventions using computer technology, and evaluating the impact of those interventions.

References

- Nordin, M. & Frankel, V. (2001). Basic Biomechanics of the Musculoskeletal System. Lippincott Williams & Wilkins.*
- Humphrey, J.D. & Delange, S.L. (2003). An Introduction to Biomechanics. Solids and Fluids, Analysis & Design. Springer.*
- Hall, S. J. (2003). Basic Biomechanics. McGraw-Hill Publishers Hall.
- Abd Rahman Musa (2007). Statics Made Simple. Pearson Prentice Hall.
- Donald R. Peterson and Joseph D. Bronzino (2008). Biomechanics: Principles and Applications. CRC Press.
- T. Clive Lee & Peter Niederer (Editors) (2010). Basic Engineering for Medics and Biologists. IOS Press BV, Netherlands

MEBC 1043 - Biomechanics

Objectives

Analyze biomechanics knowledge on specific movement patterns from both anatomical and mechanical

Synopsis

This course provides the students with application of the principles of mechanics and the techniques of engineering to the human body. The series of lectures explore the musculoskeletal system and highlights selected applications in the area of orthopedics (gait analysis, joint replacement) and analyzing the various forms of human movement.

References

- Nordin, M. & Frankel, V. (2001). Basic Biomechanics of the Musculoskeletal System. Lippincott Williams & Wilkins.*
- Humphrey, J.D. & Delange, S.L. (2003). An Introduction to Biomechanics. Solids and Fluids, Analysis & Design. Springer.*
- Hall, S. J. (2003). Basic Biomechanics. McGraw-Hill Publishers Hall.
- Abd Rahman Musa (2007). Statics Made Simple. Pearson Prentice Hall.
- Donald R. Peterson and Joseph D. Bronzino (2008). Biomechanics: Principles and Applications. CRC Press.

MEBC 1184 - Master Project 1

Objectives

To apply engineering knowledge in professional practices in overcome biomedical engineering issues.

Solve research problems and present research results logically, creatively, innovatively and analytically based on scientific facts and research experience.

Communicate effectively across a range of context and audiences.

Synopsis

The research project proposal emphasizes integration and application of knowledge to solve a biomedical engineering problem. The student must identify a thesis advisor, conduct preliminary research, write research proposal and make a presentation which will be evaluated. For seminar, student will attend paper presentation to expose themselves into research and to gain new knowledge.

References

School of Graduate Study. UTM Thesis Manual.<http://www.sps.utm>.

MEBC 1198 - Master Project 2

Objectives

To apply engineering knowledge in professional practices in overcome biomedical engineering issues.

Solve research problems and present research results logically, creatively, innovatively and analytically based on scientific facts and research experience

Communicate effectively across a range of context and audiences.

Work responsibly with specialized laboratory equipment with appropriate technical, transferable and interpersonal skills

Synopsis

The research project thesis emphasizes integration and application of knowledge to solve a biomedical engineering problem. The student must conduct research, document the findings and make a presentation which will be evaluated.

References

School of Graduate Study. UTM Thesis Manual.<http://www.sps.utm>.

UMBP0010 - Research Methodology

Objectives

To discuss the principles, various techniques, skills and process in conducting academic research.

Synopsis

This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Amongst topics that will be covered are introduction to research and its philosophy, problem formulation and research objective, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

References

FSKSM ((2010). *Handbook of Research Methods in Computing*, UTM.

ELECTIVE COURSES

MEBC 1053 - Anatomy and Physiology for Engineers

Objectives

Identify and relate the structure and function of the tissue, organ, and systems in humans.

Synopsis

This course provides fundamental concepts of the basic structure and function of the human body as an integrated set of systems from an engineering perspective. This course will expand student's knowledge in the engineering approach toward understanding functions and by giving some engineering solutions and increasing the ability of the students to integrate between the engineering technology and multiple related medical disciplines. Engineering principles will be used to analyse anatomical structures and physiological functions at the tissue, organ, and systems levels.

References

Principles of Anatomy and Physiology, 12th Edition, Gerard J. Tortora, Bryan H. Derrickson, 2009

Hole's human anatomy and physiology, David Shier, Jackie Butler and Ricki Lewis, McGraw-Hill, 2004

Essentials of anatomy and physiology, Frederic H. Martini and Edwin F. Bartholomew, Prentice Hall, 2000

Atlas Netter Interactive Atlas of Human Anatomy v3.0, F. Netter.Medical. CD-ROM

MEBC 1063 - Biomedical Fluid Mechanics

Objectives

Explain and categorize biomedical fluids mechanic knowledge of mass conservation, energy conservation, and momentum balance to flowing fluids to solve biomedical engineering problem and relate the structure and function of the tissue, organ, and systems in humans. Analyze biomedical problems related to biofluid using current techniques

Synopsis

This course provides the students with application of the principles of mechanics and the engineering techniques which is the fluid mechanics to the biological fluid flow, in particular cardiovascular system. Other system related to biological flow will be explored such as respiratory flow, flow around body, and bird flight mechanism. By the end of the course, student should be able to understand fluid mechanics and its pertinent application to flow in the biological system – cardiovascular system, respiratory system and the likes. Other outcome of this course would be for the student to apply fluid mechanics analysis of human circulation, as well as artificial organs implanted within human body for disease treatment.

References

Jagan N. Mazumdar, *Biofluid Mechanics*, World Scientific Publishing, 2004
Krishnan B. Chandran, Stanley E. Rittgers, and Ajit P. Yoganathan, *Biofluid Mechanics: The Human Circulation, 2nd Edition*, CRC Press, 2012
Megh R. Goyal, *Biofluid Dynamics of Human Body Systems*, Apple Academic Press, 2014
Biofluid Methods in Vascular and Pulmonary Systems, Biomechanical Systems Techniques and Application Volume IV, Editor : Cornelius Leondes, CRC Press LLC, 2001

MEBC 1073 - Biostatistics

Objectives

Explain and apply biostatistics knowledge in biomedical engineering

Synopsis

This course provides statistical concepts and methods with emphasis on applications in clinical medicine, epidemiology and public health. This course also explores advanced biostatistical methods that have been used in designing and analyzing biomedical and public health investigations.

References

Bernard Rosner (2005). *Fundamental of Biostatistics*. Duxbury Press.
Jerrold Zar (2009). *Biostatistical Analysis*. Pearson.
Leon Gordis (2004). *Epidemiology*. WB Saunders.
Douglas G. Altman (1990). *Practical Statistics for Medical Research*. Chapman & Hall, CRC.

MEBC 1083 - Health Care Technology Management

Objectives

To Identify and explain the systems or procedures relating to plan and procurement, utilization and maintenance of healthcare technologies
Analyze and adapt the existing health care technology policies in health care management

Synopsis

This course provides the students the ability to develop a systematic process for planning and managing health technology assets to achieve the highest quality care at the best cost. It explains the concepts of health care management and describes the various types of health plan in operation today. This course also covers the strategic planning as well as technology assessment, facilities planning, procurement, and service or maintenance management.

References

Dyro, J. F. (2004). *Clinical Engineering Handbook*. Elsevier.
Joseph D Bronzino and Robert J Austin-LaFrance (1992). *Management of medical technology: a primer for clinical engineers*, Boston: Butterworth-Heinemann.
David Y, Judd T (1993). *Medical technology management*, Redmond, WA, SpaceLabs Medical, INC.

MEBC 1093 - Medical Imaging and Image Processing

Objectives

To apply the techniques in image major by using image analysis knowledge.

Synopsis

This course provides students with an overview of the key concepts behind the main imaging modalities used in diagnostic imaging. The course also introduces students in the basic concepts and methods for image analysis and processing in biomedical engineering and medical physics as well as the use of basic software for image analysis and processing in biomedical engineering and medical physics.

References

- Gonzalez, Rafael C., and Richard E. Woods. "Digital image processing prentice hall." Upper Saddle River, NJ (2002).*
- Gonzalez, Woods, and Richard E. Woods. "Eddins, Digital Image Processing Using MATLAB." Third New Jersey: Prentice Hall (2004).*
- Suri, Jasjit S., David Wilson, and Swamy Laxminarayan, eds. Handbook of biomedical image analysis. (Vol 1) Springer Science & Business Media, 2005.*
- Suri, Jasjit S., David Wilson, and Swamy Laxminarayan, eds. Handbook of biomedical image analysis. (Vol 2) Springer Science & Business Media, 2005.*
- Suri, Jasjit S., David Wilson, and Swamy Laxminarayan, eds. Handbook of biomedical image analysis. (Vol 3) Springer Science & Business Media, 2005.*
- Isaac. N. Bankman, "Handbook of Medical Imaging, Processing and Analysis", Academic Press, 2000.*

MEBC 1103 - Neuroscience

Objectives

To analyze on various techniques, skills and modern equipment used in neuroscience.

Synopsis

This Neuroscience course is a comprehensive introduction to the mammalian nervous system, focusing on the structure and function of the human brain. Anatomical, cellular, chemical, physiological, and molecular aspects of neuroscience will be discussed. Topics that will be covered include: neurons and glia, neuroanatomy, action potentials, synaptic transmission, neurotransmitters, sensory systems (vision, hearing, and touch), motor systems, behavioral responses, development, learning and memory, aging, mental illness, neurodegenerative diseases, and genomics. An inquiry-based approach will be taken to facilitate student learning of the material.

References

- Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. Neuroscience: Exploring the Brain. 3rd ed. Baltimore, Md.: Lippincott Williams & Wilkins, 2001. ISBN: 0-7817-6003-8.*
- Kandel, Eric R., James H. Schwartz, and Thomas M. Jessell. Principles of Neural Science. 4th ed. New York: McGraw-Hill, 2000. ISBN: 0-8385-7701-6. This textbook is recommended.*

Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Anthony-Samuel Lamantia, James O. McNamara, Leonard E. White (2007). Neuroscience. Sinauer Associates Inc., U.S.

Larry R. Squire, James L. Roberts, Nicholas C. Spitzer, Michael J. Zigmond, Susan K. McConnell, Floyd E. Bloom (2002). Fundamental Neuroscience. Academic Press.

MEBC 1113 – Pathophysiology

Objectives

To attain and apply knowledge in the field of pathophysiology and how to use advanced techniques to provide solution or innovative practice

Synopsis

This course provides concepts of physiology of altered health state, specifically, the changes that accompany injury, syndrome or diseases. Clinical features will be described to provide an overview of pathological aspects of common physiological disorders in human body. Discussion on the basis of the illustration of the systemic approach for understanding diseases and rational therapeutic design of their diagnosis/treatment through an engineering approach will be addressed in this course.

References

Carol M Porth (2010). Essentials of Pathophysiology Concepts of Altered Health States, 3rd Edition.

Pathophysiology: Functional Alterations in Human Health By Carie A. Braun, Cindy Anderson (2007)

Carie A Braun, RN Cindy M Anderson (2010). Pathophysiology A Clinical Approach 2nd edition.

Mary V. Burns (1998). Pathophysiology: A Self Instructional Program, Prentice Hall.

Wheater's Functional Histology: A Text and Colour Atlas, 5th Edition (2006) Barbara Young, James S. Lowe, Alan Stevens, and John W. Heath

MEBC 1123 – Advanced Biosignal Processing

Objectives

To explain concepts of signal processing and apply signal processing tools from various sources in standard medical devices to solve biomedical engineering problems

Synopsis

This course presents two fundamental concepts of signal processing: linear systems and stochastic processes. Various estimation, detection and filtering methods are taught and demonstrated on biomedical signals. All methods will be developed to answer concrete question on specific biomedical signal such as ECG, EEG and etCO₂. The focus of the course is a series of labs that provide practical experience in processing biomedical data, with examples from cardiology, neurology, respiratory and speech processing.

References

Introduction to Biomedical Engineering, Second Edition by John Enderle, Publisher: Elsevier Academic Press, ISBN: 0-12-238622-0

Biomedical Signal Processing: Principles and Technique, D. C. Reddy, McGraw-Hill Publishing Company Limited, ISBN: 0-07-058388-9

MEBC 1143 – Rehabilitation Engineering

Objectives

To apply knowledge, concepts and methods in rehabilitation engineering and adapt current technical concepts and practices for optimal outcomes issues pertaining to rehabilitation engineering

Synopsis

This course will focus on the principles and application of rehabilitation sciences & assistive technology from the rehabilitation engineering perspective. It aims to provide the students with in depth understanding pertaining important issues in rehabilitation engineering and equip students with knowledge and skills for the application of science, technology and engineering to the design and development of assistive (adaptive) technology and rehabilitation systems. It will also provide students with an understanding of the nature of problems confronting people with disabilities and an ability to provide technical solutions for these problems. Interdisciplinary interaction and teamworking for optimal disability management will be stressed, with emphasis being given to the role of the rehabilitation engineering professional in the team.

References

Cook and Hussey's Assistive Technologies: Principles and Practice Albert M. Cook and Janice Miller Polgar Publisher: Mosby; 3 edition (September 19, 2007)

Rehabilitation Engineering Applied to Mobility and Manipulation Rory A Cooper, Publisher: Taylor & Francis; 1 edition (January 1, 1995)

Aaos Atlas of Orthoses and Assistive devices, JOHN D. HSU, JOHN MICHAEL , JOHN FISK Publisher: Mosby; 4 edition (June 24, 2008)

An Introduction to Rehabilitation Engineering, Cooper, Rory A., Hisaichi Ohnabe, and Douglas A. Hobson Publisher: Taylor & Francis; 1 edition (December 26, 2006)

Intelligent Systems and Technologies in Rehabilitation Engineering Teodorescu, Horia-Nicolai L., and Lakhmi C. Jain Publisher: CRC Press; 1 edition (December 26, 2000)

MEBC 1153 – Cardiovascular Engineering

Objectives

To adapt the basic anatomical and cardiovascular principles in the teaching and coaching of existing cardiovascular diagnostic skills in producing scientific research and to signal processing tools from various sources in standard cardiovascular devices

Synopsis

Cardiovascular Engineering integrates physiology, cell and molecular biology, bioelectricity and biomechanics to describe, understand, and re-engineer the cardiovascular systems. The objective of this course is to provide the students with tools for modeling and understanding of cardiovascular disease development and treatment, and for designing appropriate systems and devices for diagnosis and intervention.

References

- Ned H. C. Hwang. (2010). *Advances in Cardiovascular Engineering*. NATO ASI series, Springer; 1 edition (February 28, 1993).
- Guccione, Julius M.; Kassab, Ghassan S.; Ratcliffe, Mark B. (Eds.) 2010. *Computational Cardiovascular Mechanics Modeling and Applications in Heart Failure*. Springer.
- Dhanjoo N. Ghista (2008). *Cardiovascular Engineering: Protheses, assist and artificial organs*. University of Michigan.
- Ajit Yoganathan. *Cardiovascular Engineering and Technology*. Springer.

MEBC 1173 Biomedical Electronic System Design

Objectives:

To construct front-end biomedical sensors and transducers with amplifiers, filters and analog to digital converters and to design a back-end digital computation system targeted for biomedical or health care application from high level algorithm down to low level architecture implementation.

Synopsis:

Biomedical Electronic system design covers the design scope from front-end analog circuit design down to back-end digital computation architecture design to form a complete system targeted for biomedical or health care application. The front-end analog circuit design includes signal acquisition and conditioning circuit design, which involves amplifier, analog filter, analog to digital converter and so on. On the other hand, the back-end digital system design involves the design methodology from high-level algorithm down to low-level computing architecture using Register Transfer Level (RTL) design approach to generate a synthesizable circuit. The digital system will be verified in terms of simulation or prototyping on Field Programmable Gate Array (FPGA) platform.

References:

C. Raja Rao, Sujoy K. Guha, Principles of Medical Electronics and Biomedical Instrumentation, Universities Press, 2001.

Claudio Becchetti, Alessandro Neri, Medical Instrument Design and Development: From Requirements to Market Placements, John Wiley & Sons, 2013.

John G. Webster, Amit J Nimunkar, Medical Instrumentation: Application and Design, Edition 5, Wiley, 2020.

Zainalabedin Navabi, Verilog Digital System Design: RT Level Synthesis, Testbench and Verification, Second Edition, McGraw-Hill, 2006.

Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic With Verilog Design, 3rd edition, McGraw-Hill Education, 2013.

Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Second Edition, Prentice Hall, February 21, 2003.

MEBC 1183 Bio-Material Characterization and Analysis**Objectives**

To introduce basic principle of material's characterization instruments in characterizing biomaterials and to adapt suitable characterization instruments to analyze specific physico-chemical properties of biomaterials

Synopsis

This course is intended to expose the students with the most important characterization instruments to analyze the physico-chemical properties of biomaterials. A range of advanced techniques for the materials characterization analysis, including materials composition, surface morphological, thermal, spectroscopy and chromatography analyses are introduced by discussing the basic underlying principle and the analysis procedures. Several case studies and recording data are evaluated and analyzed to improve the student's understanding in selecting types of characterization instruments in analyzing biomaterials. Depending on the availability and functionality of instruments, lab visits and demonstrations will be scheduled following the class.

References

Yang Leng, 2008, Materials Characterization – Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons Pte Ltd

D.O. Northwood, T. Rang, J. De Hosson & C.A. Brebbia, 2018, Materials Characterisation, WIT Press

J. Richard Brundle, Charles A. Evans, Jr & Shaun Wilson, 1992, Encyclopedia of Materials Characterization, Elsevier

MEBC 1193 Genetic Engineering

Objectives

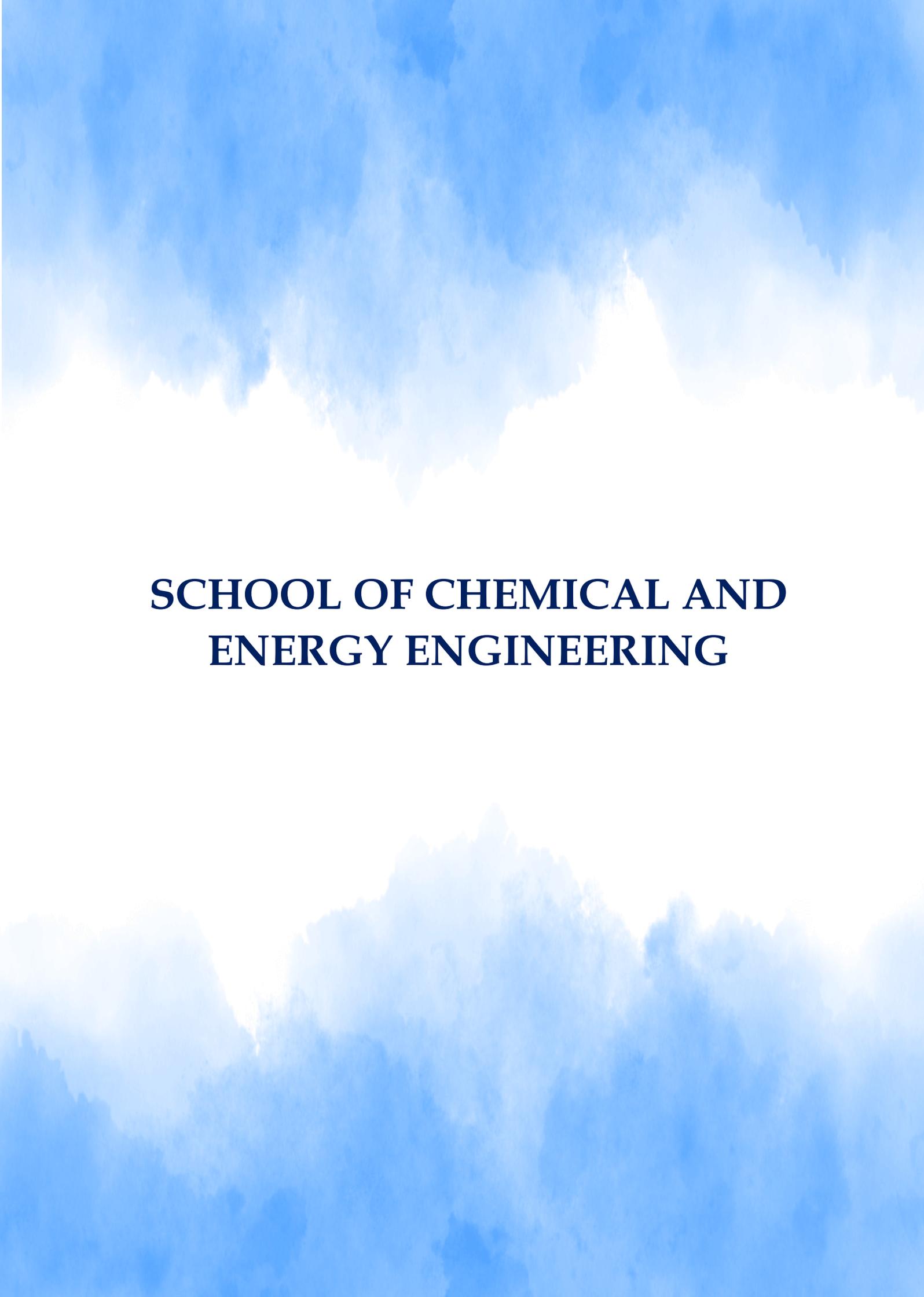
To interpret the concept of genetic engineering including the techniques, applications and limitations and to demonstrate the ability to design recombinant molecules and their functions.

Synopsis

This course will provide students with the recent knowledge of genetic engineering. Participants are given information related to cellular and molecular function and those responsible for DNA transcription and translation processes. Additionally, this course will focus on recombinant DNA technology, DNA manipulation, transgenic animals, and the ethics of genetic engineering. The participants will be equipped with basic emphasis on assembling a gene for expression in a cell. More advanced studies of genes appear in high-level classes and may include subjects such as Mendelian genetics, speciation, and evolutionary genetics. This course also equips the participants with social responsibility and ethics for the development of effective genetic manipulation for beneficial purpose.

References

- Nicholl D.S.T. (2008) An Introduction to Genetic Engineering, 3rd Edition, Cambridge University Press.*
- Rastogi S., and Pathak N. (2009) Genetic Engineering, New Delhi: Oxford University Press.*
- Fridell R. (2006) Genetic Engineering, Minneapolis: Lerner Publications Group.*



**SCHOOL OF CHEMICAL AND
ENERGY ENGINEERING**

DOCTOR OF PHILOSOPHY
FIELD OF RESEARCH: BIOPROCESS ENGINEERING
Conventional, Active and Cooperative Learning (Taught Course)

PROGRAMME SPECIFICATIONS

The Doctor of Philosophy Field of Research: Bioprocess Engineering (PKKB) is offered on a full-time basis. The duration of study is in between a minimum of three (3) years to a maximum of eight (8) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Doctor of Philosophy	
4. Final Award		Doctor of Philosophy Field of research: Bioprocess Engineering	
5. Programme Code		PKKB	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/Part Time)		Full Time	
11. Study Duration		Minimum : 3 years Maximum : 8 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	6	16	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 6 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to in-depth knowledge in bioprocess engineering related areas.
PEO2	Graduates are able to formulate, solve and conduct problems through effective and critical thinking skills.
PEO3	Graduates are able to organize relevant knowledge and expertise through effective oral and written communications.
PEO4	Graduates are able to develop relevant knowledge, promote professional and ethical responsibilities including contemporary issues and environmental awareness.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Incorporate continuing and advanced knowledge in bioprocess engineering related areas.
PLO2	Formulate hypothesis, design and reorganize experiments/research scientifically to solve and evaluate observed phenomena.
PLO3	Analyze and evaluate critically problems in related areas through effective thinking skills, particularly in situations with limited information and to provide solutions through the application of appropriate tools and techniques.
PLO4	Display ideas and technical findings in both written and oral forms effectively.
PLO5	Plan and perform research undertakings professionally, ethically and responsibly.
PLO6	Perform lifelong learning for the needs of continuing professional development.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology			
3	PKKB XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) refereed article or two (2) indexed conference proceedings accepted as published in SCOPUS/ERA/WOS)			

DOCTOR OF PHILOSOPHY

FIELD OF RESEARCH: CHEMICAL ENGINEERING

PROGRAMME SPECIFICATIONS

The Doctor of Philosophy Field of Research: Chemical Engineering (PKKK) is offered on a full-time basis. The duration of study is in between minimum of three (3) year to a maximum of eight (8) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia		
2. Teaching Institution	Universiti Teknologi Malaysia		
3. Programme Name	Doctor of Philosophy		
4. Final Award	Doctor of Philosophy Field of research: Chemical Engineering		
5. Programme Code	PKKK		
6. Professional or Statutory Body of Accreditation	MQA		
7. Language(s) of Instruction	English		
8. Mode of Study (Conventional, distance learning, etc)	Research		
9. Mode of operation (Franchise, self-govern, etc)	Self-governing		
10. Study Scheme (Full Time/Part Time)	Full Time		
11. Study Duration	Minimum : 3 years Maximum : 8 years		
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	6	16	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 6 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Enable graduate to incorporate in-depth knowledge in chemical engineering related areas
PEO2	Formulate, solve and conduct problems through effective and critical thinking skills
PEO3	Enable graduate to organise relevant knowledge and expertise through effective oral and written communications
PEO4	Enable graduate to develop relevant knowledge, promote professional and ethical responsibilities including contemporary issues and environmental awareness.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Able to demonstrate an in-depth advance knowledge in chemical engineering-related areas using the techniques and skills for chemical engineering practice.
PLO2	Ability to independently manage problem in scientific research, individually or collectively using acceptable methodologies and tools.
PLO3	Ability to articulate and convince ideas and findings through collaborative work, oral presentation and scientific/journal writing.
PLO4	Ability to perform intellectual honesty and integrity throughout the learning process
PLO5	Ability to perform lifelong learning from any resources.
PLO6	Ability to display work both independently and in team including providing motivation, and delegating tasks.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology			
3	PKKK XX00	Research (Minimum 6 semesters)			
4		Thesis			
5		Publication (minimum one (1) referred article or two (2) indexed conference proceeding accepted as published in SCOPUS/ERA/WOS			

DOCTOR OF PHILOSOPHY

FIELD OF RESEARCH: ENVIRONMENTAL ENGINEERING

PROGRAMME SPECIFICATIONS

The Doctor of Philosophy Field of Research: Environmental Engineering (PKKS) is offered on a full-time basis. The duration of study is in between a minimum of three (3) years to a maximum of eight (8) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Doctor of Philosophy	
4. Final Award		Doctor of Philosophy Field of research: Environmental Engineering	
5. Programme Code		PKKS	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/Part Time)		Full Time	
11. Study Duration		Minimum : 3 years Maximum: 8 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	6	16	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 6 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to in-depth knowledge in environmental engineering related areas.
PEO2	Graduates are able to formulate, solve and conduct problems through effective and critical thinking skills.
PEO3	Graduates are able to organize relevant knowledge and expertise through effective oral and written communications.
PEO4	Graduates able to develop relevant knowledge, promote professional and ethical responsibilities including contemporary issues and environmental awareness.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Incorporate continuing and advanced knowledge in environmental engineering related areas.
PLO2	Formulate hypothesis, design and reorganize experiments/research scientifically to solve and evaluate observed phenomena.
PLO3	Analyze and evaluate critically problems in related areas through effective thinking skills, particularly in situations with limited information and to provide solutions through the application of appropriate tools and techniques.
PLO4	Display ideas and technical findings in both written and oral forms effectively.
PLO5	Plan and perform research undertakings professionally, ethically and responsibly.
PLO6	Perform lifelong learning for the needs of continuing professional development.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology			
3	PKKS XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) referred article or two (2) indexed conference proceeding accepted as published in SCOPUS/ERA/WOS			

DOCTOR OF PHILOSOPHY

FIELD OF RESEARCH: GAS ENGINEERING

PROGRAMME SPECIFICATIONS

The Doctor of Philosophy Field of Research: Gas Engineering (PKPG) is offered on a full-time basis. The duration of study is in between minimum of three (3) years to a maximum of eight (8) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Doctor of Philosophy	
4. Final Award		Doctor of Philosophy Field of research: Gas Engineering	
5. Programme Code		PKPG	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/Part Time)		Full Time	
11. Study Duration		Minimum : 3 years Maximum : 8 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	6	16	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 6 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates effectively incorporate the in-depth scholarship of gas engineering knowledge, research and problem solving skills to formulation and solution of diverse gas engineering problems taking into account safety, environmental, economic and societal impacts.
PEO2	Graduates communicate effectively to convey and acquire technical ideas, information, and recommendations in a multi-disciplinary environment.
PEO3	Graduates responsibly practice professional ethics with appreciation for the value of continuing professional development in maintaining their professional competence.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Able to demonstrate an in-depth scholarship of their area of research in gas engineering.
PLO2	Able to contribute to original research to broaden the boundary of knowledge in gas engineering through thesis or dissertation
PLO3	Able to make critical analysis, evaluation and synthesis of new ideas in research problems related to gas engineering
PLO4	Able to plan and perform independent research undertakings professionally, ethically and responsibly, and to lead research projects
PLO5	Able to report research findings to peers at levels suitable for international publications
PLO6	Able to recognize the needs for continuing professional development

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology			
3	PKPG XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) refereed article or two (2) indexed conference proceedings accepted as published in SCOPUS/ERA/WOS)			

DOCTOR OF PHILOSOPHY

FIELD OF RESEARCH: PETROLEUM ENGINEERING

PROGRAMME SPECIFICATIONS

The Doctor of Philosophy Field of Research: Petroleum Engineering (PKKP) is offered on a full-time basis. The duration of study is in between minimum of three (3) year to a maximum of eight (8) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia		
2. Teaching Institution	Universiti Teknologi Malaysia		
3. Programme Name	Doctor of Philosophy		
4. Final Award	Doctor of Philosophy Field of research: Petroleum Engineering		
5. Programme Code	PKKP		
6. Professional or Statutory Body of Accreditation	MQA		
7. Language(s) of Instruction	English		
8. Mode of Study (Conventional, distance learning, etc)	Research		
9. Mode of operation (Franchise, self-govern, etc)	Self-governing		
10. Study Scheme (Full Time/Part Time)	Full Time		
11. Study Duration	Minimum : 3 years Maximum : 8 years		
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	6	16	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 6 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates effectively incorporate the in-depth scholarship of petroleum engineering knowledge, research and problem solving skills to formulation and solution of diverse petroleum engineering problems taking into account safety, environmental, economic and societal impacts.
PEO2	Graduates communicate effectively to convey and acquire technical ideas, information, and recommendations in a multi-disciplinary environment.
PEO3	Graduates responsibly practice professional ethics with appreciation for the value of continuing professional development in maintaining their professional competence.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Able to demonstrate an in-depth scholarship of their area of research in petroleum engineering.
PLO2	Able to contribute to original research to broaden the boundary of knowledge in petroleum engineering through thesis or dissertation.
PLO3	Able to make critical analysis, evaluation and synthesis of new ideas in research problems related to petroleum engineering.
PLO4	Able to plan and perform independent research undertakings professionally, ethically and responsibly, and to lead research projects.
PLO5	Able to report research findings to peers at levels suitable for international publications
PLO6	Able to recognize the needs for continuing professional development.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology			
3	PKKP XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) referred article or two (2) indexed conference proceeding accepted as published in SCOPUS/ERA/WOS			

DOCTOR OF PHILOSOPHY

FIELD OF RESEARCH: POLYMER ENGINEERING

PROGRAMME SPECIFICATIONS

The Doctor of Philosophy Field of Research: Polymer Engineering (PKKR) is offered on a full-time basis. The duration of study is in between minimum of three (3) year to a maximum of eight (8) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Doctor of Philosophy	
4. Final Award		Doctor of Philosophy Field of research: Polymer Engineering	
5. Programme Code		PKKR	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/Part Time)		Full Time	
11. Study Duration		Minimum : 3 years Maximum : 8 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	6	16	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 6 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to incorporate in-depth relevant knowledge in engineering practices.
PEO2	Graduates are able to apply a wide range of relevant knowledge formulate, conduct and solve problems effectively and innovatively through critical thinking skills.
PEO3	Graduates are able to communicate effectively to convey and acquire technical information and recommendation intellectually, ethically and professionally
PEO4	Graduates able to adopt the latest relevant niche knowledge and technologies through life-long learning process by taking into account safety, environmental, economic and societal impacts

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Incorporate continuing and advanced knowledge in polymer engineering related areas.
PLO2	Formulate hypothesis, design and reorganize research scientifically to solve problems.
PLO3	Analyze and evaluate problems critically in polymer engineering area, through effective thinking skills particularly in situations with limited information and provide solutions using appropriate tools and techniques.
PLO4	Display ideas and technical findings effectively in oral and written.
PLO5	Conduct professional ethics in research with minimal supervision and adhere to legal, ethical and professional code of practice.
PLO6	Adopt the latest relevant knowledge and technologies through life-long learning.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology			
3	PKKR XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) referred article or two (2) indexed conference proceeding accepted as published in SCOPUS/ERA/WOS			

MASTER OF PHILOSOPHY

FIELD OF RESEARCH: BIOPROCESS ENGINEERING

PROGRAMME SPECIFICATIONS

The Master of Philosophy Field of Research: Bioprocess Engineering (MKKB) is offered on a full-time basis. The duration of study is in between a minimum of one (1) year to a maximum of four (4) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Master of Philosophy	
4. Final Award		Master of Philosophy Field of Research: Bioprocess Engineering	
5. Programme Code		MKKB	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/Part Time)		Full Time	
11. Study Duration		Minimum : 1 year Maximum : 4 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	2	8	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 2 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to in-depth knowledge in bioprocess engineering related areas
PEO2	Graduates are able to formulate and conduct problems through effective critical thinking skills.
PEO3	Graduates are able to apply a wide range of relevant knowledge through effective oral and written communications.
PEO4	Graduates able to adopt the latest relevant knowledge, balance professional and ethical responsibilities including contemporary issues and environmental awareness.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Apply advanced knowledge in bioprocess engineering related areas.
PLO2	Design and manage scientific research using acceptable methodologies through effective thinking skills.
PLO3	Analyze and evaluate critically problems in related areas through effective thinking skills and the application of appropriate tools and techniques.
PLO4	Demonstrate technical findings in both written and oral forms effectively.
PLO5	Adapt intellectual honesty and integrity in performing scientific work.
PLO6	Identify available information and research evidence and apply it in the relevant context.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology			
3	MKKB XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) publication from journal article or conference proceeding or book chapter)			

MASTER OF PHILOSOPHY

FIELD OF RESEARCH: CHEMICAL ENGINEERING

PROGRAMME SPECIFICATIONS

The Master of Philosophy Field of Research: Chemical Engineering (MKKK) is offered on a full-time basis. The duration of study is in between a minimum of one (1) year to a maximum of four (4) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia		
2. Teaching Institution	Universiti Teknologi Malaysia		
3. Programme Name	Master of Philosophy		
4. Final Award	Master of Philosophy Field of research: Chemical Engineering		
5. Programme Code	MKKK		
6. Professional or Statutory Body of Accreditation	MQA		
7. Language(s) of Instruction	English		
8. Mode of Study (Conventional, distance learning, etc)	Research		
9. Mode of operation (Franchise, self-govern, etc)	Self-governing		
10. Study Scheme (Full Time/Part Time)	Full Time		
11. Study Duration	Minimum : 1 year Maximum : 4 years		
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	2	8	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 2 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduate become the expertise in chemical industry decipline and contribute to national development.
PEO2	Graduate become a creative, innovative and adaptable senior engineer in their organization and society.
PEO3	Graduate contribute toward the environmental well-being and sustainable development.
PEO4	Graduate able to conduct research to add value to existing products.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to master the knowledge in chemical engineering discipline
PLO2	Ability to apply research skills in chemical engineering discipline.
PLO3	Ability to demonstrate effective communication skills in both written and oral form to report the scientific and technical facts.
PLO4	Ability to conduct professional ethics in research with minimal supervision and adhere to legal, ethical and professional code of practice.
PLO5	Ability to demonstrate leadership qualities and working effectively with peers and stakeholders.
PLO6	Ability to analyze problems in chemical engineering field using scientific and critical thinking approaches.
PLO7	Ability to manage information for lifelong learning and identify business opportunity in chemical engineering field.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology			
3	MKKK XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) publication from journal article or conference proceeding or book chapter)			

MASTER OF PHILOSOPHY

FIELD OF RESEARCH: ENVIRONMENTAL ENGINEERING

PROGRAMME SPECIFICATIONS

The Master of Philosophy Field of Research: Environmental Engineering (MKKS) is offered on a full-time basis. The duration of study is in between minimum of one (1) year to a maximum of four (4) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Master of Philosophy	
4. Final Award		Master of Philosophy Field of research: Environmental Engineering	
5. Programme Code		MKKS	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/Part Time)		Full Time	
11. Study Duration		Minimum : 1 year Maximum : 4 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	2	8	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 2 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to in-depth knowledge in environmental engineering related areas.
PEO2	Graduates are able to formulate and conduct problems through effective critical thinking skills.
PEO3	Graduates are able to apply a wide range of relevant knowledge through effective oral and written communications.
PEO4	Graduates able to adopt the latest relevant knowledge, balance professional and ethical responsibilities including contemporary issues and environmental awareness.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Apply advanced knowledge in environmental engineering related areas.
PLO2	Design and manage scientific research using acceptable methodologies through effective thinking skills and able to identify business opportunity.
PLO3	Analyze and evaluate critically problems in related areas through effective thinking skills and the application of appropriate tools and techniques.
PLO4	Demonstrate technical findings in both written and oral forms effectively.
PLO5	Adapt intellectual honesty and integrity in performing scientific work.
PLO6	Identify available information and research evidence and apply it in the relevant context.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology			
3	MKKS XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) publication from journal article or conference proceeding or book chapter)			

MASTER OF PHILOSOPHY

FIELD OF RESEARCH: GAS ENGINEERING

PROGRAMME SPECIFICATIONS

The Master of Philosophy Field of Research: Gas Engineering (MKPG) is offered on a full-time basis. The duration of study is in between minimum of one (1) year to a maximum of four (4) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Master of Philosophy	
4. Final Award		Master of Philosophy Field of Research: Gas Engineering	
5. Programme Code		MKPG	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/Part Time)		Full Time	
11. Study Duration		Minimum : 1 year Maximum : 4 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	2	8	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 2 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates effectively incorporate the in-depth scholarship of gas engineering knowledge, research and problem solving skills to formulation and solution of diverse gas engineering problems taking into account safety, environmental, economic and societal impacts.
PEO2	Graduates communicate effectively to convey and acquire technical ideas, information, and recommendations in a multi-disciplinary environment.
PEO3	Graduates responsibly practice professional ethics with appreciation for the value of continuing professional development in maintaining their professional competence.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Able to demonstrate an in-depth scholarship of their area of research in gas engineering
PLO2	Able to contribute to original research to broaden the boundary of knowledge in gas engineering through thesis or dissertation
PLO3	Able to make critical analysis, evaluation and synthesis of new ideas in research problems related to gas engineering
PLO4	Able to plan and perform independent research undertakings professionally, ethically and responsibly, and to lead research projects
PLO5	Able to report research findings to peers at levels suitable for international publications
PLO6	Able to recognize the needs for continuing professional development

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology			
3	MKPG XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) publication from journal article or conference proceeding or book chapter)			

MASTER OF PHILOSOPHY

FIELD OF RESEARCH: PETROLEUM ENGINEERING

PROGRAMME SPECIFICATIONS

The Master of Philosophy Field of Research: Petroleum Engineering (MKKP) is offered on a full-time basis. The duration of study is in between minimum of one (1) year to a maximum of four (4) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Master of Philosophy	
4. Final Award		Master of Philosophy Field of research: Petroleum Engineering	
5. Programme Code		MKKP	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/Part Time)		Full Time	
11. Study Duration		Minimum : 1 year Maximum : 4 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	2	8	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 2 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduate able to successfully incorporate the advanced knowledge of petroleum engineering, research and problem solving skills to formulation and solution of diverse petroleum engineering problems taking into account safety, environmental, economic and societal impacts.
PEO2	Graduate able to communicate effectively to convey and acquire technical ideas, information, and recommendations in a multi-disciplinary environment.
PEO3	Graduate able to responsibly practice professional ethics with appreciation for the value of continuing professional development in maintaining their professional competence.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Able to demonstrate continuing and advanced knowledge in petroleum engineering and have the capabilities to further develop or use these in new situations or multi-disciplinary contexts.
PLO2	Able to appraise available information and research evidence and apply it in the petroleum engineering context.
PLO3	Able to analyze and evaluate critically problems in petroleum engineering, particularly in situations with limited information and to provide solutions through the application of appropriate tools and techniques.
PLO4	Able to plan and perform research undertakings professionally, ethically and responsibly
PLO5	Able to report technical findings in both written and oral forms.
PLO6	Able to recognize the needs for continuing professional development.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology			
3	MKKP XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) publication from journal article or conference proceeding or book chapter)			

MASTER OF PHILOSOPHY

FIELD OF RESEARCH: POLYMER ENGINEERING

PROGRAMME SPECIFICATIONS

The Master of Philosophy Field of Research: Polymer Engineering (MKKR) is offered on a full-time basis. The duration of study is in between minimum of one (1) year to a maximum of four (4) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal and viva.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Master of Philosophy	
4. Final Award		Master of Philosophy Field of research: Polymer Engineering	
5. Programme Code		MKKR	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/Part Time)		Full Time	
11. Study Duration		Minimum : 1 year Maximum : 4 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	2	8	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 2 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to incorporate in-depth relevant knowledge in engineering practices.
PEO2	Graduates are able to apply a wide range of relevant knowledge to formulate and conduct problems effectively and innovatively through critical thinking skills.
PEO3	Graduates are able to communicate effectively to convey and acquire technical information intellectually, ethically and professionally.
PEO4	Graduates able to adopt the latest relevant knowledge and technologies through life-long learning process by taking into account safety, environmental, economic and societal impacts.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Apply advanced knowledge in polymer engineering related areas
PLO2	Design and conduct scientific research using acceptable methodologies and solve research problems through effective thinking skills.
PLO3	Analyze and evaluate technical findings through effective thinking skills and application of appreciate tools and techniques.
PLO4	Demonstrate technical findings effectively in oral and written.
PLO5	Conduct professional ethics in research with minimal supervision and adhere to legal, ethical and professional code of practice.
PLO6	Adopt the latest relevant knowledge and technologies through life-long learning

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0010	Research Methodology			
3	MKKR XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) publication from journal article or conference proceeding or book chapter)			

DOCTOR OF ENGINEERING

SPECIALIZATION: PROCESS PLANT MANAGEMENT

PROGRAMME SPECIFICATIONS

The Doctor of Engineering (EngD) in Process Plant Management programme by mixed-mode is aimed at developing individuals who will innovate but also be able to implement the innovations. The programme is to provide solutions to one or more significant and challenging problems in managing complex process plants. Thus, the solution to the problem will have to consider factors such as financial constraints, timescales and human capital management as well as technological issues.

The EngD. is a radical alternative to the traditional PhD. being better suited to the needs of the industry and providing a more vocationally oriented doctorate in the process industry. It is highly flexible and able to accommodate candidates from all levels of management. It is a full-time postgraduate programme where candidates are expected to spend most of their time carrying out research works at their organizations or industries.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Doctor of Engineering Specialization: Process Plant Management	
4. Final Award		Doctor of Engineering Specialization: Process Plant Management	
5. Programme Code		EKKL	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Mixed Mode	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/ Part Time)		Full Time	
11. Study Duration		Minimum : 3 years Maximum : 8 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Maximum	
Normal	6	16	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	30%
ii.	Programme Core	21	
iii.	Programme elective (1 course)	-	
iv	Doctorate Research Project	56	70%
	Total	80	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Become experts in the process plant management field who are capable of directly contributing towards national development, analyze critically, plan and innovatively solve complex problems.
PEO2	Become experts in the process plant management field who are creative, innovative and able to assimilate in society.
PEO3	Be able to contribute professionally towards environmental well-being and sustainable development. Easily adapt to different roles, responsibilities, surroundings and communities, enabling them to contribute and lead in their organizations and society at large scale.
PEO4	Have the ability to conduct cutting-edge research which can add value to existing products through innovation and creativity.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduates are able to create new knowledge and recommend innovation in the application of knowledge of process plant management.
PLO2	Graduates are able to initiate and solve issues related to process plant management.
PLO3	Graduates are able to demonstrate findings through communication skills effectively and to display the ability to work in a team.
PLO4	Graduates are able to practice professional ethics in research projects that are related to process plant management.
PLO5	Graduates are able to practice the knowledge on business, management, process and plant technology
PLO6	Graduates are able to create financial and business opportunities in process plant management.
PLO7	Graduates are able to work comfortably as members or leaders of multidisciplinary groups.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist with minimum B grade. Students must achieve a total of 24 credit hours with a minimum cumulative B grade or CGPA of 3.0 and pass a research dissertation project and have submitted the approved dissertation to UTM. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the courses are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
UNIVERSITY ELECTIVE					
1	UHAP6013	Seminar Pembangunan Isu-Isu Sosial dan Ekonomi Global	3	3	
2	UHAW 6023	Falsafah Sains dan Pembangunan Sosial	3	3	
3	UHAF 6033	Kepimpinan Dinamik	3	3	
4	UHAZ 6113	Budaya Malaysia I	3	3	
5	UHZ 6123	Budaya Malaysia II	3	3	
6	UHAZ 6313	Bahasa Malaysia Akademik I	3	3	
7	UHAZE 6323	Bahasa Malaysia Akademik II	3	3	
8	UBSE 1123	Organizational Behavior	3	3	
9	UCSM 1263	Pengurusan Projek IT	3	3	
10	ULAJ 6013	Japanese Language for Postgraduates	3	3	
TOTAL CREDIT OF UNIVERSITY ELECTIVE			3	3	
PROGRAMME CORE COURSES					
1	EKKL 1013	Research Methodology	3	3	
2	EKKL 1113	Building Operational Excellence	3	3	
3	EKKL 1163	Green Operational Management	3	3	
4	EKKL 1223	Financial Decision Making	3	3	
5	EKKL 1243	Production Planning	3	3	
6	EKKL 1253	Wellness For Top Management	3	3	
7	EKKL 1263	Product Design	3	3	
TOTAL CREDIT OF PROGRAM CORE			21	21	
PROGRAMME ELECTIVE COURSES* (none)					
DISSERTATION					
1	EKKL ****	Doctoral Research Project (4 Semesters minimum)	56	56	
TOTAL CREDIT OF DISSERTATION			56	56	
TOTAL CREDIT TO GRADUATE			80	80	
<i>*The courses are offered subjected to availability of the courses for the particular semester in the School of Chemical and Energy Engineering</i>					

COURSE SYNOPSIS

CORE COURSES

EKKL 1013 - Research Methodology

In this course the students will be exposed to various aspects of the research process. Students will learn how to conduct research in terms of producing research problems and questions, proposal writing and supervision, writing a dissertation, literature reviews, research methods and how to ensure ethical integrity when conducting research. Students will also learn how to create value to a product. The module on value creation through 5 disciplines of innovation will be based on the SRI International model.

EKKL 1113 - Building Operational Excellence

The objective of this module is to provide an understanding of the fundamentals of process unit equipment in the process industry. This seminar would be beneficial to those directly or indirectly involved in the process industry. To those with experience in the process industry, this seminar can reinforce their practical experience and broaden their database. To those new in the process industry, this seminar can serve as a platform to build their database of experience. This seminar focuses on the core building blocks of the process unit equipment. The program will emphasize process unit equipment fundamentals, safe utilization of these fundamentals by operation and maintenance personnel, and equipment troubleshooting techniques.

EKKL 1163 - Green Operational Management

In recent years, operation management in the process plant faces new challenges in handling issues of sustainability as compared to their traditional areas of interest. How to make the process and the operational management GREEN is the new growing business pressure, especially to pay more attention to the environmental and resources consequences of the products and services. This course introduces the two strategic fundamentals in green operational management: strategy design and strategy implementation. Participants will learn the effective execution of strategy by manipulating the different dimensions of operational management in the process industry. The course introduces green operational strategy with Total Quality Management (TQM), Statistical Process Control (SPC). Students will learn the concept and techniques of process optimization with Process-graph (P-graph). They will also gain exposure to life cycle assessment (LCA) and carbon footprint reduction concepts, tools, and techniques.

EKKL 1223 - Financial Decision Making

The aim of this module is to provide a broad understanding of long term financial decision making and it covers two complementary aspects of finance. An important aspect of the investment decision making process is the financial evaluation including the risk and return assessment and refinements. The other aspect is the sources of funding for long term projects and this is reviewed from the point of view of the implications for long term decision making.

EKKL 1243 - Production Planning

Production planning is a crucial element to ensure business competitiveness. Good production planning means higher profitability for the company. Supply chain, equipment, finance and human resources are among the several important aspects in production planning. In this course, several process integration techniques for production planning for sustainable processes are introduced, i.e. supply chain optimisation, financial and human resource planning. The techniques are built on graphical representation where a production planner will be able to obtain good insights in various decision-making scenarios, e.g. optimum production planning, minimum waste and optimum use of resources.

EKKL 1253 - Wellness for Top Management

The objective of this module is to provide an overview and understanding on the nature of human health and wellness. The knowledge is then used to chart out proactive strategies for the promotion and enhancement of health and wellness for optimum performance. The World Health Organization defines health and wellness as a state of complete physical, mental and social well being and not merely the absence of disease or infirmity. In addition, wellness encompasses emotional stability, clear and creative thinking and lifestyle that lead to a more balanced and fulfilling life. The modules focus on the building block of life and their physiological and psychological requirements. It is structured to highlight the importance of cellular metabolism and systemic behavior of the whole body in maintaining homeostasis. The importance of wholesome nutrition, clean air and water and conducive living environment will be discussed. The effect of mental and emotional states of homeostasis will be deliberated. The module draws on well-known engineering principles such as material and energy balance, charge or ionic balance and process control strategies or the maintenance of homeostasis and wellness.

EKKL1263 - Product Design

Product design varies from project to project depending on the project strategies and objectives. However, there is a basic structure that is fundamental to the product design process. The aims of this course are to introduce to the students the processes involved when designing a product, and to provide the students with a conceptual framework and case studies for understanding the role of product design in the industries. The course encompasses topics such as new product idea generation, idea screening, concept-proving, product market positioning, product launching, product evaluation, etc

MASTER OF ENGINEERING

SPECIALIZATION: BIOPROCESS

PROGRAMME SPECIFICATIONS

Master of Engineering (Bioprocess) by Mixed-Mode is a master programme by mode of taught course and research. This programme equips students with technical knowledge in advanced bioprocess engineering field including biotechnology, industrial bioprocessing, facilities and infrastructures in bioprocess engineering and bioproduct development. Course assessment is based on group or individual assignments, reports, presentations, tests, exams and projects. The programme provides students with research exposure via a one-semester research project.

This programme is suitable for any bachelor graduates from science, technology and engineering fields. Graduates from other disciplines with relevant experiences are also encouraged to apply. Depending on the candidate's background, pre-requisite courses may be imposed to assist the candidate to comprehend more in-depth advanced courses offered.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia		
2. Teaching Institution	Universiti Teknologi Malaysia		
3. Programme Name	Master of Engineering		
4. Final Award	Master of Engineering Specialization: Bioprocess		
5. Programme Code	MKKB		
6. Professional or Statutory Body of Accreditation	MQA		
7. Language(s) of Instruction	English		
8. Mode of Study (Conventional, distance learning, etc)	Mixed-Mode		
9. Mode of operation (Franchise, self-govern, etc)	Self-governing		
10. Study Scheme (Full Time/Part Time)	Full Time		
11. Study Duration	Minimum : 1.5 years Maximum : 4 years		
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	3	8	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	50%
ii.	Programme Core	15	
iii.	Programme Elective (1 course)	3	
iv	Dissertation	21	50%
	Total	42	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduate become the expertise in chemical-bioprocess industry and biotechnology discipline and contributes to national development
PEO2	Graduate become creative, innovative and adaptable technology specialist as leaders or team members in their organization and society
PEO3	Graduate contribute toward the environmental well-being and sustainable development
PEO4	Graduate has the ability to conduct research and entrepreneurial innovation

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to integrate advanced engineering and scientific knowledge in professional practices for the benefits of bioprocess engineering and biotechnology discipline
PLO2	Ability to formulate hypothesis, design and reorganize experiments/research skill scientifically to solve and evaluate observed phenomena
PLO3	Ability to analyze problems in bioprocess and biotechnology field using scientific and critical thinking approaches
PLO4	Ability to demonstrate professional ethics in research and explain ethics related with biotechnology from spiritual and material aspects
PLO5	Ability to analyze situations, justify and react effectively through oral and written to scientific, industry and public communities
PLO6	Ability to display lifelong learning skills by conducting independent work with minimum supervision.
PLO7	Ability to demonstrate team working skills.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist with minimum B grade. Students must achieve a total of 42 credit hours with a minimum cumulative B grade or CGPA of 3.0 and pass a master research dissertation project and have submitted the approved dissertation to UTM. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the courses are not allowed to graduate.

NO	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSE D
UNIVERSITY ELECTIVE (Choose 1)					
1	UHAP6013	Seminar Pembangunan Isu-Isu Sosial dan Ekonomi Global	3	3	
2	UHAW6023	Falsafah Sains dan Pembangunan Sosial	3	3	
3	UHAF6033	Kepimpinan Dinamik	3	3	
4	UHAZ6113	Budaya Malaysia I	3	3	
5	UHAZ6123	Budaya Malaysia II	3	3	
6	UHAZ6313	Bahasa Malaysia Akademik I	3	3	
7	UHAZ6323	Bahasa Malaysia Akademik II	3	3	
8	UDPE1123	Organizational Behavior dan Development	3	3	
9	UCSM1263	Pengurusan Projek IT	3	3	
10	ULAJ 6013	Japanese Language for Postgraduates	3	3	
TOTAL CREDIT OF UNIVERSITY ELECTIVE			3	3	
PROGRAMME CORE COURSES					
1	MKKB1103	Biotechnology for Engineers	3	3	
2	MKKB1113	Industrial Bioprocessing	3	3	
3	MKKB1123	Facilities and Infrastructures in Bioprocess Engineering	3	3	
4	MKKB1133	Bioproduct Development	3	3	
5	UKKP0013	Research Methodology	3	3	
TOTAL CREDIT OF PROGRAM CORE			15	15	
PROGRAMME ELECTIVE COURSES*(Choose 1)					
1	MKKT1023	Herbal Quality Management	3	3	
2	MKKT1033	Herbal Processing	3	3	
3	MKKH1373	Human Factor	3	3	
4	MKKK1513	Advanced Transport Phenomena	3	3	
5	MKKH1513	Environmental Management	3	3	
6	MKKH1523	Pollution Control Technology	3	3	
7	MKKK1613	Energy Analysis and Management	3	3	
8	MKKK1653	Safety and Health in Process Industries	3	3	
9	MKKK1683	Process Integration	3	3	
TOTAL CREDIT OF PROGRAMME ELECTIVE			3	3	
DISSERTATION					
1	MKKB ##80	Dissertation	21	HL	

TOTAL CREDIT OF DISSERTATION	21	21	
TOTAL CREDIT TO GRADUATE	42	42	
<i>*The courses are offered subjected to availability of the courses for the particular semester in the School of Chemical and Energy Engineering</i>			

COURSE SYNOPSIS

CORE COURSES

MKKB 1103 - Biotechnology for Engineers

This course consists of two sections; 1) molecular biology and genetic engineering, and 2) biotechnology application and industrial outreach. Section 1 aimed at providing the fundamentals of biotechnology and knowledge. It covers basic understanding of microorganisms and genetic engineering involved in biotechnology. The concept of protein expression, different expression systems used in biotechnology and the omics technology are also covered. Section 2 covers biotechnology application in different areas (i.e. food, agriculture, medical, and environment), global scenario of biotechnology industry and biotechnology in Malaysia and current issues. It also discusses how this technology contributes towards wealth creation, health improvement, environmental protection and issues related to social security globally.

MKKB 1113 - Industrial Bio-Processing

This course introduces students to the fundamentals of various industrial bioprocessing areas based on the sources and applications. Emphasis will be on the technologies in which the students will be guided in being independently acquired and explain information on some key issues in food and bioproducts engineering, biopharmaceutical engineering, renewable resources and waste management bioprocessing science and technology.

MKKB 1123 - Facilities and Infrastructures In Bioprocess Engineering

This course provides a complete overview about the production facility from the beginning of the project up to the production process and how to perform all project steps according to the guidelines of the Good Manufacturing Practice (cGMP). Topics include the primary and detailed engineering in the production area, flow inside facility (personnel, material, product and waste), the design of HVAC system and clean area according to the cGMP requirements. Besides the engineering and design aspects, the course also encompasses all aspects of the cGMP requirements for the production equipment, from cell bank to the final product. Furthermore, non-design/equipment components of the cGMP such as human resource, process design and operation procedure based on Standard Operation Procedures (SOPs) sheet is also introduced.

MKKB 1133 - Bio-Product Development

This course introduces students to the fundamentals of bio-product development based on the sources and functional applications. Emphasis will be on the technologies in the development of bio-products; various types of materials/bio-materials, design, operations and analysis of desired performances. The course also exposes students to the different stages in the development of a bio-product, from the research and development to manufacturing, bio-product approval and release of the final product.

UKKP 0013 - Research Methodology

The aim of this course is to equip students with the essential knowledge and skills to do research work and write dissertation systematically. This course has 9 modules which will be conducted through a weekly 3-hour seminar. Each seminar will consist of a lecture, discussion and workshop. In the end of course, students need to produce a research proposal and present it in the class as part of assessment for this course.

ELECTIVE COURSES

MKKT 1023 - Herbal Quality Management

Every herbal product must be subjected to quality assurance and quality control before it can be commercialized. In this course, students will learn about quality, quality management, quality control, standardization procedures of herbal products, good manufacturing practices and hazard and operability study (HAZOP).

MKKT 1033 – Herbal Processing

Herbal processing is an integral part of herbal product development. In this course, students will learn about herbal processing complete cycle starting from cultivation and collection of plant materials, reprocessing, processing, packaging and finally good manufacturing practices.

MKKH 1373 – Human Factor

This course introduces students to a basic knowledge of human factors design principles and the nature of human interaction with physical work environment. The content of this course includes both physical and cognitive conditions, ergonomics, socio-technical systems, and the nature of human performance at the workplace.

MKKK 1513 – Advanced Transport Phenomena

This course presents the laws and mechanism of mass transfer in two and multi-component system, elementary boundary layers in mass transfer and the relationships between heat, mass and momentum transfer.

MKKH 1513 – Environmental Management

This course covers environmental management system principle, environmental act and international protocols or framework in achieving global sustainable development. The course also includes discussion on the fundamental of environmental cycle, carbon footprint and life cycle assessment. Students will analyse a range of underlying drivers to unsustainable use of the environment, the economics of global climate change, resource consumption, as well as climate change mitigation.

MKKH 1523 – Pollution Control Technology

This course introduces students to the cause, effect and method to control pollution from industries. The course covers the three major categories of industrial pollution: water pollution, air pollution and industrial waste management. In the first part, the course includes the source and types of water pollutants, environmental regulations pertaining to waste water discharge, and techniques to treat raw water and waste water before discharging to the environment. The

second part of the course covers the solid and hazardous waste characteristics and effect of air pollution, regulations requirement for air pollution control, technology to control air pollution emissions from industries. The third part covers the management of industrial waste that includes definition of scheduled waste, scheduled waste regulations, and technique to manage the waste.

MKKK 1613 – Energy Analysis and Management

This course presents the principles and methodology to develop an understanding of Pinch Analysis technique and acquire the skills to apply the technique for optimal resource conservation for the ultimate aim of producing cost effective, clean and energy efficient designs of new and existing chemical process systems.

MKKK1653 - Safety and Health in Chemical Industries

This course presents fundamental principle of safety and health in chemical process industry. The course starts with introduction to associated terms i.e. safety, health, hazard and risk. Then categories of hazards are covered for both safety and health aspects. The course is then progressing into more technical content on hazard and risk assessment. For both safety and health, common techniques widely used for operating processes as well as indices for inherent hazard assessment are dealt with in detail. Finally, a systematic and comprehensive safety and health management systems are also included.

MKKK 1683 – Process Integration

This course presents the principles and methodology to develop an understanding of Pinch Analysis technique and acquire the skills to apply the technique for optimal resource conservation for the ultimate aim of producing cost effective, clean and energy efficient designs of new and existing chemical process systems.

MASTER OF ENGINEERING SPECIALIZATION: CHEMICAL

PROGRAMME SPECIFICATIONS

The Master of Engineering (Chemical) is offered on a full-time basis at UTM Main Campus in Johor Bahru. The duration of study is one and a half (1.5) years to a maximum of four (4) years. This program is open for any bachelor graduate from science, technology and engineering courses. Graduates from other discipline but with relevant experiences are also encouraged to apply. Depending on the candidate's background, pre-requisite courses may be imposed to assist the candidate to comprehend more in-depth advanced courses offered.

The programme is offered on full-time basis and is based on a 2-Semester per academic session. Generally, students are expected to undertake courses equivalent to between three (3) to fifteen (15) credit hours per semester. Assessment is based on courseworks, final examinations and dissertation project given throughout the semester.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Programme Name	Master of Engineering			
4. Final Award	Master of Engineering Specialization: Chemical			
5. Programme Code	MKKK			
6. Professional or Statutory Body of Accreditation	MQA			
7. Language(s) of Instruction	English			
8. Mode of Study (Conventional, distance learning, etc)	Mixed-Mode			
9. Mode of operation (Franchise, self-govern, etc)	Self-governing			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Minimum : 1.5 years Maximum: 4 years			
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	3	-	14	-
Short	-	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University General Courses	6	14.29%
ii.	Programme Core	12	28.57%
iii.	Programme Electives	3	7.14%
iv	Dissertation	21	50.00%
	Total Credit Hours	42	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduate become the expertise in chemical industry decipline and contribute to national development.
PEO2	Graduate become a creative, innovative and adaptable senior engineer in their organization and society.
PEO3	Graduate contribute toward the environmental well-being and sustainable development.
PEO4	Graduate able to conduct research to add value to existing products.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to master the knowledge in chemical engineering discipline
PLO2	Ability to apply research skills in chemical engineering discipline.
PLO3	Ability to demonstrate effective communication skills in both written and oral form to report the scientific and technical facts.
PLO4	Ability to conduct professional ethics in research with minimal supervision and adhere to legal, ethical and professional code of practice.
PLO5	Ability to demonstrate leadership qualities and working effectively with peers and stakeholders.
PLO6	Ability to analyze problems in chemical engineering field using scientific and critical thinking approaches.
PLO7	Ability to manage information for lifelong learning and identify business opportunity in chemical engineering field.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
SCHOOL OF CHEMICAL AND ENERGY ENGINEERING					
PRE-REQUISITE COURSES (if applicable)					
1	MKKK 0413	Chemical Engineering Thermodynamics	3	HW	
2	MKKK 0423	Chemical Reactions Engineering	3	HW	
3	MKKK 0513	Transport Processes and Unit Operations	3	HW	
4	MKKK 0613	Mass Balance	3	HW	
5	MKKK 0623	Basic Numerical Methods	3	HW	
PROGRAMME CORE COURSES (Compulsory)					
1	MKKK 1413	Advanced Thermodynamic	3	3	
2	MKKK 1423	Advanced Chemical Reaction Engineering	3	3	
3	MKKK 1513	Advanced Transport Phenomena	3	3	
4	MKKK 1643	Numerical Computation in Chemical Engineering	3	3	
	TOTAL CREDIT OF CORE COURSES (a)		12	12	
PROGRAMME ELECTIVE COURSES (Choose only 1 Course)					
5	MKKK 1613	Energy Analysis and Management	3	3	
6	MKKK 1653	Safety and Health in Chemical Industries			
7	MKKK 1683	Process Integration			
	TOTAL CREDIT OF ELECTIVE COURSE (b)		3	3	
UNIVERSITY GENERAL COURSES					
8	U*** **3	University General Course	3	3	
9	UKKP 0013	Research Methodology	3	3	
	TOTAL CREDIT OF UNIVERSITY GENERAL COURSE (c)		6	6	
DISSERTATION					
10	MKKK **80	Dissertation	0	HL	
	TOTAL CREDIT TO GRADUATE (a+b+c)		21	21	

COURSE SYNOPSIS

CORE COURSES

MKKK 1413 - Advanced Thermodynamic

This course presents the fundamentals of thermodynamics theories in equilibrium system. Selected equation of states as well as several equilibrium models will be utilised in predicting the chemical properties of chemical components at equilibrium with and without chemical reactions. The course features extensive work group exercises as well as individual project and assignments.

MKKK 1423 - Advanced Chemical Reaction Engineering

This course is an advanced course on kinetics and chemical reaction engineering with emphasis on quantitative treatment of chemical reaction engineering. Beginning with basic kinetics for homogeneous reactor design and analysis, students will eventually solve problems on heterogeneous systems. Kinetics of heterogeneous reaction and transport limitation on reaction rates will be covered. Effectiveness factor for different pore geometry for first-order and general order kinetics are derived. Similarly, isothermal and non-isothermal cases for external and internal diffusional limited cases will be covered. Students will also be exposed to many problems requiring numerical solution and software packages such as PolyMath and MATLAB through homeworks, projects and case studies.

MKKK 1513 - Advanced Transport Phenomena

This course presents the laws and mechanism of mass transfer in two and multi-component system, elementary boundary layers in mass transfer and the relationships between heat, mass and momentum transfer.

MKKK 1643 - Numerical Computation in Chemical Engineering

The main objective of this course is to provide the students with the opportunity to improve their programming skills using the MATLAB environment as a tool for solving problems in chemical engineering. This course includes the coverage of basics and application of MATLAB software to solve problems arising in chemical engineering which involve numerical operations like algebraic equations, curve fitting, system of linear and nonlinear equations, integrals and ordinary differential equations. With this foundation of basic MATLAB applications in engineering problem solving, the course provides opportunities to explore advanced topics in application of numerical computation as a powerful engineering tool.

ELECTIVE COURSES

MKKK 1613 - Energy Analysis and Management

This course presents the principles and methodology to develop an understanding of Pinch Analysis technique and acquire the skills to apply the technique for optimal resource conservation for the ultimate aim of producing cost effective, clean and energy efficient designs of new and existing chemical process systems.

MKKK 1653 - Safety and Health in Chemical Industries

This course presents fundamental principle of safety and health in chemical process industry. The course starts with introduction to associated terms i.e. safety, health, hazard and risk. Then categories of hazards are covered for both safety and health aspects. The course is then progressing into more technical content on hazard and risk assessment. For both safety and health, common techniques widely used for operating processes as well as indices for inherent hazard assessment are dealt with in detail. Finally, a systematic and comprehensive safety and health management systems are also included.

MKKK 1683 - Process Integration

This course presents the principles and methodology to develop an understanding of Pinch Analysis technique and acquire the skills to apply the technique for optimal resource conservation for the ultimate aim of producing cost effective, clean and energy efficient designs of new and existing chemical process systems.

GENERAL COURSES

UKKP 0013 - Research Methodology

The aim of this course is to equip students with the essential knowledge and skills to do a research and write dissertation systematically. This course has 9 modules which will be conducted through weekly 3-hour seminar. Each seminar will be consisted a lecture, discussion and workshop. In the end of course, students need to produce a research proposal and have a mini conference as part of assessment and proposal presentation practice.

DISSERTATION

MKKK XX80 - Dissertation

For Dissertation, student needs to conduct research work in chemical laboratories, computer laboratories or companies and analyse the data critically to solve a research problem. The student then has to write a complete thesis which will be evaluated by examiners at the end of the course. Student also has to present and defend their findings.

MASTER OF ENGINEERING

SPECIALIZATION: ENVIRONMENTAL

PROGRAMME SPECIFICATIONS

The Master of Engineering Specialization in Environmental is offered on a full-time basis at UTM Main Campus in Johor Bahru. The duration of study is one and a half (1.5) years to a maximum of four (4) years. This program is open for any bachelor graduate from science, technology and engineering courses. Graduates from other discipline but with relevant experiences are also encouraged to apply.

The programme is based on a 2-Semester per academic session. Generally, students are expected to undertake courses equivalent to between nine (9) to fifteen (15) credit hours per semester. The course assessment is based on courseworks, final examination and dissertation project given throughout the semester.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Master of Engineering	
4. Final Award		Master of Engineering Specialization: Environmental	
5. Programme Code		MKKN	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study (Conventional, distance learning, etc)		Mixed-Mode	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme (Full Time/Part Time)		Full Time	
11. Study Duration		Minimum : 1.5 years Maximum : 4 years	
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	3	8	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (2 courses)	6	13%
ii.	Programme Core	9	20%
iii.	Programme elective (3 courses)	9	20%
iv	Dissertation	21	47%
	Total	45	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to acquire advanced knowledge on the principles of environmental engineering and can practice in accordance to the acceptable standards in environmental engineering and related fields.
PEO2	Graduates are able to work independently or in a group, able to search and manage knowledge and can readily adapt to the changing situations.
PEO3	Graduates able to communicate effectively to different types of audience and can demonstrate consistent professional ethics with high integrity in serving their organisation and society.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduates are able to integrate advanced scientific and technical knowledge of environmental engineering and related principles.
PLO2	Graduates are able to generate hypotheses, design and carry out studies and scientific research to solve and explain phenomena that occur through the application of appropriate instruments and techniques.
PLO3	Graduates are able to analyse and evaluate the problems in environmental engineering and is able to resolve through critical problem solving skill.
PLO4	Graduates are able to demonstrate high ethical standard in professional practice including environmental and societal issues.
PLO5	Graduates are able to communicate effectively through written and oral modes.
PLO6	Graduates are able to perpetually seek advanced knowledge and technology of environmental engineering and related fields for life-long learning.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
PROGRAMME CORE COURSES (Compulsory)					
1	MKKN 1003	Environmental Management and Sustainability	3	3	
2	MKKN 1413	Water Pollution Control	3	3	
3	MKKN 1513	Solid and Hazardous Waste Management	3	3	
	TOTAL CREDIT OF CORE COURSES (a)		9	9	
PROGRAMME ELECTIVE COURSES (Choose only 3 Courses)					
4	MKKN 1063	Water Quality Assessment and Management	3	3	
5	MKKN 2123	Environmental Quality Analysis	3	3	
6	MKKN 2223	Environmental Laws & Institution	3	3	
7	MKKN 2233	Land Use & Environmental Planning	3	3	
8	MKKN 2243	Environmental Economics	3	3	
9	MKKN 2413	Physico-Chemical Treatment Processes	3	3	
10	MKKN 2423	Biological Treatment Process	3	3	
	TOTAL CREDIT OF ELECTIVE COURSE (b)		9	9	
UNIVERSITY GENERAL COURSES					
11	U*** **3	University General Course	3	3	
12	UKKP 0013	Research Methodology	3	3	
	TOTAL CREDIT OF UNIVERSITY GENERAL COURSE (c)		6	6	
DISSERTATION					
13	MKKN **80	Dissertation	25	HL	
	TOTAL CREDIT OF DISSERTATION (d)		25	25	
	TOTAL CREDIT TO GRADUATE (a+b+c+d)		45	45	

COURSE SYNOPSIS

CORE COURSES

MKKN 1003 - Environmental Management and Sustainability

This course is designed to expose students to various aspects in environmental management and the concept of sustainability. Topics discussed include the principles of sustainable development, understanding the environmental sensitive areas particularly the natural water bodies, catchment management, development of coastal and inland areas. Current issues related to environmental problems especially on climate change and water supply are the main aspects to be addressed. Some methods and concepts of sustainable approaches are introduced in order to promote and achieve sustainable development goals. At the end of the course, the students should be able to understand the concept of environmental sustainability. The course enables the students to understand, plan and incorporate the concept of sustainability in environmental management.

MKKN 1413 - Water Pollution Control

This course introduces students to water and domestic wastewater treatment system. The content is designed to enable students to understand the processes that are involved in treating water and domestic wastewater. Students will be introduced to characterization of water and wastewater based on basic water quality parameters. This is followed by water treatment processes, which include coagulation, flocculation, sedimentation, filtration and disinfection. Topics on domestic wastewater treatment includes suspended growth processes i.e. activated sludge, oxidation pond, aerated lagoon and biofilm process i.e. biofilter. Students will be given the basic concept of each process and its conceptual design and analysis.

MKKN 1513 - Solid and Hazardous Waste Management

The course aims to analyse the component of solid and hazardous waste management. Upon completion of the course, student should be able to apply the concept of solid and hazardous waste management and identify the issue in waste management. The course covers the analysis of sources, generation and characteristics of industrial and municipal wastes, selection and evaluation of collection systems, handling and disposal practices of municipal wastes, management of scheduled wastes, the design of waste treatment system and the pollution prevention and techniques.

ELECTIVE COURSES

MKKN 1063 - Water Quality Assessment and Management

This course is designed to expose students to current trends and various aspects in water quality assessment and management for river catchments, lakes, reservoirs and wetlands. It tackles problems involving water pollution and its impacts on the environment and legislation. Water quality monitoring projects carried out by students will enable application of proper sampling and monitoring methods. At the end of the course students will then be able to assess water quality problems and plan mitigation and control measures for water pollution.

MKKN 2123 - Environmental Quality Analysis

This course is designed to expose and train students on analytical principles and method for analyzing environmental quality. Topics discussed will include the theory and practical approaches of analytical tools based on biological, chemical and physical properties and methods. The quality parameters are BOD, COD, TOC, DO, metals constituents, inorganic and organic impurities in air and water samples. Methods based on biological tools are also introduced to the students. Among instrumentations employed for the course are UV VIS spectrophotometer, HPLC, GC, AA spectrometer and IR spectrometer. The students are also required to conduct analysis in laboratory. At the end of the course, the student should be able to explain, determine and apply the methods for environmental analysis.

MKKN 2223 - Environmental Laws & Institution

This course is designed to equip students with the philosophy, knowledge and mechanism of resource and environmental law. Aspects included are the development of law governing resource and environment; sources of environmental law; principles and techniques of resource and environmental law; regulatory bodies for resource and environment; common law approach to environmental; historical context of environmental law in Malaysia; components and mechanism of Environmental Quality Act 1974; future challenges of environmental law

MKKN 2233 - Land Use & Environmental Planning

This course covers the fundamental concepts and mechanisms underlying land use and environmental planning from conceptual to its implementation. It focuses on the understanding of ecosystems, the impacts of land development activities along with the appropriate tools/techniques of environmental planning and management used to mitigate them. It provides an overview of the field, along with the fundamentals of land use planning, and presents a collaborative approach to environmental planning while explaining the principles of ecosystem management, restoration, and protection; land conservation; and the mitigation of natural hazards.

MKKN 2243 - Environmental Economics

The course aims to equip students with the application of relevant techniques and approaches in environmental economics. It requires students to understand the market failures concept in handling environmental resources, apply the corrective measures by using the principles of market economics and economic valuation of environmental resources and undertake a specific research project in the application of techniques and approaches in environmental economics. It includes development and environmental relationship in order to balance economic development and environmental conservation, tools and instrument of sustainability assessment, the adverse impacts of development on economics and the environment, fundamental economic forces and the economic consequences on the current global environmental economic issues

MKKN 2413 - Physico-Chemical Treatment Processes

This course emphasizes on physico-chemical processes of water and wastewater treatment. The content is tailored to enable students to understand, analyze and apply essential theories and principles in removing various types of contaminant from water and wastewater using

physic-chemical processes. Students will be introduced to process fundamentals which include thermodynamic and kinetics of reaction, mass balance concept and reactor analysis. Processes that will be discussed include aeration and air stripping, chemical oxidation, disinfection, chemical precipitation, coagulation, sedimentation, filtration, carbon adsorption, ion exchange and membrane processes. Students will be given the basic concept of each process, its applications, advantages and weaknesses. The conceptual design and analysis will be explained in detail.

MKKN 2423 - Biological Treatment Process

The course is designed to expose students to biological treatment processes in engineered wastewater system. It covers major wastewater engineering aspects such as process analysis and design, treatment technologies, modeling and membrane bioreactor. It will also demonstrate a typical calculation, design and analysis on common biological treatment processes. At the end of the course, students should be able to incorporate and utilize technology in the design of operational unit of wastewater engineering.

GENERAL COURSES

UKKP 0013 - Research Methodology

The aim of this course is to equip students with the essential knowledge and skills to do a research and write dissertation systematically. This course has 9 modules which will be conducted through weekly 3-hour seminar. Each seminar will be consisted a lecture, discussion and workshop. In the end of course, students need to produce a research proposal and have a mini conference as part of assessment and proposal presentation practice.

DISSERTATION

MKKN XX80 - Dissertation

For Dissertation, student needs to conduct research work in chemical laboratories, computer laboratories or companies and analyse the data critically to solve a research problem. The student then has to write a complete thesis which will be evaluated by examiners at the end of the course. Student also has to present and defend their findings.

MASTER OF SCIENCE

SPECIALIZATION: POLYMER TECHNOLOGY

PROGRAMME SPECIFICATIONS

The Master of Science Specialization in Polymer Technology is offered on a full-time basis at UTM Main Campus in Johor Bahru. The duration of study is one and a half (1.5) years to a maximum of four (4) years. This program is open for any bachelor graduate from science, technology and engineering courses. Graduates from other discipline but with relevant experiences are also encouraged to apply.

The assessment is based on course works, final examinations and dissertation project given throughout the semester.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia		
2. Teaching Institution		Universiti Teknologi Malaysia		
3. Programme Name		Master of Science		
4. Final Award		Master of Science Specialization: Polymer Technology		
5. Programme Code		MKKA		
6. Professional or Statutory Body of Accreditation		MQA		
7. Language(s) of Instruction		English		
8. Mode of Study (Conventional, distance learning, etc)		Mixed-Mode		
9. Mode of operation (Franchise, self-govern, etc)		Self-governing		
10. Study Scheme (Full Time/Part Time)		Full Time		
11. Study Duration		Minimum : 1.5 years Maximum: 4 years		
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	3	-	14	-
Short	-	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University General Courses	3	7.14%
ii.	Programme Core	15	35.71%
iii.	Programme Electives	3	7.14%
iv	Dissertation	21	50.00%
	Total Credit Hours	42	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduate become the expertise in polymer technology decipline and contribute to national development.
PEO2	Graduate become creative, innovative and adaptable technology specialist as leaders or team members in their organization and society.
PEO3	Graduate contribute toward the environmental well-being and sustainable development.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to master the knowledge in polymer technology discipline.
PLO2	Ability to apply research skills in polymer technology discipline.
PLO3	Ability to analyze problems in polymer technology field using scientific and critical thinking approaches.
PLO4	Ability to conduct professional ethics in research with minimal supervision and adhere to legal, ethical and professional code of practice.
PLO5	Ability to associate ideas through communication on societal issues in polymer technology discipline.
PLO6	Ability to manage information for lifelong learning in polymer technology field.
PLO7	Ability to demonstrate team working qualities and working effectively with peers and stakeholders.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO	CODE	COURSE	CREDIT EARNE D (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSE D
SCHOOL OF CHEMICAL & ENERGY ENGINEERING					
CORE COURSES (Compulsory)					
1	MKKR 1113	Polymer Characterization	3	3	
2	MKKR 1123	Polymer Synthesis	3	3	
3	MKKR 1133	Polymer Physic and Properties	3	3	
4	MKKR 1143	Polymer Additives, Blends and Rheology	3	3	
5	MKKR 1153	Polymer Processing	3	3	
	TOTAL CREDIT OF CORE COURSES (a)		15	15	
ELECTIVE COURSE (Choose only 1 Course)					
6	MKKR 1223	Rubber and Latex Technology	3	3	
7	MKKR 1243	Surface and Foam Technology			
	TOTAL CREDIT OF ELECTIVE COURSE (b)		3	3	
UNIVERSITY GENERAL COURSE					
8	U*** **3	University General Course	3	3	
9	UKKP 0010	Research Methodology	0	HL	
	TOTAL CREDIT OF UNIVERSITY GENERAL COURSE (c)		3	3	
DISSERTATION					
10	MKKR **80	Dissertation	0	HL	
	TOTAL CREDIT TO GRADUATE (a+b+c)		21	21	

COURSE SYNOPSIS

CORE COURSES

MKKR 1113 - Polymer Characterization

This course introduces students with comprehensive knowledge of the various techniques available to characterize polymeric materials, the underlying principles of each characterization methods, the use and the limitations of each technique. This course will focus mainly four approaches of characterization, which are characterization of polymers in solution, spectroscopy, thermal analysis and microscopy. In characterization of polymers in solution, it will cover measurements of molecular weight and molecular weight distribution. In spectroscopy student will learn classification of spectroscopic methods and different type of spectroscopy instruments. This topic will also focus on fundamental concept in Infra-red (IR) spectroscopy for polymer applications. In thermal analysis students will learn various techniques of thermal analysis such as differential scanning calorimeter (DSC), thermal gravimetric analysis (TGA), and dynamic mechanical analysis (DMA). The microscopy topic will cover various techniques of microscopy analysis such as optical microscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM) and atomic force microscopy (AFM).

MKKR 1123 - Polymer Synthesis

Basic terminologies, principles on polymers and structural relationship towards polymer classification are discussed. An overview on the polymer industry is elaborated together with its impact on human life. Molecular weight relationships toward polymer properties and its implication are briefly presented. This course emphasis specifically on the advanced of polymer synthesis including step-growth, chain-growth and co-ordination polymerizations. Kinetic for the polymerization mechanism is described and its relationship to molecular weight is explained in details. The limitations and application for each polymerization mechanism are discussed. The polymerization systems used for the polymerization process are discussed together with their advantages and the disadvantages. Finally, this course also exposed students to the pilot scale set-up of the polymerization systems.

MKKR 1133 - Polymer Physic and Properties

This course is designed to expose students to the properties of polymer which have great importance. It will emphasize on the mechanical properties, electrical properties, polymer characterization and rubber elasticity. A strong emphasis will be given on the mechanical properties which include viscoelastic behavior, tensile and impact properties. Plastics design using creep deformation data is also included. At the end of the course students should be able to explain the interrelation between polymer properties, structures and applications. The students should also be able to describe the appropriate test and characterization for each property.

MKKR 1143 - Polymer Additives, Blends and Rheology

This course consists of three parts: (a) Polymer Additives (b) Blending (c) Rheology. Polymer additives cover the topics on fillers and fibres, heat stabiliser, impact modifiers, antioxidants, lubricants, plasticizer, flame retardants and other. The theory and mechanism of each additive

will be explained in details. Polymer blending explains the methods of blending, compatibilizing mechanism and current development in polymer blends. Whilst polymer rheology elaborates the behaviour of polymer flow in a pipe as well as between plate.

MKKR 1153 - Polymer Processing

This course introduces students to processing of thermoplastic and composite materials in general. Details fundamental of polymer processing such as extrusion and injection moulding will be emphasized. Element of product design will also be covered in this course. The course will further discuss and explain the preparation and manufacture of fibre reinforced polymer composite. At the end of the course, students should be able to derive, calculate stress, strain and modulus for a given problem of unidirectional composite and composites materials design.

ELECTIVE COURSES

MKKR 1223 - Rubber and Latex Technology

The course will provide students with a basic knowledge of rubber technology covering the important characteristics of common rubber materials, applications of rubbers, fundamental principles of rubber compounding, and basic mixing techniques to produce good rubber compounds. Emphasis will be given to discuss on material selection to formulate a rubber compound and its curing system especially with regard to sulfurs curing practice. Furthermore, a laboratory work on compounding and curing of rubber compounds will be demonstrated. This course will also introduce the students with a fundamental understanding of latex technology highlighting on compounding and processing of latex.

MKKR 1243 - Surface and Foam Technology

This course is designed to introduce students to the basic principles and concepts in adhesion and adhesives. It will deal with the various types of adhesives, joining of polymers/plastics by means of welding, solvent bonding, coupling agents and also introduce the various applications of adhesives. This course includes various aspects of polymer coatings and paints including the coating methods and polymer coatings industry, types of paints, pigments in paints, paint compounding and preparation and characterization techniques of paints and coatings. This course also introduces the formation of foams of various polymers including thermoset, thermoplastic and reinforced foams.

GENERAL COURSES

UKKP 0010 - Research Methodology

The aim of this course is to equip students with the essential knowledge and skills to do a research and write dissertation systematically. This course has 9 modules which will be conducted through weekly 3-hour seminar. Each seminar will be consisted a lecture, discussion and workshop. In the end of course, students need to produce a research proposal and have a mini conference as part of assessment and proposal presentation practice.

DISSERTATION

MKKR XX80 - Dissertation

For Dissertation, student needs to conduct research work in chemical laboratories, computer laboratories or companies and analyse the data critically to solve a research problem. The student then has to write a complete thesis which will be evaluated by examiners at the end of the course. Student also has to present and defend their findings.

MASTER OF PETROLEUM ENGINEERING

PROGRAMME SPECIFICATIONS

The Master of Petroleum Engineering (MKPP) is offered both on a full-time basis, and on a part-time basis (referred to as offshore programme). The duration of study for the full-time students is between three (3) semesters to a maximum of six (6) semesters. For the offshore programme, the minimum duration of study takes four (4) normal semesters (not including the short semester), while the maximum duration is eight (8) normal semesters.

Students need to complete 47 credit hours, which also include individual Master Projects and the Field Development Project (group project). The programme is suitable for any graduate from science, technology, and engineering backgrounds who meet the entry requirement.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia		
2. Teaching Institution	Universiti Teknologi Malaysia		
3. Programme Name	Master of Petroleum Engineering		
4. Final Award	Master of Petroleum Engineering		
5. Programme Code	MKPP		
6. Professional or Statutory Body of Accreditation	MQA		
7. Language(s) of Instruction	English		
8. Mode of Study (Conventional, distance learning, etc)	Conventional (Taught Course)		
9. Mode of operation (Franchise, self-govern, etc)	Self-governing		
10. Study Scheme (Full Time/Part Time)	Full Time & Offshore Programme		
11. Study Duration	Full Time Minimum : 1.5 years Maximum : 4 years Offshore Minimum : 2 years Maximum : 4 years		
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	3	6	14
Short	1 or 2 (for offshore)		10

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	6.4
ii.	Research Methodology	3	6.4
iii.	Master Project 1 & Master Project 2	10	21.3
iv.	Programme Cores	25	53.2
v.	Programme Electives	6	12.7
	Total	47	100

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates incorporate in-depth petroleum engineering knowledge and principles in their professional works.
PEO2	Graduates manage conducive working environment and readily pursue different challenging roles in global petroleum engineering positions through effective team work, leadership and communication.
PEO3	Graduates demonstrate ethical responsibilities including social issues, safety and environmental awareness and continuously engage in personal and professional growth.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to integrate the advanced knowledge in petroleum engineering discipline.
PLO2	Ability to apply research skills in petroleum engineering discipline.
PLO3	Ability to analyze problems in petroleum engineering field using scientific and critical thinking approaches.
PLO4	Ability to demonstrate professional ethics and values with full responsibility and integrity.
PLO5	Ability to demonstrate effective communication skills in both written and oral form to report the scientific and technical facts.
PLO6	Ability to acquire knowledge and engage in life-long learning in petroleum engineering field independently and effectively.
PLO7	Ability to work effectively with team members that may involve diverse multi-disciplinary settings.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses and assessment in this checklist. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessment are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNT ED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL & ENERGY ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKKP 0013	Research Methodology			
3	MKPP 1113	Petroleum Economics & Management			
4	MKPP 1213	Applied Geoscience & Geophysics			
5	MKPP 1323	Formation Evaluation			
6	MKPP 1333	Reservoir Rock & Fluids Properties			
7	MKPP 1413	Drilling Engineering & Well Completion			
8	MKPP 2353	Reservoir Engineering			
9	MKPP 2513	Petroleum Production Engineering			
10	MKPP 3804	Field Development Project			
11	MKPP 2**3	Programme Elective 1			
12	MKPP 2**3	Programme Elective 2			
13	MKPP 3904	Master Project 1			
14	MKPP 3906	Master Project 2			
PROGRAMME ELECTIVES COURSES (select any two courses)					
15	MKPP 2323	Reservoir Simulation			
16	MKPP 2333	Enhanced Oil Recovery			
17	MKPP 2433	Water Flooding			
18	MKPP 2523	Well Diagnosis and Treatment			
UNIVERSITY ELECTIVES (select only one course)					
19	UHAP 6013	Seminar Pembangunan Isu-isu Sosial dan Ekonomi Global			
20	UICW 6023	Falsafah Sains dan Ketamadunan			
21	UPPF 6033	Kepimpinan Dinamik			
22	UCSM 1263	Pengurusan Projek IT			
23	UDPE 1123	Organizational Behavior and Development			
24	UHAZ 6123	Masyarakat dan Budaya Malaysia			
25	ULAB 6013/ ULAB 6023	Kursus Bahasa Inggeris Pascasiswazah			

COURSE SYNOPSIS

CORE COURSES

UKKP 0013 - Research Methodology

The course is designed to deliver some important aspects and skills regarding research methodology to the postgraduate students. In general, this course will enable the students to identify and apply appropriate research methodology in order to plan, conduct, and evaluate the undertaken research. Students will be taught the approaches to write meaningful problem statement, measurable objectives, and systematic scope of study. Students will also be introduced to the techniques and useful resources to conduct an effective literature review. The purposes of planning a proper research design and the relationships between the research methodology and research design are clearly described to the students. This course also aims to deliver the technique for data collections and analysis. Finally, the students will be exposed to the skills and techniques required for the preparation of research proposal and thesis, as well as the final thesis oral assessment.

MKPP 1113 - Petroleum Economics & Management

Understanding of the big picture of petroleum industry is an important prerequisite to successfully identifying, evaluating and selecting petroleum projects. There are many factors that need to be considered and these factors need to be evaluated accordingly. The course focuses in giving an understanding of petroleum industry and factors that influence the economic feasibility of the petroleum upstream project. The cash flow model incorporating fiscal terms is introduced with discounting and sensitivity aspects into the cash flow model of the project, the oil company, and the government (national oil company). Important economic indicators such as Net Present Value (NPV), payback period, unit technical cost (UTC), profit-investment ratio (PIR) will be discussed. The last part covers the managing of the field under production, declining production and abandonment phases.

MKPP 1213 - Applied Geoscience & Geophysics

This course introduces students with the introduction of petroleum geology, sedimentology and applied geophysics to the search for and production of oil and gas. The course emphasis on the Earth materials, processes, basin and petroleum systems (including Plate Tectonic context of petroleum basins). These aspects will be viewed in relation to the transport, deposition and deformation processes of sediment. Next, explore the reservoir heterogeneity, architecture, faults and seals. The geophysical techniques used to locate a reservoir. Mapping and correlation. Finally, to estimate the bulk volume of such reservoirs.

MKPP 1323 - Formation Evaluation

The course covers methods of formation evaluation, both direct and indirect (wireline logging). The concept, acquisition, and application of drill cuttings and core samples including the important aspects of commonly used well logging techniques, like the working principles of the tools, how measurements take place, application, advantages and disadvantages of the various techniques, and how to make interpretations from various log data are discussed. Shaly sand analysis, cross-plotting and overlaying techniques for determination of lithology,

mineral identification and other important parameters are also included in the teaching and delivery.

MKPP 1333 - Reservoir Rock and Fluids Properties

This course covers the description and characterization of reservoir rock and fluid properties of the oil and gas reservoir, calculation of fluid in-place and the recoverable reserves, determination of reservoir phase behaviours, calculation of reservoir fluid and rock properties, PVT analysis, effect of capillary pressure, interaction of fluid-rock system, and investigation of reservoir formation heterogeneity.

MKPP 1413 - Drilling Engineering & Well Completion

The course covers the drilling systems, drilling fluids, well control and procedures, various types of drilling techniques, configurations and measurements, special operations, design of casing and tubing string and their recommended running procedures, cementing, well completion practices, subsurface equipment, well space-out, and slickline operation.

MKPP 2353 - Reservoir Engineering

This course is intended to explore further concepts in reservoir engineering. Students are presented with the physics of reservoir engineering and mathematical techniques to solve complex reservoir problems. The course covers topics such as the equation of fluid flow in reservoir, oil recovery mechanisms, vapor-liquid equilibrium relations, material balance equation including various water-influx models, and the immiscible displacement theory.

MKPP 2513 - Petroleum Production Engineering

This course covers principles and methodology for oil & gas wells productivity, encompassing wide range of petroleum production fundamentals, pertinent to modern petroleum industry. The content includes vapour/liquid mixture behavior & related calculation, well productivity & performance analysis & evaluation, downhole and surface production system installation & operation. Students will also learn well performance prediction & optimization, artificial lift system, surface facilities, and stimulation work.

MKPP 3804 - Field Development Project

Field Development Project exposes students to the process and methods in developing an optimum plan for a particular petroleum field. It covers all aspects of field development planning, commencing with screening studies, after discovering hydrocarbons, to project sanction. Analysis of this field data results in an assessment of the respective reservoir and leads to the design of an appropriate production system. Students are required to work in small groups, submit written plans, and present their proposals to a panel.

MKPP 3904 - Master Project 1

The first part of Master Project requires students to prepare a research proposal. This might involve practical activities such as literature review and gantt chart preparation. At the end of the course, students should be able to defend and prepare a research proposal according to the UTM thesis-writing format. In addition, students will have the opportunity to gain important generic skills such as communication, team working, problem-solving and creative and critical thinking.

MKPP 3906 - Master Project 2

This course is the continuation of the Master Project 1 (MKPP 3904). The second part of Master Project requires students to execute the research proposal that has been prepared in the previous semester. This might involve practical activities such as laboratory works, data collection from industry and computer programming / simulation. At the end of the course, students should be able to prepare a full report compiling the first and second part of the Master Project, and subsequently present their research findings. Finally, students must submit a bound thesis according to the UTM thesis-writing format. In addition, students will have the opportunity to gain important generic skills such as communication, team working, problem-solving and creative and critical thinking.

ELECTIVE COURSES

MKPP 2323 - Reservoir Simulation

This course covers the fundamental of numerical reservoir simulation which include the development of simple governing equations, partial differential flow model, finite difference approximation, and error & stability analysis. Students will be involved with simple programming and the use of commercial simulator. The course is conducted by normal lectures and student individual /group project, based on development of simple reservoir simulator.

MKPP 2333 - Enhanced Oil Recovery

This course provides students with important concepts, theories, and methods of enhanced oil recovery (EOR). This course covers the general classification of EOR processes, microscopic displacement of multiphase fluids in porous media, the concept of mobilization and trapping of oil, mobility ratio, capillary number, gravity segregation, and recovery efficiencies. Also included are the important concepts and operational procedures of various types of EOR methods such as polymer flooding, surfactant/micellar flooding, alkaline flooding, ASP flooding, miscible gas flooding, thermal recovery processes and microbial EOR.

MKPP 2433 - Water Flooding

This course covers the waterflooding technique as a secondary recovery method to increase the oil recovery normally implemented after primary recovery stage. The displacement and the entrapment of oil by water will be discussed, followed by prediction of the waterflood performance using various published methods. The selection of water for waterflooding, and the water injection system will be elaborated as well.

MKPP 2523 – Well Diagnosis and Treatment

This course covers topics on the causes of low well productivity of problem wells, where the diagnosis of problem wells information were obtained from the analysis of well data and production log. The treatment of problem wells such as formation damage and sand production are discussed. Control methods to remedy the problems are analysed, such as workover method and planning, gravel pack for sand control, and formation stimulation.

MASTER OF SCIENCE (HERBAL TECHNOLOGY)

PROGRAMME SPECIFICATIONS

Master of Science (Herbal Technology) by taught course is suitable for any bachelor graduates from science, technology and engineering field. Graduates from other discipline with relevant experiences are also encouraged to apply. Depending on the candidate's background, pre-requisite courses may be imposed to assist the candidate to comprehend more in-depth advanced courses offered.

The programme graduates are able to analyze critically, plan, solve complex problems associated with herbal science and technology and related fields and design plant-wide processes including unit operations leading to a professional qualification that will serve the herbal or phytochemical industry. The graduates will also acquire strategic knowledge on "seed to shelf" concept at the herbal business value chain.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia		
2. Teaching Institution	Universiti Teknologi Malaysia		
3. Programme Name	Master of Science (Herbal Technology)		
4. Final Award	Master of Science (Herbal Technology)		
5. Programme Code	MKKT		
6. Professional or Statutory Body of Accreditation	MQA		
7. Language(s) of Instruction	English		
8. Mode of Study (Conventional, distance learning, etc)	Conventional (Taught Course)		
9. Mode of operation (Franchise, self-govern, etc)	Self-governing		
10. Study Scheme (Full Time/Part Time)	Full Time		
11. Study Duration	Minimum : 2 years Maximum: 8 years		
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	4	8	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	75%
ii.	Programme Core	27	
iii.	Programme elective (1 course)	-	
iv	Master Project	10	25%
	Total	40	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	The ability to analyze critically, plan, solve complex problems associated with herbal science and technology and related fields and design plant-wide processes including unit operations leading to professional herbal qualification.
PEO2	The ability to communicate effectively, advocate their ideas and practice professional, ethical, environmental and societal responsibilities irrespective of different global and cultural perspectives
PEO3	The ability to easily adapt to different roles, responsibilities, surroundings and communities, enabling them to contribute and lead in their organizations and society at large.
PEO4	The ability to be lifelong learners who are able to demonstrate business acumen and higher-order thinking skills needed to solve problems through innovation and creativity

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduates are able to integrate scientific knowledge in the field of herbal technology and evaluate (C6) related processes
PLO2	Graduates are able to construct (P4) research project to explain phenomena studied through master's project in the field of herbal technology
PLO3	Graduates are able to display (P4) the ability to clearly communicate findings, knowledge, recommendations and rationale to peers and experts in the related fields
PLO4	Graduates are able to demonstrate (A3) universal values in professional practices by displaying truth, intellectual integrity and ethics.
PLO5	Graduates are able to demonstrate (A3) contemporary knowledge to expand enquiring mind and knowledge culture.
PLO6	Graduates are able to organize (P4) complex matters (project/ research) and identify competitive and workable business plan (KK1)
PLO7	Graduates are able to work (A3) comfortably as members or leaders of multi-disciplinary groups.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist with minimum B grade. Students must achieve a total of 40 credit hours with a minimum of cumulative B grade or CGPA of 3.0 and passed master research dissertation project and has submitted the approved dissertation to UTM. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNE D (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
UNIVERSITY ELECTIVE COURSES					
1	UHAP6013	Seminar Pembangunan Isu-Isu Sosial dan Ekonomi Global	3	3	
2	UHAW6023	Falsafah Sains dan Pembangunan Sosial	3	3	
3	UHAF6033	Kepimpinan Dinamik	3	3	
4	UHAZ6113	Budaya Malaysia I	3	3	
5	UHAZ6123	Budaya Malaysia II	3	3	
6	UHAZ6313	Bahasa Malaysia Akademik I	3	3	
7	UHAZ6323	Bahasa Malaysia Akademik II	3	3	
8	UBSE1123	Organizational Behavior	3	3	
9	UCSM1263	Pengurusan Projek IT	3	3	
10	ULAJ 6013	Japanese Language for Postgraduates	3	3	
TOTAL CREDIT OF UNIVERSITY ELECTIVE			3	3	
PROGRAMME CORE COURSES					
11	MKKT1013	Botany And Herbal Chemistry	3	3	
12	MKKT1023	Herbal Quality Management	3	3	
13	MKKT1033	Herbal Processing	3	3	
14	MKKT1043	Product Formulation	3	3	
15	MKKT1053	Practical Science And Herbal Technology	3	3	
16	MKKT 2013	Herbal Cosmeceutical	3	3	
17	MKKT 2023	Nutraceutical And Functional Food	3	3	
18	MKKT2053	Legislation And Registration Of Herbal Product	3	3	
19	MKKT2063	Research Methodology And Value Creation Through Innovation	3	3	
TOTAL CREDIT OF PROGRAM CORE			27	27	
PROGRAMME ELECTIVE COURSES* (none)					
DISSERTATION					

20	MKKT 2014	MASTER PROJECT 1	4	4	
21	MKKT 3016	MASTER PROJECT 2	6	6	
TOTAL CREDIT OF DISSERTATION			10	10	
TOTAL CREDIT TO GRADUATE			40	40	
<p><i>*The courses are offered subjected to availability of the courses for the particular semester in the School of Chemical and Energy Engineering.</i></p>					

COURSE SYNOPSIS

CORE COURSES

MKKT 1013 - Botany and Herbal Chemistry

In this course the students will learn about botany, identification of medicinal plants and phytochemistry. The course emphasizes on plant active compounds which mainly are the secondary metabolites from natural sources such as phenolics, steroids, terpenoids, glycosides and alkaloids.

MKKT 1023 - Herbal Quality Management

Every herbal product must be subjected to quality assurance and quality control before it can be commercialized. In this course, students will learn about quality, quality management, quality control, standardization procedures of herbal products, good manufacturing practices and hazard and operability study (HAZOP).

MKKT 1033 - Herbal Processing

Herbal processing is an integral part of herbal product development. In this course, students will learn about herbal processing complete cycle starting from cultivation and collection of plant materials, reprocessing, processing, packaging and finally good manufacturing practices.

MKKT 1043 - Product Formulation

Product formulation is a very important part of herbal product development. Herbal product can be marketed under different dosage forms. In this course students will learn the fundamental of product formulation and other aspects of product formulation such as dosage forms, stability testing, and various types of herbal products

MKKT 1053 - Practical Science and Herbal Technology

There are many unit operations involved in developing an herbal product. During this course, students will be able to conduct different experiments related to herbal processing, product formulation and QC. This knowledge will help the students in developing herbal products.

MKKT 2013 - Herbal Cosmeceutical

Cosmeceuticals refers to the combination of cosmetics and pharmaceuticals. Basically, cosmeceuticals are cosmetics containing active ingredients that are capable of altering the structure and function of the body. In this course students will learn about skin physiology, hair physiology and natural active ingredients that can be used for skin and hair health.

MKKT 2023 - Nutraceutical and Functional Food

For this course, nutraceuticals are defined as natural active ingredients that have nutritional and physiological benefits and are sold in medicinal forms. Students will learn how nutraceuticals are metabolized in the body, the bioavailability and pharmacokinetics of nutraceuticals, their safety and the different classes of nutraceuticals.

MKKT 2053 - Legislation and Registration of Herbal Product

Legislation of herbal products is important to ensure that the herbal products introduced into the market are safe for human use. In this course, students learn about the different legislation on herbal products according to different continents or countries. Students will also learn about various tests that must be conducted to ensure safety and prove efficacy of the herbal products. A case study on the registration process of herbal products in Malaysia will also be included in this course.

MKKT 2063 - Research Methodology and Value Creation Through Innovation

In this course the students will be exposed to various aspects of the research process. Students will learn how to conduct research in terms of producing research problems and questions, proposal writing and supervision, writing a dissertation, literature reviews, research methods and how to ensure ethical integrity when conducting research. Students will also learn how to create value to a product. The module on value creation through 5 discipline of innovation will be based on SRI International model.

MASTER OF GAS ENGINEERING AND MANAGEMENT

PROGRAMME SPECIFICATIONS

The Master of Gas Engineering and Management is offered on a full time basis. The duration of study for the full-time students is between three (3) semesters to a maximum of six (6) semesters.

The candidate must complete a minimum of 46 credits, and must obtain a final academic grade of at least 3.0 CGPA (Cumulative Grade Point Average). The minimum 46 credits taught course consists of several courses including compulsory courses, a university elective course and a master project. Each course normally carries 3 credits, and the assessment is carried out by examinations and assignments. The master project is to be completed in the final semester and will be assessed by a research proposal seminar, a final project report and an oral examination

General Information

1. Awarding Institution	Universiti Teknologi Malaysia					
2. Teaching Institution	Universiti Teknologi Malaysia					
3. Program Name	Master of Gas Engineering and Management					
4. Final Award	Master of Gas Engineering and Management					
5. Program Code	MKPM					
6. Professional or Statutory Body of Accreditation	MQA					
7. Language of Instruction	English					
8. Mode of Study (conventional, distance learning, etc.)	Conventional (Taught Course)					
9. Mode of operation (franchise, self-govern, etc.)	Self-governing					
10. Study Scheme (Full Time/Part Time)	Full Time					
11. Study Duration	Minimum: 1.5 years Maximum: 4 years					
Type of Semester	No. of Semesters				No. of Weeks	
	Full Time		Part Time			
	Min	Max	Min	Max	Full Time	Part Time
Normal	3	6	-	-	14	-
Short	-	-	-	-	-	-

Course Classifications

No	Classification	Credit Hours	Percentage
i.	Compulsory modules (university)	3	6.5 %
ii.	Core/Major/Concentration: <ul style="list-style-type: none"> • Courses/modules • Projects/thesis/dissertation 	27 10	58.7% 21.7%
iii.	Optional/elective courses/modules	6	13.1%
	Total Credit Value	46	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates incorporate in-depth engineering techniques and natural gas management principles in project technical and economic analysis of gas production, processing, transportation and utilization projects.
PEO2	Graduates manage conducive working environment and readily pursue different challenging roles in regional and global natural gas operation and management positions through effective team work, leadership and communication skills.
PEO3	Graduates demonstrate ethical responsibilities including social issues, safety and environmental awareness and continuously engage in personal and professional growth.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to integrate advanced scientific and technical knowledge of gas engineering and related management principles
PLO2	Ability to utilize appropriate methodologies, techniques and tools to produce research work of scholarly quality
PLO3	Propose solutions to gas engineering operational problems, designs and management through systematic planning and critical thinking problem solving skills
PLO4	Ability to demonstrate high ethical standards in professional practice including environmental and social issues.
PLO5	Ability to communicate effectively through written and oral modes
PLO6	Ability to perpetually seek advanced knowledge and technology of gas engineering and management for lifelong learning
PLO7	Ability to demonstrate team working qualities and working effectively with peers and stakeholders
PLO8	Ability to incorporate knowledge of gas engineering and management in business thinking /entrepreneurship related decision making process

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist with minimum B grade. Students must achieve a total of 46 credit hours with a minimum of cumulative B grade or CGPA of 3.0 and passed master research dissertation project and has submitted the approved dissertation to UTM. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
SCHOOL OF CHEMICAL AND ENERGY ENGINEERING					
PROGRAMME CORE COURSES (Compulsory)					
1	MKPM 1113	Hydrocarbon Gas Exploration, Production and Processing	3	3	
2	MKPM 1123	Hydrocarbon Gas Transportation and Storage	3	3	
3	MKPM 1133	Natural Gas Supply Engineering and Economic	3	3	
4	MKPM 1143	Hydrocarbon Gas Thermodynamic Properties and Utilization	3	3	
5	MKPM 1213	Risk and Safety Management	3	3	
6	MKPM 1223	Asset Management and Control	3	3	
7	MKPM 1233	Gas Contract Negotiation and Implementation	3	3	
8	MKPM1243	Gas Project Planning, Development and Financing	3	3	
9	MKPM 1414	Graduate Project 1	4	4	
10	MKPM 1426	Graduate Project 2	6	6	
	TOTAL CREDIT OF CORE COURSES (a)		34	34	
PROGRAMME ELECTIVE COURSES (Choose only 2 Courses)					
11	MKPM 1153	LNG Technology	6	6	
12	MKPM 1323	Flow Measurement			
13	MKPM 1353	Fire and Explosion			
	TOTAL CREDIT OF ELECTIVE COURSE (b)		6	6	
UNIVERSITY GENERAL COURSE					
14	U*** **3	University General Course	3	3	
15	UKKP 0013	Research Methodology	3	3	
	TOTAL CREDIT OF UNIVERSITY GENERAL COURSE (c)		6	6	
DISSERTATION					
	TOTAL CREDIT TO GRADUATE (a+b+c)		46	46	

COURSE SYNOPSIS

CORE COURSES

MKPM 1113 - Hydrocarbon Gas Exploration, Production and Processing

This course is intended to expose students to the major stages in the life of an oil or gas field; from exploration, production, and finally to processing and demonstrate the link between the many disciplines involved. The contents of the course cover comprehensive introduction to the upstream and downstream that include basic methods, concepts and current and emerging technologies used and as well as issues related to operations, safety and environment.

MKPM 1123 - Hydrocarbon Gas Transportation and Storage

This subject enables students to acquire and practice the fundamental knowledge of liquefied petroleum gases (LPG), natural gases (NG) and liquefied natural gases (LNG) storage. The course also emphasizes on gas reticulation systems which include service pipe sizing, pipe route, pressure testing and corrosion protection systems. The students are also required to prepare a group technical report and present their project at the end of the course. Students also will be exposed to computer software to enhance their learning quality.

MKPM 1133 – Natural Gas Supply Engineering and Economic

This course enables students to understand the fundamentals of gas supply engineering and its relations to gas supply economic. The contents of the course have been designed to emphasize on the fundamental knowledge of gas supply system, pipeline integrity, pressure regulation and measurement as well as pipeline quality control. The contents of the course also highlight various aspects of gas supply economic of both local and international and interaction of gas supply engineering and gas supply economic in newly-developed and existing market. In addition, the course also reviews some energy policy related issues that will influence the development of gas supply system and gas supply economic.

MKPM 1143 - Hydrocarbon Gas Thermodynamic Properties and Utilization

This course provides students further understanding of knowledge of hydrocarbon gas thermodynamic properties and its relation to other various gas utilization related properties such as combustion, flames etc. The contents of the course have been designed to emphasize more on the advanced knowledge of combustion operation, control, and industrial applications and as well as combustion-related safety aspects. The contents of the course also highlight various hydrocarbon fuels derived energy generating technologies and equipment and its impact on environment. In addition, the course content also focuses on the understanding of gas burner system and burner management system for efficient utilization of hydrocarbon gases.

MKPM 1213 – Risk and Safety Management

This course enables students to appreciate and apply the theoretical and practical aspect of safety, risk management, standards and regulations in gas industry and employ the techniques of hazard identification and risk assessment in the design, operation and management of gas related facilities.

MKPM 1223 - Asset Management and Control

The Asset and Management and Control course (MKTM 1223) is dealing with the study of system that monitors and maintains things of value to an entity of group. It may apply to both tangible assets such as buildings and to intangible concepts such as intellectual property and goodwill. Throughout the course, strong emphasis is placed on how the practice of managing assets to achieve the greatest return (particularly useful for productive assets such as plant and equipment) and the process of monitoring and maintaining facilities systems with the objective of providing the best possible service to users.

MKPM 1233 - Gas Contract Negotiation and Implementation

This course enables students to understand the concept of gas negotiation to sustain the stable supply of energy since consumers are interested in long term stability, predict the potential policy mistake, gas development risks, strategy for the gas chain and relationship between gas supply and purchase agreement, prepare the draft invoice for gas supply and purchase agreement, legal framework, contract structure, and explain the role of government with regard to the energy supply.

MKPM 1243 - Gas Project Planning, Development and Financing

This course enables students to elaborate confidently on government policy and regulatory framework related to oil and gas industry, set out the principles of planning on development of gas projects, become leader in safe and efficient operation in the oil, gas and petrochemical industry in Malaysia, and prepare an analysis on investment and financing of gas potential projects.

MKPM 1414 - Graduate Project 1

The first part of Graduate Project requires students to prepare the research proposal. This might involve practical activities such as literature review and gantt chart preparation. At the end of the course, students should be able to prepare a proposal compiling the research proposal according to the UTM thesis-writing format. In addition, students will have opportunity to gain important generic skills such as communication, team working, problem-solving and creative and critical thinking.

MKPM 1426 - Graduate Project 2

This course is continuation of the Graduate Project I (MKTM 1414). The second part of Graduate Project requires students to implement the research proposal that has been prepared in the previous semester. This might involve practical activities such as laboratory works, data collection from industry and computer programming / simulation. At the end of the course, students should be able to prepare a full report compiling the first and second part of the Graduate Project and subsequently present their research findings. Finally, students must submit a bound thesis according to the UTM thesis-writing format. In addition, students will have opportunity to gain important generic skills such as communication, team working, problem-solving and creative and critical thinking.

ELECTIVE COURSES

MKPM 1153 - LNG Technology

This course enables students to forecast of world energy consumption and role of Gas-to-Liquid (GTL) technology, determine the most accepted method to liquefy natural gas and suitable equipment as well as material used under cryogenic conditions, propose and design the storage system as well as identify its accessories, identify the latest technology to enhance the performance of the storage system and carry out inspection to enhance the integrity of the liquefaction plant.

MKPM 1323 - Flow Measurement

This course provides student advance understanding of knowledge of flowmeter technologies and designs have evolved in order to cover the vast number of applications. These range from the flow of blood in small arteries to the flow in rivers and canals, from cryogenic liquids up to high temperature gases. The operating conditions and applications often dictate the choice of technology. The contents of the course have been designed to emphasize more on the advanced knowledge of fluid flow terminology, flow measuring principles, installation, operation and maintenance, and flow selection. The contents also highlight special applications as well as calibration and verification of the flowmeter. Furthermore, the course content also focuses on the accreditation and international standards involve in the flow measurement operations.

MKPM 1353 - Fire and Explosion

This course enables students to understand the basic concept of fire science and combustion and related calculations as well as to expose them to the concept of explosion and detonation. In addition, the principles of fire and explosion protection and mitigation will be discussed within the context of understanding the fire and explosion development mechanism. At the end of the course, students should be able to explain and relate the fundamental knowledge of combustion, flame and explosion and its important safety aspects involving gaseous fuel utilization. Students should be able to apply general combustion and engineering principles to fires and explosion and should know the parameters involved on the initiation of both fire and explosion. The students should be also able to use CFD fire modeling (CFast) to analyze the fire development on the case studies given.

GENERAL COURSES

UKKP 0013 - Research Methodology

This course is designed to deliver some important aspects and skills regarding of research methodology to the postgraduate students. In general, this course will enable the students to identify and apply appropriate research methodology in order to plan, conduct and evaluation this undertaken research. The students will be taught for the approaches to write meaningful problem statement, measurable objectives and systematic scope of study. Students will also be introduced to the techniques and useful resources to conduct an effective literature review. The purposes of planning a proper research designed and the relationships between the research methodology and research design are clearly described to the students. This course also aims to deliver the technique for data collections and analysis. Finally, the students will be

exposed to the skills and techniques required for the preparation of research proposal and thesis, as well as the final thesis oral assessment.

MASTER OF SCIENCE (ENERGY MANAGEMENT)

PROGRAMME SPECIFICATIONS

The UTM Master of Science (Energy Management) programme is offered on a full-time basis at the UTM main campus in Johor Bahru and also on a part-time basis (weekend classes) in Kuala Lumpur (blending learning mode). The duration of study is one to three years for full-time and two to four years for part-time. This programme is open for any graduates with a degree in science, technology and engineering. Graduates from other disciplines but with relevant experiences are also encouraged to apply.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Programme Name	Master of Science (Energy Management)			
4. Final Award	Master of Science (Energy Management)			
5. Programme Code	METE			
6. Professional or Statutory Body of Accreditation	MQA			
7. Language(s) of Instruction	English and Bahasa Melayu			
8. Mode of Study (Conventional, distance learning, etc.)	Conventional, Active and Cooperative Learning (Taught Course) Blended learning (hybrid physical class and distance learning)			
9. Mode of operation (Franchise, self-govern, etc.)	Self-governing			
10. Study Scheme (Full Time/Part Time)	Full-Time and Part-Time			
11. Study Duration	<p><i>Full-Time</i> Minimum: 1 year Maximum: 3 years</p> <p><i>Part-Time</i> Minimum: 2 years Maximum: 4 years</p>			
Type of Semester	No. of Semesters		No. of Weeks	
	Full Time	Part Time	Full Time	Part Time
Normal	2	4	14	14
Short	1	1	8	8

Course Classification

No	Classification	Credit Hours	Percentage
i.	University General Courses	3	6.7%
ii.	Programme Core	18	40.0%
iii.	Programme Electives	12	26.7%
iv	Research Skills	12	26.7%
	Total Credit Hours	45	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of Energy Management.
PEO2	Practice professionalism and high standards of ethical conducts within organization and society.
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Synthesize complex information, specialized concepts, theories, methods and practice independently in the field of energy management.
PLO2	Solve complex problems critically and integratively using systematic approaches.
PLO3	Apply practical skills to solve problems in the field of Energy Management.
PLO4	Demonstrate effective collaboration with stakeholders professionally.
PLO5	Communicate effectively the knowledge, skills and ideas using appropriate methods to peers, experts and communities
PLO6	Use digital technologies and appropriate softwares competently to enhance study and practice.
PLO7	Evaluate numerical and graphical data critically using quantitative or qualitative tools in solving problems.
PLO8	Demonstrate leadership, autonomy and responsibility in managing resources.
PLO9	Engage self-advancement through continuous learning or professional development
PLO10	Initiate entrepreneurial projects supported by relevant knowledge and skills.
PLO11	Demonstrate respectable ethical conducts and professionalism skills in an organization and society.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist with minimum B grade. Students must achieve a total of 45 credit hours with a minimum of cumulative B grade or CGPA of 3.0 and passed master research project and has submitted the approved dissertation to UTM. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNE D (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
PROGRAMME CORE COURSES (Compulsory)					
1	METU 1013	Research Methodology	3	3	
2	METE 1113	Sustainable Energy System Management	3	3	
3	METE 1123	Mechanical Energy Management and Audit	3	3	
4	METE 1133	Electrical Energy Management and Audit	3	3	
5	METE 1143	Thermal Energy Management and Audit	3	3	
6	METE 1153	Occupational Safety for Energy Systems	3	3	
TOTAL CREDIT OF CORE COURSES (a)			18	18	
PROGRAMME ELECTIVE COURSE (Choose only 4 Courses)					
7	METE 1213	Renewable Energy	12	12	
8	METE 1223	Energy Life Cycle Cost and Emission Analysis			
9	METE 1233	Energy Integration and Resource Conservation			
10	METE 1243	Industrial Process Analyses			
11	METE 1253	Energy Planning for Conservation and Sustainable Development			
12	METE 1263	Project Management and Ethics			
TOTAL CREDIT OF ELECTIVE COURSE (b)			12	12	
UNIVERSITY GENERAL COURSE					
13	U*** **3	University General Course	3	3	
TOTAL CREDIT OF UNIVERSITY GENERAL COURSE (c)			3	3	
RESEARCH SKILLS					
14	METE 1315	Energy Project 1	5	5	
15	METE 2327	Energy Project 2	7	7	
TOTAL CREDIT OF RESEARCH SKILLS (d)			12	12	
TOTAL CREDIT TO GRADUATE [(a)+(b)+(c)+(d)]			45	45	

COURSE SYNOPSIS

CORE COURSES

METU 1013 - Research Methodology

This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Amongst topics that will be covered are introduction to research and its philosophy, problem formulation and research objective, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

METE 1113 - Sustainable Energy System Management

This course presents a holistic approach for energy management for an organisation. It provides the key strategies and approaches to establish a sustainable energy management system in an organisation and to implement practical measures for energy conservation using various analysis tools, involving various process equipment, for thermal as well as electrical energy systems.

METE 1123 - Mechanical Energy Management and Audit

This course provides an opportunity for students to explore topics in mechanical energy systems in buildings and industries. Students will be exposed to an in-depth energy analysis of mechanical plant and systems as well as methods for evaluating the plant and system efficiency. The course will discuss energy management for mechanical systems including monitoring and controlling of key parameters. This course is designed to give students “hands-on” experience with carrying out energy audit measurements and studies of mechanical plant and systems to identify possible savings through selected energy conservation measures. A baseline of energy usage will be established and energy conservation is then applied to deduce possible savings and the return of investment. Students will be introduced to the International Measurement and Verification Protocol (IPMVP) in reporting savings achieved by energy efficiency projects.

METE 1133 - Electrical Energy Management and Audit

This course introduces students to electrical energy management and audit for buildings and industries. Students will be exposed to the basic concepts of energy management and energy audit. The implementation of efficient management of electrical energy regulation and the role of the energy manager under this regulation will be discussed. The students will also be exposed to the fundamentals of electrical system. The structure related to energy pricing and the cost saving measures of electricity bill will also be discussed. Energy saving potential in electrical equipment such as lighting system, electric motor and transformer will be highlighted. Electrical energy audit with practical case study will also be covered in this course. At the end of the course, students would be able to apply energy management concepts and conduct electrical energy audit.

METE 1143 - Thermal Energy Management and Audit

This course presents the principles and a system approach methodology to analyse thermal energy system in the industries. The course will cover the fundamentals of typical industrial steam system, including steam generation, steam distribution, steam end-uses, condensate recovery and cogeneration system. This course also presents the key parameters and measurements that are required to conduct the steam system evaluation. This course also introduces process integration to improve the energy efficiency of a thermal energy system.

METE 1153 - Occupational Safety for Energy Systems

Occupational safety is an area concerned with the safety, health and well-being of people engaged in work or employment. It is a two way relationship between work environment and safety. Occupational safety is a part of the safety science curriculum. Occupational safety concerns more on the workers welfare merely due to day-to-day work activities than the impacts on lives, assets and environment due to abnormal process operation. This course introduces concepts of occupational safety with primary focus on various types of occupational hazards in typical workplace environment with focus related to energy system. Students are provided with detailed discussion, ranging from understanding the hazard to the factors that may cause the accidents in the workplace. The types of injuries that may be caused by the hazards are also discussed before appropriate recommendations to avoid or reduce the hazards are presented. Overall, through this course, students will acquire the knowledge and judgment to function as an entry-level practitioner in occupational safety and health for energy system.

ELECTIVE COURSES

METE 1213 - Renewable Energy

The course provides an understanding of the management diversity of the renewables/sustainable low-carbon energies portfolio for sustainable energy future. The module includes the assessment of economic and environmental benefits of renewable energy (RE) from various sources such as biomass, biogas, solar, water, geothermal and wind. The emphasis will be given for the conversion of the renewable sources into fuels, energy, chemicals and bio-products. This module also will examine the business opportunities of RE including the industry structure, RE related policies, financing, risk management, regulatory mechanisms and technologies.

METE 1223 - Energy Life Cycle Cost and Emission Analysis

This course discusses life cycle cost analysis for energy conservation projects and emission analysis thorough the life cycle of a product. It presents the principles, methodology and case studies to develop an understanding of life cycle cost and emission analysis that can reduce environmental impact and promote sustainable practice.

METE 1233 - Energy Integration and Resource Conservation

This course presents the principles and methodology of Pinch Analysis technique for optimal resource recovery. The course will cover mainly on Heat Pinch Analysis to maximise thermal energy recovery for process industries. The method can help industries to achieve triple bottom line benefit: reducing energy bills, emissions, and investment costs. Besides thermal

energy, the course will also introduce the concept of Pinch Analysis for other resource recovery such as power, water, waste and carbon emissions.

METE 1243 - Industrial Process Analyses

This course discusses the fundamentals of designing and analysing chemical industrial processes for energy process analyses. The course covers the input-output of common chemical processes and their analyses. Several digital technologies and software to support industrial process analyses is introduced here including commonly used industrial process simulator and industrial type of process control systems. This course employs Active Learning (AL) which embraces authenticity of generic skills (digital skills, life-long learning and teamworking) when engaging in the process of learning and completing tasks given.

METE 1253 - Energy Planning for Conservation and Sustainable Development

This course provides students with the ability to use optimisation software such as Generalized Algebraic Modeling Systems (GAMS), AIMMS as a tool for efficient and holistic energy planning. Students are expected to develop the strategic energy planning for micro and macro level includes industry, regional and country-wide. Emphasis will be placed on the formulation of mathematical model, interpret meaningful scenario analysis in engineering, science and business. A series of hands-on exercises will be conducted in class to enhance the understanding

METE 1263 - Project Management and Ethics

The course intends to develop comprehensive understanding on various aspects of project management which relevant to energy project, including the planning, programming, budgeting and acquisition of capital assets. The principal focus is to ensure energy management projects are delivery on schedule, within budget, with the required performance capability, and compliant with quality, environmental, safety and health standards. Ethics moral are integrated with respective Project Management topics

RESEARCH PROJECT

METE 1315 - Energy Project 1

The course aims to develop skills in solving problems in energy efficiency and energy audit projects. This is the first part of the Energy Project. Students will be assigned with, or give a freedom to choose, any topics related to energy efficiency and energy audit tasks. Students will plan and conduct the project under the supervision of a supervisor since the beginning of the first part until the second part of the Energy Project. Prior to the execution of the work, each student is required to come up with written proposal and present them in a seminar. The proposal should include the background of study, problem statement, objectives of study, scope of study, and significance of study. Also required are literature review, overall methodology, planning, and expected/preliminary results. The proposal must be submitted at the end of the semester to be evaluated. If passed, only then, student can proceed to the second part of the Energy Project.

METE 2327 - Energy Project 2

The course aims to develop skills in solving problems in energy efficiency and energy audit projects. Student will be assigned with a related topic under a supervisor since the Energy Project 1 course. Prior to this second part of the project, each student is required to come up with a proposal and defend it in a seminar. The proposal should include the project background, literature survey, scopes and objectives, methodology, preliminary outcomes (if any), theories, and planning schedule. A full Energy Project report is to be submitted at the end of the semester.

MASTER OF SCIENCE (PROCESS PLANT MANAGEMENT)

PROGRAMME SPECIFICATIONS

Current globalization trend demands future managers to have the ability to change by shaping a definitive shift toward the development of high growth and sustainable process industry. Thus, the Integrated Process Plant Management Scheme (IPPMS), a modular-based training programme, affords qualified professionals from the chemical and related industries an opportunity to gain the degree of aforementioned competency and working knowledge requisite to affect the transfer, adaptation and integration of new technologies intrinsic to process plant management, future-ready to further spur the surge of national advancement within a global framework.

Master of Science (Process Plant Management) by Taught Course is suitable for any bachelor graduates from science, technology and engineering field. Graduates from other discipline with relevant experiences are also encouraged to apply. Depending on the candidate's background, pre-requisite courses may be imposed to assist the candidate to comprehend more in-depth advanced courses offered.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia		
2. Teaching Institution	Universiti Teknologi Malaysia		
3. Programme Name	Master of Science (Process Plant Management)		
4. Final Award	Master of Science (Process Plant Management)		
5. Programme Code	MKKL		
6. Professional or Statutory Body of Accreditation	MQA		
7. Language(s) of Instruction	English		
8. Mode of Study (Conventional, distance learning, etc)	Conventional (Taught Course)		
9. Mode of operation (Franchise, self-govern, etc)	Self-governing		
10. Study Scheme (Full Time/Part Time)	Full Time		
11. Study Duration	Minimum : 2 years Maximum : 8 years		
Type of Semester	No. of Semesters		No of Weeks/Semester
	Min	Max	
Normal	4	8	14
Short	-	-	-

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	75%
ii.	Programme Core	24	
iii.	Programme elective (1 course)	3	
iv	Master Project	10	25%
	Total	40	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates become the expertise in process plant management decipline and contribute to national development.
PEO2	Graduates become creative, innovative and adaptable senior engineer in their organization and society.
PEO3	Graduates contribute toward the environmental well-being and sustainable development.
PEO4	Graduates able to conduct research to add value to existing products.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduates are able to integrate scientific knowledge in the field of process plant management and evaluate (C6) related processes
PLO2	Graduates are able to construct (P4) research project to explain phenomena studied through master's project in the field of process plant management
PLO3	Graduates are able to display (P4) the ability to clearly communicate findings, knowledge, recommendations and rationale to peers and experts in the related fields
PLO4	Graduates are able to demonstrate (A3) universal values in professional practices by displaying truth, intellectual integrity and ethics.
PLO5	Graduates are able to demonstrate (A3) contemporary knowledge to expand enquiring mind and knowledge culture
PLO6	Graduates are able to organize (P4) complex matters (project/ research) and identify competitive and workable business plan (KK1)
PLO7	Graduates are able to work (A3) comfortably as members or leaders of a multi-disciplinary groups

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist with minimum B grade. Students must achieve a total of 40 credit hours with a minimum of cumulative B grade or CGPA of 3.0 and passed master research dissertation project and has submitted the approved dissertation to UTM. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNE D (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSE D
UNIVERSITY ELECTIVE					
1	UHAP6013	Seminar Pembangunan Isu-Isu Sosial dan Ekonomi Global	3	3	
2	UHAW6023	Falsafah Sains dan Pembangunan Sosial	3	3	
3	UHAF6033	Kepimpinan Dinamik	3	3	
4	UHAZ6113	Budaya Malaysia I	3	3	
5	UHAZ6123	Budaya Malaysia II	3	3	
6	UHAZ6313	Bahasa Malaysia Akademik I	3	3	
7	UHAZ6323	Bahasa Malaysia Akademik II	3	3	
8	UBSE1123	Organizational Behavior	3	3	
9	UCSM1263	Pengurusan Projek IT	3	3	
10	ULAJ 6013	Japanese Language for Postgraduates	3	3	
TOTAL CREDIT OF UNIVERSITY ELECTIVE			3	3	
PROGRAMME CORE COURSES					
11	MKKL1113	Introduction to Chemical Processes Engineering and industry	3	3	
12	MKKL 1123	Chemical Process & Equipment	3	3	
13	MKKL 1133	Process Operation control & Troubleshooting	3	3	
14	MKKL 1143	Energy Management	3	3	
15	MKKL 1153	Environmental Management Plan	3	3	
16	MKKL 1523	Quality Management	3	3	
17	MKKL 1533	Financial Analysis	3	3	
18	MKKL 2063	Research Methodology and value creation through innovation	3	3	
TOTAL CREDIT OF PROGRAM CORE			24	24	
PROGRAMME ELECTIVE COURSES* (Choose 1)					
19	MKKL1513	Human Factors in Industry	3	3	
20	MKKL1873	Strategic Marketing, Planning, Management	3	3	
TOTAL CREDIT OF PROGRAMME ELECTIVE			3	3	

DISSERTATION					
21	MKKL2004	Project 1	4	4	
22	MKKL2006	Project 2	6	6	
TOTAL CREDIT OF DISSERTATION			10	10	
TOTAL CREDIT TO GRADUATE			40	40	
<i>*The courses are offered subjected to availability of the courses for the particular semester in the School of Chemical and Energy Engineering</i>					

COURSE SYNOPSIS

CORE COURSES

MKKL1113 - Introduction to Chemical Processes Engineering and Industry

This course presents the principles of chemical processes that play important roles in the chemical engineering curriculum. It prepares the student to formulate and solve material & energy balance on chemical process systems and lays the foundation for subsequent courses in thermodynamics, unit operations, kinetics, and process dynamics.

MKKL 1123 - Chemical Process & Equipment

This course organizes and compares different types of chemical processes and equipments involved in the chemical and other physical processing industries such as sedimentation, filtration, absorption, distillation, liquid-liquid extraction, solid-liquid extraction (leaching) and membrane processes. It also deals with design of separation operations using mass transfer principles. A part of the module allows hands-on experience for students to operate some equipments such as filter presses, crystallisation and extraction processes.

MKKL 1133 - Process Operation, Control & Troubleshooting

This course covers the fundamentals of operation, design and troubleshooting in chemical processes. The course reviews general concepts of process design, modelling and simulation for reaction, separation and heat exchanger network systems. Then, the students will identify and describe control and advanced control systems used in reaction, separation and heat exchanger network systems. Some specific examples that illustrate the trade-offs between steady-state design and dynamic controllability in chemical processes will be analyzed. A new model-based integrated process design and control methodology to overcome the trade-offs between steady-state design and dynamic controllability for reaction, separation and heat exchanger network systems will be reviewed. At the end, some troubleshooting strategy for reaction, separation and heat exchanger network systems will be reviewed.

MKKL 1143 - Energy Management

This course presents the principles for a holistic approach for energy management in a company setting. It provides strategies and methodologies for setting up a sustainable energy management system in a company and for implementing state-of-the-art energy conservation measures using various analysis tools, involving various process equipment, for thermal as well as electrical energy systems.

MKKL 1153 - Environmental Management Plan

This course aims to provide the student with comprehensive theoretical and practical understanding of factors related to environmental management particularly aspects related to water and air pollution as well as control technologies coherent to meeting regulatory requirements. Topics related to watershed characteristics, water quality parameters, legislations, guidelines, non-point source pollution, Total Maximum Daily Load (TMDL) strategies, and water quality modeling will be discussed. The course will also address principles of wastewater collection, treatment, storage, and disposal. In addition, aspects of air pollution characterization and control are also vital in ensuring the preservation of ambient

air quality from potentially detrimental pollution sources due to industrial and commercial activities. Air pollution control engineering is primarily concerned with the control of particulate and gaseous emissions. The relevant technologies developed are therefore coherent to these two constituents and will be discussed in the course.

MKKL 1523 – Quality Management

This module treats quality and reliability as an integral part of all functions of both manufacturing and service organizations. It shows how philosophies, systems, legal aspects, employee involvement and techniques should all contribute to improving quality, reliability, safety and reducing cost.

MKKL 1533 – Financial Analysis

This course module provides an understanding of basic accounting principle, terminology and techniques; so that in their work participants can interpret financial reports and financial information, and apply appropriate management accounting practice, and contribute to departmental financial planning and control effectively.

MKKL 2063 - Research Methodology and Value Creation Through Innovation

In this course the students will be exposed to various aspects of the research process. Students will learn how to conduct research in terms of producing research problems and questions, proposal writing and supervision, writing a dissertation, literature reviews, research methods and how to ensure ethical integrity when conducting research. Students will also learn how to create value to a product. The module on value creation through 5 disciplines of innovation will be based on SRI International model.

ELECTIVE COURSES

MKKL 1513 – Human Factors in Industry

This course module provides a thorough appreciation of the roles and management of people in the manufacturing industry. It also addresses the issue raised by enhanced technology, changing working practices and the search for higher productivity.

MKKL 1873 – Strategic Marketing, Planning, Management

This course is designed to introduce postgraduate students (working executives) to marketing management, its role and importance of organizational performance in the hyper-competitive, rapid internalization and globalization of the business environment. The course, whilst introducing basic concepts and tools of marketing management, deals with the analysis of marketing mix, marketing opportunities, consumer and business markets.

MASTER OF SCIENCE (SAFETY, HEALTH & ENVIRONMENT)

PROGRAMME SPECIFICATIONS

The UTM Master of Science (Safety, Health & Environment) programme is offered on a full-time basis at the UTM main campus in Johor Bahru and also on a part-time basis (Offshore) (weekend classes) in Kuala Lumpur. The duration of the study is one to three years for full-time and two to four years for part-time. This programme is open for any graduate with a degree in science, technology and engineering. Graduates from other disciplines but with relevant experiences are also encouraged to apply.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia		
2. Teaching Institution		Universiti Teknologi Malaysia		
3. Programme Name		Master of Science (Safety, Health & Environment)		
4. Final Award		Master of Science (Safety, Health & Environment)		
5. Programme Code		METW		
6. Professional or Statutory Body of Accreditation		MQA		
7. Language(s) of Instruction		English and Bahasa Melayu		
8. Mode of Study (Conventional, distance learning, etc.)		Conventional, Active and Cooperative Learning (Taught Course)		
9. Mode of operation (Franchise, self-govern, etc.)		Self-governing		
10. Study Scheme (Full Time/Part Time)		Full-Time and Part-Time (Offshore)		
11. Study Duration		<i>Full-Time</i> Minimum: 1 year Maximum: 3 years <i>Part-Time (Offshore)</i> Minimum: 2 years Maximum: 4 years		
Type of Semester	No. of Semesters		No. of Weeks	
	Full Time	Part Time	Full Time	Part Time
Normal	2	4	14	14
Short	1	1	8	8

Course Classification

No	Classification	Credit Hours	Percentage
i.	University General Courses	3	6.5%
ii.	Programme Core	21	45.6%
iii.	Programme Electives	9	19.6%
iv	Research Skills	13	28.3%
	Total Credit Hours	46	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	To equip graduate students with knowledge of safety, health and environment discipline that can contribute to improving the quality of safety, health, and environment of operations in industries.
PEO2	To train graduate students applying the knowledge of safety, health and environment in the employee management, concept, business strategy, and organization goals.
PEO3	To equip graduate students with skills for reviewing documents and making decisions related to safety, health, and environment.
PEO4	To equip graduate students with problem-solving skills related to safety, health, and environment in any activities and industries.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to master the knowledge in safety, health & environmental discipline.
PLO2	Ability to apply research knowledge in safety, health & environmental discipline.
PLO3	Ability to demonstrate several methodologies to analyze problems in safety, health & environmental field using scientific and critical thinking approaches.
PLO4	Ability to apply to legal, ethical and professional code of practice in safety, health & environmental discipline.
PLO5	Ability to deliver effective communication on safety, health & environmental issues.
PLO6	Ability to apply the concept of lifelong learning in safety, health & environmental field.
PLO7	Ability to adapt and interact in society on safety, health & environmental aspects.
PLO8	Ability to work effectively in a team towards achieving common goal and interest.
PLO9	Ability to demonstrate leadership qualities with peers and stakeholders.

PLO10	Ability to manage relevant information in safety, health & environmental field.
PLO11	Ability to identify business opportunity in safety, health & environmental field.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist with minimum B grade. Students must achieve a total of 46 credit hours with a minimum of cumulative B grade or CGPA of 3.0 and passed master research project and has submitted the approved project report to UTM. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNE D (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
PROGRAMME CORE COURSES (Compulsory)					
1	METW 1213	Risk Assessment & Accident Modeling	3	3	
2	METW 1123	Safety and Health Legislations	3	3	
3	METW 1113	Safety and Health Management	3	3	
4	METW 1143	Occupational Safety	3	3	
5	METW 1133	Occupational Health	3	3	
6	METW 1313	Environmental Management	3	3	
7	METW 1323	Pollution Control Technology	3	3	
TOTAL CREDIT OF CORE COURSES (a)			21	21	
PROGRAMME ELECTIVE COURSE (Choose only 4 Courses)					
8	METW 1223	Accident Prevention through Design	12	12	
9	METW 1233	Crisis and Emergency Management			
10	METW 1243	Process Safety & Loss Prevention			
11	METW 1253	Asset Integrity			
12	METW 1263	Incident Investigation			
13	METW 1273	Human Factor			
TOTAL CREDIT OF ELECTIVE COURSE (b)					12
UNIVERSITY GENERAL COURSE					
14	U*** **3	University General Course	3	3	
TOTAL CREDIT OF UNIVERSITY GENERAL COURSE (c)			3	3	
RESEARCH SKILLS					
15	METW 1613	Research Methodology & Design of Experiment	3	3	
16	METW 1614	SHE Project 1	4	4	
17	METW 1626	SHE Project 2	6	6	
TOTAL CREDIT OF RESEARCH SKILLS (d)			13	13	
TOTAL CREDIT TO GRADUATE [(a)+(b)+(c)+(d)]			46	46	

COURSE SYNOPSIS

CORE COURSES

METW 1213 - Risk Assessment & Accident Modeling

Students learn to assess risks associated to safety (e.g. risk of fire and explosion from process plant), health (e.g. risk of occupational disease), and environment (e.g. eco-system risk assessment), security (e.g. risk of terrorist attacks) with emphasis on those that are related to the process industry. Students build and interpret causal models of risks and test the accuracy of these models against incidence reports. The course includes various accident modelling techniques, qualitative and quantitative risk assessment methods, tolerability criteria, and mitigating measures.

METW 1123 - Safety and Health Legislations

This course explains in depth about the principles of Occupational Safety and Health (OSH) and Legislations. OSH legislations are a set of standards that must be met in order to ensure the safety and health of all employees and others that might be affected at the workplace, and responsible for the workplace protection. OSH consists of important regulations such as Occupational Safety and Health (OSH) Act 1994, Factories and Machinery (FMA) Act 1967, Fire Service Act 1988, Petroleum Safety Measures Act 1984, Gas Supply Act 1993 etc. OSH laws must be abide to ensure any accidents/incidents that might results from abnormal work activity can be prevented while maintaining a safe and properly controlled working environment.

METW 1113 - Safety and Health Management

This course presents the principles and methodology of occupational safety and health management systems. In particular, it emphasises on the key elements of management systems which include policy, planning, implementation and operation, checking and corrective action, management review and continual improvement. The course features extensive use of case studies from industry through group presentation.

METW 1143 - Occupational Safety

Occupational safety is an area concerned with the safety, health and well-being of people engaged in work or employment. It is a two way relationship between work environment and safety. Occupational safety is a part of the safety science curriculum. Compared to process safety, occupational safety concerns more on the workers welfare merely due to day-to-day work activities than the impacts on lives, assets and environment due to abnormal process operation. This course introduces concepts of occupational safety with primary focus on various types of occupational hazards in typical workplace environment. For each type of hazard, students are provided with detailed discussion, ranging from understanding the hazard to the factors that may cause the accidents in the workplace. Also, the types of injuries that may be caused by the hazards are also discussed before appropriate recommendations and strategies to avoid or reduce the hazards are presented. Overall, through this course, students will acquire the knowledge and judgment to function as an entry-level practitioner in occupational safety and health. Students also should be able to contribute to the development and maintenance of a safe and healthy work environment.

METW 1133 - Occupational Health

This course provides a comprehensive knowledge in the field of occupational health, with a focus on workplace-related diseases and industrial hygiene. This course covers the knowledge of occupational health and strategies to deal with occupational health issues. It presents information related to the recognition, evaluation and control of the chemical, physical and environmental factors that can have impact on human health in the workplace and in the community. The course also enables graduates to facilitate the application of principles of occupational health to control the risks in their workplace. Graduates of this will be able to identify occupational health hazards and seek solutions and interventions to bring about change in the workplace.

METW 1313 - Environmental Management

This course covers environmental management system principle, environmental act and international protocols or framework in achieving global sustainable development. This course also includes discussion on the fundamental of environmental cycle, carbon footprint and life cycle assessment. A range of underlying drivers for unsustainable use of the environment are also analysed: the economics of global climate change; resource consumption and climate change mitigation. This course will use Massive Open Online Course (MOOC) Blended learning approach in delivering selected subjects.

METW 1323 - Pollution Control Technology

This course introduces the cause, effect and method to control pollution from industries. The course covers the three major categories of industrial pollution: water pollution, air pollution and industrial waste management. In the first part, the course includes the source and types of water pollutants, environmental regulations pertaining to waste water discharge, and techniques to treat raw water and waste water before discharging to the environment. The second part of the course covers the solid and hazardous waste characteristics and effect of air pollution, regulations requirement for air pollution control, technology to control air pollution emissions from industries. The third part covers the management of industrial waste that includes definition of scheduled waste, scheduled waste regulations, and technique to manage the waste.

METW 1613 - Research Methodology and Design of Experiment

This course provides guidelines for preparing a research proposal and defends it. It provides the rationale for the research, the research objectives, the proposed methods for data collection, and data analysis. The proposal is based on the individual interest either in safety, health and environment topic. In the proposal you will present the research and statistical methodology and with expected result and discussion

METW 1614 - SHE Project 1

This course is a first stage of the Master's Project which involve in preliminary studies and planning of research activity on selected safety, health and environment (SHE) topics. The study may include the work on accident data analysis, process simulation, modelling, survey, experiment and case study. The research project is designed to expose the students in writing a research proposal that covers literature review, writing a problem statement, scope identification, objective and method determination. At the end of the course, students should

be able to write a research proposal in a professional practice. The students should also be able to manage and plan their research project according the time given.

METW 1626 - SHE Project 2

This course is a second stage of the Master's Project which is continuity of SHE Project 1 (MKKH 1614). The proposed study in project 1 will be reviewed, modified (if any) and implemented. In this course, the work of data analysis, process simulation, modelling, survey, experiment and case study is carried out systematically as planned. The students should also be able to manage and plan their research according the time given. It is expected the students to analyze, discuss and report the finding of the study at the end of the semester. He or she is required to share and communicate the result effectively through written and oral presentation.

ELECTIVE COURSES

METW 1223 – Accident Prevention through Design

The main goal of any HSE design of new process plant or modification of existing plant should be to apply the principles of inherent safety. The concept of inherent safety professes that a plant should be designed to be fundamentally safer rather than relying on external add-on control systems. Basically, this concept of inherent safety as well as its principles are introduced to the students in this course. Besides, the students will be exposed to the methods available for inherent safety assessment before they are taught on systematic approaches for inherently safer design. This course also covers inherent occupational health, a new concept which is originated from inherent safety. Students will be taught on how to assess the inherent occupational health performance of a plant using different methods at different stages of process design. Fugitive emissions will also be covered in detailed including the quantification of the amount released and the estimation of the associated health risk among the workers exposed. At the end of the course, students will be introduced to several simple techniques for multi-criteria decision making in designing a chemical plant which is both inherently safer and healthier.

METW 1233 – Crisis and Emergency Management

This course offers students the basics steps to recognise the common major hazard in the chemical process industry (CPI) and the ways to handle emergency situation at work. Unwanted event such as toxic release, chemical spills, fire, and explosion are frequently occur in the chemical process industry. The readiness and effectiveness of response during emergency depends on many factors such as knowledge, planning, system implemented, and training. In this cause, students will be exposed the current issue in the CPI and fundamental of emergency management which is covers identifying, preventing, controlling, and mitigating the emergency situations.

METW 1243 - Process Safety & Loss Prevention

This course is concerned with all aspects of Chemical Process Safety and Loss Prevention. The course emphasizes quantitative engineering analysis based upon the application of mass and energy balances, transport phenomena, process control and process design. The course emphasize on the appreciation for orders of magnitude estimation and relative significance. In

addition, concepts of management and individual responsibility are stressed, along with the ability to work as a team.

METW 1253 - Asset Integrity

This course provides the practices of asset integrity, legislation and management practices related to managing of asset and facility in the process industries. The course covers basics of process safety management, corrosion, risk assessment, maintenance programmed, Malaysia and international law, asset integrity management and its key asset integrity elements. Element of process safety management will be discussed based on PSM element by PSM USA and risk control system UK_HSE. Standard code of practices in the industries such as API, ASME, IEC will be discussed. In making discussion, the method such as cost and benefit, life cycle cost analysis will be explained. Emphasize is given in managing oil and gas, chemical and power plant's asset integrity. The course also to open discussion on exploring the business opportunity related with asset integrity management in Malaysia.

METW 1263 - Incident Investigation

This course presents the principles and methodology of incident investigation. In loss prevention, the strategy can be divided to proactive and reactive. Proactive strategy is about activity that provides feedback on safety performance within an organization before an accident, case of ill-health or an incident. Meanwhile, reactive monitoring measures accidents, cases of ill-health and incidents. The idea being to identify the causes of these failures and to take remedial action which will prevent them occurring again. Results of these activities will allow organization to measure its effectiveness as well as assisting them in charting future action plan for improvement. In Malaysia, accident investigation is a legal requirement under OSHA 1994.

METW 1273 - Human Factors

This course introduces a basic knowledge of human factors design principles and the nature of human interaction with their physical work environment. The content of this course includes cognitive engineering, ergonomics, socio-technical systems, and the nature of human performance in the workplace.

The background of the page is a vibrant blue sky filled with soft, white, fluffy clouds. The clouds are scattered across the top and bottom portions of the image, leaving a clear white space in the center where the text is located.

SCHOOL OF CIVIL ENGINEERING

DOCTOR OF PHILOSOPHY

PROGRAMME SPECIFICATIONS

The Doctor of Philosophy Field of Research: Civil Engineering (PKAW) is offered on a full-time basis. The duration of study is in between a minimum of three (3) years to a maximum of eight (8) year, with two compulsory courses need to be taken.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal, Doctoral thesis and viva (oral presentation).

1. Programme Name	Doctor of Philosophy Field Of Research: Civil Engineering
2. Final Award	Doctor of Philosophy Field Of Research: Civil Engineering
3. Awarding Institution	UTM
4. Teaching Institution	UTM
5. Programme Code	PKAW
6. Professional or Statutory Body of Accreditation	MQA
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Scheme (Full Time/Part Time)	Full Time
11. Study Duration	Minimum : 6 semesters Maximum : 16 semesters
12. Entry Requirement	<ul style="list-style-type: none">▪ Master Degree with cumulative grade average of 3.00, or equivalent from a recognized university▪ An international student should satisfy the English language minimum requirement of TOEFL score of 550 or IELTS band 6.0, or equivalent. A local student must produce a satisfactory score from MUET.▪ Accepted by the post-graduate selection committee of the faculty involved.▪ At least one member from the faculty who has at least a Master degree in the field of study is qualified and willing to supervise the candidate.▪ Pass the health, financial and other requirements as specified by the university.

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 6 semesters)	0	
iv	Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to in-depth knowledge in bioprocess engineering related areas.
PEO2	Graduates are able to formulate, solve and conduct problems through effective and critical thinking skills.
PEO3	Graduates are able to organize relevant knowledge and expertise through effective oral and written communications.
PEO4	Graduates are able to develop relevant knowledge, promote professional and ethical responsibilities including contemporary issues and environmental awareness.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Incorporate continuing and advanced knowledge in bioprocess engineering related areas.
PLO2	Formulate hypothesis, design and reorganize experiments/research scientifically to solve and evaluate observed phenomena.
PLO3	Analyze and evaluate critically problems in related areas through effective thinking skills, particularly in situations with limited information and to provide solutions through the application of appropriate tools and techniques.
PLO4	Display ideas and technical findings in both written and oral forms effectively.
PLO5	Plan and perform research undertakings professionally, ethically and responsibly.
PLO6	Perform lifelong learning for the needs of continuing professional development.

CURRICULUM STRUCTURE

University's General Elective Courses	
UXX XXX3	University's General Elective Course
UAPA 0010 (HW)	Research Methodology
Doctoral Dissertation	
PKAW1100	Sem 1 Year 1
PKAW1200	Sem 2 Year 1
PKAW2100	Sem 1 Year 2
PKAW2200	Sem 2 Year 2
PKAW3100	Sem 1 Year 3
PKAW3200	Sem 2 Year 3
PKAW4100	Sem 1 Year 4
PKAW4200	Sem 2 Year 4
PKAW5100	Sem 1 Year 5
PKAW5200	Sem 2 Year 5
PKAW6100	Sem 1 Year 6
PKAW6200	Sem 2 Year 6
PKAW7100	Sem 1 Year 7
PKAW7200	Sem 2 Year 7
PKAW8100	Sem 1 Year 8
PKAW8200	Sem 2 Year 8
Assessments	
First Stage Proposal Evaluation	2 nd Semester
Progress Presentation	4 rd Semester
Continuous Assessments	
Progress Report	Every Semester
Final Assessments	
VIVA (Oral Examination) – End of Study Period	End Semester
Publication Requirement for Thesis Submission	
A doctoral candidate may submit his/her thesis for viva-voce provided that he/she produced at least one (1) indexed journal article or (2) indexed conference proceedings accepted or published in SCOPUS/ERA or WOS.	
Duration of Study	
Full Time	: 6 - 16 semester

MASTER OF PHILOSOPHY

PROGRAMME SPECIFICATIONS

The Master of Philosophy consist of twelve (12) programme of different field of researches. It is offered on a full-time basis. The duration of study is in between a minimum of one (1) year to a maximum of four (4) years.

The assessment of the research program is based on the progress report, supervisor's evaluation, research proposal, master thesis and viva.

1. Programme Name	Master of Philosophy
2. Final Award	i. Master of Philosophy Field of Research: Transportation ii. Master of Philosophy Field of Research: Coastal and Maritime iii. Master of Philosophy Field of Research: Materials iv. Master of Philosophy Field of Research: Construction v. Master of Philosophy Field of Research: Highway and Traffics vi. Master of Philosophy Field of Research: Structures and Materials vii. Master of Philosophy Field of Research: Hydraulics viii. Master of Philosophy Field of Research: Environmental ix. Master of Philosophy Field of Research: Geotechnics x. Master of Philosophy Field of Research: Structures xi. Master of Philosophy Field of Research: Hydrology and Water Resources xii. Master of Philosophy Field of Research: Hydraulics and Hydrology
3. Awarding Institution	UTM
4. Teaching Institution	UTM
5. Programme Code	MKAB, MKAE, MKAG, MKAJ, MKAL, MKAN, MKAT, MKAU, MKAV, MKAW, MKAQ, MKAM
6. Professional or Statutory Body of Accreditation	MQA
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Scheme (Full Time/Part Time)	Full Time

11. Study Duration	Minimum : 3 semesters Maximum : 8 semesters
12. Entry Requirement	<ul style="list-style-type: none"> ▪ A Bachelor's Degree with good honours from Universiti Teknologi Malaysia or any other institution of higher learning recognised by the Senate; or ▪ A qualification equivalent to a Bachelor's Degree and experience in the relevant field recognised by the Senate ▪ An international student should satisfy the English language minimum requirement of TOEFL score of 550 or IELTS band 6.0, or equivalent. A local student must produce a satisfactory score from MUET. ▪ Accepted by the post-graduate selection committee of the faculty involved. ▪ At least one member from the faculty who has at least a Master degree in the field of study is qualified and willing to supervise the candidate. ▪ Pass the health, financial and other requirements as specified by the university.

Course Classification

No	Classification	Credit Hours	Percentage
i.	University Elective (1 course)	3	
ii.	Research Methodology	HW	
iii.	Research (Minimum 3 semesters)	0	
iv	Master Thesis	0	
	Total	3	

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of competencies and integration of knowledge required in the profession.
PEO2	An appreciation of the value of lifelong learning and possessing enthusiasm and strong commitment to continued acquisition of new knowledge and skills.
PEO3	Advanced research skills that allow professionals to become competent in research.
PEO4	Highly developed oral and written communications skills that fit at all level, appropriate to the field of profession.
PEO5	An appreciation of the ethics and integrity in management, leadership and good governance, and responsibility to their professions and community

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduate are able to incorporate in-depth relevant knowledge in professional practices for the benefits of both national and international communities. Graduates are able to apply their knowledge and skills in the planning, analysis, design and supervision of works related to the civil engineering discipline.
PLO2	Graduate are able to formulate hypothesis, design and perform experiments/research scientifically to solve and explain observed phenomena.
PLO3	Graduate are able to manage conducive working environment qualities problem solving and higher order thinking skills. Graduate are technically competent in solving problems logically, analytically and creatively based on sound facts and ideas.
PLO4	Graduate are able to balance professional and ethical responsibilities including contemporary issues and environmental awareness
PLO5	Graduate are able to apply a wide range of relevant knowledge through effective oral and written communications. Graduates are able to communicate effectively across a range of contexts and audiences.
PLO6	Graduates are able to adopt the latest relevant knowledge and cutting-edge technologies through life-long learning process.

CURRICULUM STRUCTURE

Name of the Program		: Master of Philosophy
Name of the Degree (Field of Research)	:	Master of Philosophy - Transportation - Coastal and Maritime - Materials - Construction - Highway and Traffic - Structure & Materials - Hydraulics - Environment - Geotechnics - Structures
University's General Elective Courses(Total : 3 credits)		
UXX XXX3		3 credits
UAPA 0010	Research Methodology	0 credits
Registration of Research Code		
Sem 1 Year 1		MKAW1100
Sem 2 Year 1		MKAW1200
Sem 1 Year 2		MKAW2100
Sem 2 Year 2		MKAW2200
Sem 1 Year 3		MKAW3100
Sem 2 Year 3		MKAW3200
Sem 1 Year 4		MKAW4100
Sem 2 Year 4		MKAW4200
Students Presentation		
First Stage		2 nd Semester
Evaluation		
Progress Report		Every Semester
Duration of Study		
Full Time	:	3 - 8 semester

ENGINEERING DOCTORATE SPECIALIZATION: CONSTRUCTION TECHNOLOGY AND MANAGEMENT

PROGRAMME SPECIFICATIONS

This programme is offered as a mixed mode programme, on full-time basis. Students must attain a total of no less than 18 credit hours of taught courses with a minimum CPA of 3.0, and pass the Engineering Doctorate's dissertation and viva (oral presentation).

1. Programme Name	Engineering Doctorate Specialization: Construction Technology and Management	
2. Final Award	Engineering Doctorate Specialization: Construction Technology and Management	
3. Awarding Institution	UTM	
4. Teaching Institution	UTM	
5. Programme Code	EKAA	
6. Professional or Statutory Body of Accreditation	MQA	
7. Language(s) of Instruction	English	
8. Mode of Study (Conventional, distance learning, etc)	Conventional	
9. Mode of operation (Franchise, self-govern, etc)	Self-governing	
10. Study Duration (Full Time/Part Time)	Full Time	
11. Study Duration (semester)	Full time	Part time
Minimum	6	-
Maximum	16	-
12. Entry Requirement	<ul style="list-style-type: none"> ▪ Master Degree with cumulative grade average of 3.00, or equivalent from a recognized university with more than 1 year experience (Candidate must register 18 credits of courses based on Master of Science (Construction Management) curriculum) ▪ An international student should satisfy the English language minimum requirement of TOEFL score of 550 or IELTS band 6.0, or equivalent. A local student must produce a satisfactory score from MUET. ▪ Accepted by the post-graduate selection committee of the faculty involved. ▪ Pass the health, financial and other requirements as specified by the university. 	

Course Classification

No	Classification	Credit Hours	Percentage
i.	University	3	3.3%
ii.	Programme Core	6	6.7%
iii.	Programme Electives	9	10%
iv	Dissertation	72	80%
	Total	90	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of competencies and integration of knowledge required in the profession.
PEO2	An appreciation of the value of lifelong learning and possessing enthusiasm and strong commitment to continued acquisition of new knowledge and skills.
PEO3	Advanced research skills that allow professionals to become competent in research.
PEO4	Highly developed oral and written communications skills that fit at all level, appropriate to the field of profession.
PEO5	An appreciation of the ethics and integrity in management, leadership and good governance, and responsibility to their professions and community

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduate are able to incorporate in-depth relevant knowledge in professional practices for the benefits of both national and international communities. Graduates are able to apply their knowledge and skills in the planning, analysis, design and supervision of works related to the civil engineering discipline.
PLO2	Graduate are able to formulate hypothesis, design and perform experiments/research scientifically to solve and explain observed phenomena.
PLO3	Graduate are able to manage conducive working environment qualities problem solving and higher order thinking skills. Graduate are technically competent in solving problems logically, analytically and creatively based on sound facts and ideas.
PLO4	Graduate are able to balance professional and ethical responsibilities including contemporary issues and environmental awareness
PLO5	Graduate are able to apply a wide range of relevant knowledge through effective oral and written communications. Graduates are able to communicate effectively across a range of contexts and audiences.
PLO6	Graduates are able to adopt the latest relevant knowledge and cutting-edge technologies through life-long learning process.

CURRICULUM STRUCTURE

University's General Elective Courses(Total : 3 credits)		
UABA 0013	Principle of Engineering Management	3 credits
Core Courses (Total : 6 credits)		
EKAB 2163	Quantitative Analysis	3 credits
EKAB 2153	Research Methodology	3 credits
Elective Courses – Choose any three from the following list (Total : 9 credits)		
EKAB 2033	Construction Technology	3 credits
EKAB 2073	Project Estimating	3 credits
EKAB 2083	Construction Management Information Sys.	3 credits
EKAB 2123	Construction Plants Management	3 credits
EKAB 2153	Advance Concrete Technology	3 credits
EKAB 2013	Construction Project Management	3 credits
EKAB 2023	Construction Site Management and Safety Control	3 credits
EKAB 2043	Construction Law and Contract	3 credits
EKAB 2053	Project Planning and Scheduling	3 credits
EKAB 2103	Financial Management	3 credits
EKAB 2133	Sustainability & Environmental Management in Construction	3 credits
Dissertation (Total : 72 credits)		
EKAW XX80	Dissertation	72 credits
TOTAL CREDITS		90 credits
Duration of Study		
Full Time	:	6 – 16 semester

MASTER OF ENGINEERING (CIVIL)

PROGRAMME SPECIFICATIONS

The Programme is offered on full-time mode and is based on a 3-Semester Academic Session with several courses being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester, as well as Master Project. To graduate, students should attain a total of no less than 46 credit hours with minimum CPA of 3.0.

1. Programme Name	Master of Engineering (Civil)
2. Final Award	Master of Engineering (Civil)
3. Awarding Institution	UTM
4. Teaching Institution	UTM
5. Programme Code	MKAA
6. Professional or Statutory Body of Accreditation	MQA
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Duration (Full Time/ Part Time)	Full Time
11. Study Duration (semester)	Full Time
Minimum	3
Maximum	8

Course Classification

No	Classification	Credit Hours	Percentage
i.	University	6	13%
ii.	Programme Core	28	61%
iii.	Programme Electives	6	13%
iv	Free Electives	6	13%
	Total	46	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of competencies and integration of knowledge required in the profession.
PEO2	An appreciation of the value of lifelong learning and possessing enthusiasm and strong commitment to continued acquisition of new knowledge and skills.
PEO3	Advanced research skills that allow professionals to become competent in research.
PEO4	Highly developed oral and written communications skills that fit at all level, appropriate to the field of profession.
PEO5	An appreciation of the ethics and integrity in management, leadership and good governance, and responsibility to their professions and community

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduate are able to incorporate in-depth relevant knowledge in professional practices for the benefits of both national and international communities. Graduates are able to apply their knowledge and skills in the planning, analysis, design and supervision of works related to the civil engineering discipline.
PLO2	Graduate are able to formulate hypothesis, design and perform experiments/research scientifically to solve and explain observed phenomena.
PLO3	Graduate are able to manage conducive working environment qualities problem solving and higher order thinking skills. Graduate are technically competent in solving problems logically, analytically and creatively based on sound facts and ideas.
PLO4	Graduate are able to balance professional and ethical responsibilities including contemporary issues and environmental awareness
PLO5	Graduate are able to apply a wide range of relevant knowledge through effective oral and written communications. Graduates are able to communicate effectively across a range of contexts and audiences.
PLO6	Graduates are able to adopt the latest relevant knowledge and cutting-edge technologies through life-long learning process.

CURRICULUM STRUCTURE

University's General Elective Courses (Total : 6 credits)		
UAPA 0013	Research Methodology	3 credits
UABA 0013	Principle Engineering Management	3 credits
Core Courses (Total : 18 credits)		
MKAE 1013	Advanced Structural Analysis	3 credits
MKAE 1083	Advanced Design of Reinforced Concrete	3 credits
MKAM 1013	Construction Project Management	3 credits
MKAG 1113	Advances Hydraulics	3 credits
MKAJ 1033	Advanced Foundation Engineering	3 credits
MKAK 1003	Environmental Management & Sustainability	3 credits
Elective Courses – Choose any two from the following list (Total: 6 credits)		
Choose any two (2) courses offered by Programmes as below which is not a core subjects in this program: Master of Engineering Program (Structure) MKAE Master of Engineering Program (Hydraulic & Hydrology) MKAG Master of Engineering Program (Geotechnics) MKAJ Master Engineering Program (Environmental) MKAK Master Engineering Program (Construction Management) MKAM Master Engineering Program (Transportation) MKAQ		6 credits
Free Elective Courses (Total : 6 credits)		
Choose any two subjects offered by other programmes, faculties or from the above elective subjects.		6 credits
Masters Project (Total : 10 credits)		
MKAA 1514	Masters Project 1	4 credits
MKAA 1526	Masters Project 2	6 credits
TOTAL CREDITS		46 credits
Duration of Study		
Full Time	:	3 – 8 semester

COURSE SYNOPSIS

CORE COURSES

MKAE 1013 - Advanced Structural Analysis

This is a core course in the Structural Engineering Program that exposes the students to matrix methods for advanced structural analysis and solving many structural problems. The types of structures involved are beams, trusses and frames. Three dimensional structures are also included. This course also includes the application of matrix method for nonlinear geometric or second order elastic analysis and critical load prediction of structures. The applications of matrix methods for nonlinear material analysis of frame structures are also included in this course.

MKAM 1013 - Construction Project Management

This course review contemporary issues in construction project management process. At outset it appraises issues related to construction industry background and industry practices as well as the past, present and future performance measurement. The practice of using traditional construction work process is will be evaluated in comprehensive manner and problems associated with such practice will be identified. Various contemporary management philosophies and tools from other industry will be reviewed with regard to their potential application and benefits to the construction industry. New concept of working by using the concept collaborative working environment supported by ICT tools will be analysed as a strategy to reengineer the construction industry.

MKAE 1083 - Advanced Reinforced Concrete Design

This course is intended to provide extra knowledge on the aspect of design of reinforced concrete structural elements. As a continuation to the Reinforced Concrete Design 1 and 2, the topics discussed are analysis and design of ribbed, waffle and flat slabs, water retaining structures, shear walls, corbel and nibs. Furthermore, students will be exposed to the methods of deflection calculation, design of elements for torsion and design of raft foundations.

MKAG 1113 - Advanced Hydraulics

This course is designed to introduce advanced concepts of fluid mechanics in relation to viscous flows. It covers laminar flows, transition to turbulence and turbulent flows and will be taught with civil engineering applications in mind. The students should understand the topics of open channel flow, friction and sediment transport from the fundamental point of view. In this course, unsteady flow in open channels and pipes - topics of specific interest to civil engineers – will also be covered.

MKAJ 1033 - Advanced Foundation Engineering

This subject is one of the core subjects offered by the Department of Geotechnics and Transportation, which will highlight the application of soil mechanics to foundation design in practice. Lectures will be emphasized on foundation design in Civil Engineering projects. Foundation design must be based on parameters evaluated from Site Investigation programme and make use of the soil parameters which requires the knowledge of geology and soil mechanics principles. Various types of foundation and their criteria for selection will be presented which is interpreted from site investigation related for shallow foundation, pile,

raft foundation, drilled shaft, cofferdam and underpinning. Group piles, laterally loaded and uplift piles will be covered in the course. Settlement and bearing capacity considerations will be employed to select and design the appropriate foundation scheme for structures. At the end of the course the student will be able to understand and apply the principles of foundation design in terms of technical feasibility, economic viability, articulate and justify technical analyses through oral, written and graphical means. The student will also be able to appreciate the constantly evolving nature of civil engineering design and practice.

MKAK 1003 - Environmental Management and Sustainability

This course is designed to expose students to various aspects in environmental management and the concept of sustainability. Topics discussed include the principles of sustainable development, understanding the environmental sensitive areas particularly the natural water bodies, catchment management, development of coastal and inland areas. Current issues related to environmental problems especially on climate change and water supply are the main aspects to be addressed. Some methods and concepts of sustainable approaches are introduced in order to promote and achieve sustainable development goals. At the end of the course, the students should be able to understand the concept of environmental sustainability. The course enables the students to understand, plan and incorporate the concept of sustainability in environmental management.

ELECTIVE COURSES

Choose any two subjects offered by other programmes, faculties or from the above elective subjects.

MASTER OF ENGINEERING (STRUCTURE)

PROGRAMME SPECIFICATIONS

The Programme is offered on full-time mode and is based on a 3-Semester Academic Session with several courses being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester, as well as Master Project. To graduate, students should attain a total of no less than 46 credit hours with minimum CPA of 3.0.

1. Programme Name	Master of Engineering (Structure)
2. Final Award	Master of Engineering (Structure)
3. Awarding Institution	UTM
4. Teaching Institution	UTM
5. Programme Code	MKAE
6. Professional or Statutory Body of Accreditation	MQA
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Duration (per semester)	14 weeks
11. Study Duration (semester)	Full time
Minimum	3
Maximum	8

Course Classification

No	Classification	Credit Hours	Percentage
i.	University	6	13%
ii.	Programme Core	28	61%
iii.	Programme Electives	6	13%
iv	Free Electives	6	13%
	Total	46	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of competencies and integration of knowledge required in the profession.
PEO2	An appreciation of the value of lifelong learning and possessing enthusiasm and strong commitment to continued acquisition of new knowledge and skills.
PEO3	Advanced research skills that allow professionals to become competent in research.
PEO4	Highly developed oral and written communications skills that fit at all level, appropriate to the field of profession.
PEO5	An appreciation of the ethics and integrity in management, leadership and good governance, and responsibility to their professions and community

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduate are able to incorporate in-depth relevant knowledge in professional practices for the benefits of both national and international communities. Graduates are able to apply their knowledge and skills in the planning, analysis, design and supervision of works related to the civil engineering discipline.
PLO2	Graduate are able to formulate hypothesis, design and perform experiments/research scientifically to solve and explain observed phenomena.
PLO3	Graduate are able to manage conducive working environment qualities problem solving and higher order thinking skills. Graduate are technically competent in solving problems logically, analytically and creatively based on sound facts and ideas.
PLO4	Graduate are able to balance professional and ethical responsibilities including contemporary issues and environmental awareness
PLO5	Graduate are able to apply a wide range of relevant knowledge through effective oral and written communications. Graduates are able to communicate effectively across a range of contexts and audiences.
PLO6	Graduates are able to adopt the latest relevant knowledge and cutting-edge technologies through life-long learning process.

CURRICULUM STRUCTURE

University's General Elective Courses(Total : 6 credits)		
UABA0013	Principal Engineering Management	3 credits
UAPA 0013	Research Methodology	3 credits
CORE SUBJECTS (24 CREDITS)- CHOOSE 8 SUBJECTS FROM THE LIST OFFERED IN THE MKAE PROGRAM. AT LEAST 2 SUBJECTS MUST BE CHOSEN FROM EACH OF GROUP A, B AND C		
CORE & ELECTIVE ENGINEERING SUBJECTS OFFERED (GROUP A-CHOOSE 2 SUBJECTS)		
MKAE1013	Advanced Structural Analysis	3 credits
MKAE1143	Finite Element Method	3 credits
MKAE1163	Theory of Plate and Shell	3 credits
MKAE1173	Structural Dynamics	3 credits
MKAE1133	Advanced Mechanics of Materials	3 credits
MKAE1203	Structural Reliability	3 credits
CORE & ELECTIVE ENGINEERING SUBJECTS OFFERED (GROUP B-CHOOSE 2 SUBJECTS)		
MKAE1073	Advanced Design of Steel Structures	3 credits
MKAE1083	Advanced Design of Reinforced Concrete	3 credits
MKAE1183	Design of Pre stressed Concrete	3 credits
MKAE1193	Design of Precast Concrete	3 credits
CORE & ELECTIVE ENGINEERING SUBJECTS OFFERED (GROUP C-CHOOSE 2 SUBJECTS)		
MKAE1043	Advanced Construction Materials	3 credits
MKAE1153	Concrete Technology	3 credits
MKAE1033	Structural Assessment & Repairs	3 credits
MKAE1053	Bridge Engineering	3 credits
MKAE1093	Offshore Structures	3 credits
MKAE1023	Analysis and Design of Structural System	3 credits
MKAE1063	Tall Building System: Analysis and Design	3 credits
MKAE1113	Earthquake & Wind Engineering	3 credits
MKAE1123	Maintenance of Seismic Structures and Materials	3 credits
MKAE1213	Structural Fire Engineering	3 credits
Free Elective Courses (Total : 6 credits)		
Choose any two subjects offered by other programmes, faculties or from the above elective subjects		6 credits
Masters Project (Total : 10 credits)		
MKAE1514	Masters Project 1	4 credits
MKAE1526	Masters Project 2	6 credits
TOTAL CREDITS		46 credits
Duration of Study		
Full Time	:	3 – 8 semester

COURSE SYNOPSIS

MKAE 1013 - Advanced Structural Analysis

This is a core course in the Structural Engineering Program that exposes the students to matrix methods for advanced structural analysis and solving many structural problems. The types of structures involved are beams, trusses and frames. Three dimensional structures are also included. This course also includes the application of matrix method for nonlinear geometric or second order elastic analysis and critical load prediction of structures. The applications of matrix methods for nonlinear material analysis of frame structures are also included in this course.

MKAE 1143 - Finite Element Method

This is an elective subject for Masters programme delivered by coursework. This course is developed to expose students to the fundamental theory and application of the finite element method. The course covers linear analyses for displacements and stresses in continuum structures. Formulation of stiffness matrices for one-dimensional elements, beams, plane stress and plane strain are presented in detail. Application towards more complex engineering problems including truss and frame systems is discussed. Isoparametric formulation is emphasized. Use of mathematical / finite element software for modelling and analysis is also emphasized. At the end of the course, students should be able to formulate finite element problems and to solve them by hand calculation for simple engineering problems, and should also be able to develop finite element model, investigate and interpret results accordingly for more complicated problems. Students should also be able to analyse and discuss practical problems through project to demonstrate their understanding about the course materials.

MKAE 1163 - Theory of Plate and Shell

This course exposes the students to the analyses of plate-bending structures and shell structures. Two approaches in the theory of plates will be discussed - classical methods and finite difference method. Only elastic property of plate's material is considered. The theory is applied to analyse various shape plate structure such as rectangular and circular plates. In the theory of shells, students will learn about the membrane theory of spherical and cylindrical shells and the bending theory of cylindrical shells. In each topic, students will be given a number of work examples where the above theories can be applied.

MKAE 1173 - Structural Dynamics

The topic in structural dynamics course covers introduction, natural frequency, single degree of freedom, multi-degree of freedom system, Eigenvalues and Eigenvectors, free vibration response as well as time and frequency domain. Students will further, be exposed to experiment under the free vibration topic. At the end of the course the students should be able to solve numerous problems which involves dynamics. The students will also be able to develop and master the skills of reducing problems from its physical description to a model or symbolic representation to which the principles may be applied.

MKAE 1133 - Advanced Mechanics of Materials

This course concerns with the tensorial approach for solid mechanics, which is more general as compared to the strength of material approach previously discussed at the undergraduate level. This course is designed to discuss the theories of elasticity and to provide the mathematical background for finite element applications. The course begins with the discussion of the basic concepts in elasticity covering tensors notations, analysis of stress and strain, as well as the constitutive equations. At the end of the course, students should be able to understand multidimensional states and analyses through the ability to utilize the compact notations of tensors.

MKAE 1203 - Structural Reliability

This course aims to give students a comprehensive exposure to structural safety, risk assessment and reliability engineering concept related to civil engineering system. The course contents consist of four different module named Systems Reliability, Safety & Risk, Data Analysis & Simulation and Risk Assessment & Safety Management. Safety & Risk leads to an understanding of the principles of structural reliability theory and its application to risk and reliability engineering. Data Analysis & Simulation is designed to develop knowledge of statistical data analysis and its application in engineering and science and introduces the concepts of using simulation techniques for analysis of complex systems. It also teaches linear optimization techniques and the ability to apply them to solve simple problems. In Systems Reliability, this section gives an understanding of the qualitative and quantitative techniques that are used in the reliability, availability and maintainability analysis of all types of engineering systems. The final part of this course, Risk Assessment & Safety Management gives student an appreciation of risk from individual and societal perspectives as well as understanding the basic principles of risk assessment and modelling and how safety management works in practice.

MKAE 1073 - Advanced Design of Steel Structures

This course intends to give an extensive understanding to the students in the advanced design of steel structures which are the multi-storey steel frames, composite beams, plate girder, and portal frame. Eurocodes (EN 1993 and EN 1994) will be employed as the standards for design. The design of multi-storey steel frames covers mainly the design aspects of braced and unbraced frames. In the design of unbraced frames, a special method called a Wind-Moment method is introduced. For braced frames, three aspects of design namely simple, semi-continuous, and continuous construction are discussed and compared to give a better picture on the economic aspects of the design. Details of the design of the frames include the analysis and design of the frames for columns, beams, connections, bracing system, column and beam splices. The course also covers the design of composite beams by using linear and stress block interaction method which include the interaction of shear stud as full strength and partial strength. The design of plate girder is also included to cater for heavy load transferred to a long span or “column free” construction of multi-storey steel frames and bridges. Lastly, the design of portal frame is covered with the focus on single span symmetrical frame.

MKAE 1083 - Advanced Reinforced Concrete Design

This course is intended to provide extra knowledge on the aspect of design of reinforced concrete structural elements. As a continuation to the Reinforced Concrete Design 1 and 2, the topics discussed are analysis and design of ribbed, waffle and flat slabs, water retaining structures, shear walls, corbel and nibs. Furthermore, students will be exposed to the methods of deflection calculation, design of elements for torsion and design of raft foundations.

MKAE 1183 - Design of Pre stressed Concrete

This is an elective subject, which will provide students an understanding and ability to analyse and design prestressed concrete structural elements. Topics discussed include the concept and principles of prestressed, methods of prestressing, stress limits, losses of prestress, selection of section, serviceability and strength requirements. Students will also be exposed to the complete analysis and design procedure of simply supported prestressed concrete non-composite and composite beams, and design principles of continuous beams.

MKAE 1193 - Design Precast Concrete

The use of precast concrete multi-storey framed buildings is now widely regarded as an economic, structurally sound and architecturally versatile form of construction. It combines the benefits of very rapid construction and high quality materials with the advantages of production line economy and quality assurance. This subject deals with the design of precast concrete structures. The topics cover the general concepts of precast construction and architectural requirements, analysis and design of slabs, beams, columns, corbels and connections.

After going through the course, the students are able to:

- identify the structural system of precast concrete structures
- understand the design concept of precast concrete structures
- design precast concrete components such as slabs, beams, columns and connections
- analyse precast concrete frame structure

MKAE 1043 - Advanced Construction Materials

This course is designed for students to acquire or gain knowledge on advanced construction materials in civil engineering. It will emphasize on the use of advanced and new materials in concrete, masonry, highway, and geotechnic. The topics covered include the types of concrete in construction, concrete mix proportions or design, the use of waste materials and industrial by-products in concrete, natural fibres and polymer in concrete, production of high performance and durable concrete; development of modern masonry units in construction, properties and strength of masonry work; design and construction of flexible and rigid pavement, bituminous surfacing; and geosynthetics materials. At the end of the course students should be able to describe, identify, and discuss the properties and behaviour of different types of civil engineering materials together with the selection and applications of the materials for any particular use in practice.

MKAE 1153 - Concrete Technology

This course is designed for students to gain knowledge on advanced concrete technology in Civil Engineering. It will emphasize of materials properties and various mix proportions of concrete, different types of supplementary cementing materials, special concretes including high performance concrete, high strength concrete, lightweight concrete, flowable concrete, self-consolidating concrete, and polymer concrete, concrete deformations, durability aspects of concrete, causes of concrete deterioration and repair techniques, and developments in current concrete technology. At the end of the course students should be able to describe, identify, and discuss the properties and behaviour of different types of concrete materials together with the selection and applications of the materials in practice. In addition, students should also understand the current trend in concrete technology.

MKAE 1033 - Structural Assessment & Repairs

This is a core subject that provides an understanding and ability to visualize and analyze the causes of distress in structures, to confirm the causes of distress and able to suggest most suitable repair methods. Among the topics discussed are types and causes of distress in structures, corrosion - mechanism, assessment and repair, methods of testing of structures, semi-destructive and non destructive testing, strength assessment technique, durability assessment techniques, integrity assessment techniques, static and dynamic load testing instrumentation and procedures, repair strategy and techniques, repair material selection, strengthening techniques, post repair assessment, structural health monitoring, risk based inspection (RBI), structural reliability theory, risk analysis, monte carlo simulation modelling, probabilistic evaluation of existing structure, case studies. An introduction to forensic engineering and related case studies are also discussed.

MKAE 1053 - Bridge Engineering

This is an elective course intended to give the basic knowledge in bridge engineering. The course covers topics on basic bridge conception, structural system, bridge loading, deck analysis, selection and design of bridge substructure and superstructure, bridge management and maintenance and rehabilitation. The main part of the course focuses on the modelling, analysis and design of various types of concrete bridges. Application of design loads and load combinations based on EN 1991-2 is delivered in the grillage analysis using finite element software.

MKAE 1093 - Offshore Structures

This course emphasizes on the important principles of analysis, design and construction practices of marine structural engineering related to oil and gas industry. Marine structures include oil and gas production platform and pipeline system. The course covers vast amount of structural and material engineering topics such as Front-End Engineering Design (FEED), Environmental Loads, Response of Structures to Environmental Loading, Analysis and Design of Oil and Gas Production Platforms, Analysis and Design of Offshore Topside Modules, Components of Oil Rig Platform, Construction of Steel Platforms, Load-out and Installation Procedure, Hook-up and Commissioning of Offshore Structures, Inspection and Repair, Structural Assessment of Existing Structures, Removal of Disused Structures and Pipeline Engineering Introduction to Reliability Engineering to expose student to fundamental concept of structure reliability, risk and structure maintainability.

MKAE 1023 - Analysis and Design of Structural System

This is an elective subject for Masters programme delivered by coursework. The course exposes students to the analysis and design of structural systems of multi-storey steel, precast concrete, masonry and reinforced concrete buildings. The first part of the course covers topics on the various types of structural systems in multi-storey steel and precast concrete buildings such as cantilever column, unbraced frames and braced frames. The course also covers advanced topics on the effects of semi-rigid connections and bracing members to the behavior of frames and design of structural systems. In addition, design for stability of global frames is also covered. The second part of the course covers topics on the analysis and design of load bearing wall systems in masonry buildings. Then the third part covers topics on analysis and design of reinforced concrete shear walls for lateral stability; and design of structural ties for structural integrity and robustness for reinforced concrete buildings.

MKAE 1063 - Tall Building System: Analysis and Design

The elective course emphasized on the analysis and design of tall building structural system. The course covers an introduction to tall building structures and related issue in analysis and design. The student will be guided through the Eurocode 1, 2, 3, 4, 7 and 8 basic requirements of analysis and design of tall buildings. The analysis and design of tall building structural elements such as frame, shear wall and core wall structures will first be explained before the students are guided through the analysis and design of various tall building shapes at. Finally, the detailing of shear and core walls will be explained in detail.

MKAE 1113 - Earthquake & Wind Engineering

This is an optional course. In the early stage, introduction to structural design and dynamic effect from wind and earthquake is revealed. Steps and method of structural design for wind load will be discussed. Then, engineering aspect in seismology will be discussed. Other than that, seismic reaction on structure, general consideration on earthquake resistant design and seismic behaviour of structural system will be taught. Lastly, some issues on special topics in Earthquake Engineering will be discussed.

MKAE 1123 - Maintenance of Seismic Structures and Materials

This is an optional subject. This subject gives an introduction on seismic maintenance and concepts related to it. Dynamic analysis with computer software will also be introduced. Topics related to this subject include seismic induced damages, evaluation procedure for seismic, seismic retrofit strategies, and computer simulation for seismic retrofit method. Investigation output from forensic study following the 2015 Sabah Earthquake will be included. Real project on seismic retrofit will also be included. In this subject, students are going to conduct seismic vulnerability assessment on existing buildings on a chosen location in Malaysia together with seismic retrofit project using Etabs Software.

MKAE 1213 - Structural Fire Engineering

This course emphasizes on specific fire behavior in buildings and introduces simple methods of quantifying the threat it poses to structures. This will involve the fire behavior, fire safety, fire hazard, management fire in building and estimating the temperatures in building compartments and the temperatures that individual structural members get exposed to as a function of time. Fundamentals of the behaviour of common construction materials and estimation of the variation of mechanical properties of construction materials affected by fire

(i.e. temperature rise). Structural analysis principles are then applied to the fire problem. Simple methods to carry out calculations to determine structural behaviour in the event of a fire will be presented followed by an introduction to advanced analytical and computational tools for analysing structural behaviour in fire. Introduction to current (code based) design procedures and performance based design and assessment and repair of fire-damaged structures will be provided

MASTER OF ENGINEERING (HYDRAULIC AND HYDROLOGY)

PROGRAMME SPECIFICATIONS

The Programme is offered on full-time mode and is based on a 3-Semester Academic Session with several courses being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester, as well as Master Project. To graduate, students should attain a total of no less than 46 credit hours with minimum CPA of 3.0.

1. Programme Name	Master of Engineering (Hydraulic and Hydrology)
2. Final Award	Master of Engineering (Hydraulic and Hydrology)
3. Awarding Institution	UTM
4. Teaching Institution	UTM
5. Programme Code	MKAG
6. Professional or Statutory Body of Accreditation	MQA
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Duration (per semester)	14 weeks
11. Study Duration (semester)	Full time
Minimum	3
Maximum	8

Course Classification

No	Classification	Credit Hours	Percentage
i.	University	6	13%
ii.	Programme Core	28	61%
iii.	Programme Electives	6	13%
iv	Free Electives	6	13%
	Total	46	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of competencies and integration of knowledge required in the profession.
PEO2	An appreciation of the value of lifelong learning and possessing enthusiasm and strong commitment to continued acquisition of new knowledge and skills.
PEO3	Advanced research skills that allow professionals to become competent in research.
PEO4	Highly developed oral and written communications skills that fit at all level, appropriate to the field of profession.
PEO5	An appreciation of the ethics and integrity in management, leadership and good governance, and responsibility to their professions and community

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduate are able to incorporate in-depth relevant knowledge in professional practices for the benefits of both national and international communities. Graduates are able to apply their knowledge and skills in the planning, analysis, design and supervision of works related to the civil engineering discipline.
PLO2	Graduate are able to formulate hypothesis, design and perform experiments/research scientifically to solve and explain observed phenomena.
PLO3	Graduate are able to manage conducive working environment qualities problem solving and higher order thinking skills. Graduate are technically competent in solving problems logically, analytically and creatively based on sound facts and ideas.
PLO4	Graduate are able to balance professional and ethical responsibilities including contemporary issues and environmental awareness
PLO5	Graduate are able to apply a wide range of relevant knowledge through effective oral and written communications. Graduates are able to communicate effectively across a range of contexts and audiences.
PLO6	Graduates are able to adopt the latest relevant knowledge and cutting-edge technologies through life-long learning process.

CURRICULUM STRUCTURE

University's General Elective Courses (Total : 5 credits)		
UABA 0013	University's General Elective Courses	3 credits
UAPA 0013	Research Methodology	3 credits
Core Courses (Total : 18 credits)		
MKAG 1113	Advanced Hydraulics	3 credits
MKAG 1123	Hydraulic Structures	3 credits
MKAG1133	Coastal Engineering	3 credits
MKAG1213	Advanced Hydrology	3 credits
MKAG1223	Water Resources Management	3 credits
MKAG1233	Urban Stormwater Management	3 credits
Elective Courses – Choose any two from the following list (Total : 6 credits)		
MKAG 1143	River and Estuarine Hydrodynamics and Transport Fluvial Hydraulics	3 credits
MKAG 1153	Computational Environmental Hydraulics	3 credits
MKAG 1163	Water Supply Engineering	3 credits
MKAG 1173	Coastal Structures	3 credits
MKAG 1183	Port and Harbour Engineering	3 credits
MKAG 1193	Ground Water Hydrology	3 credits
MKAG 1243	Ground Water Modelling	3 credits
MKAG 1253	Irrigation Engineering	3 credits
MKAG 1263	Statistical Hydrology	3 credits
MKAG 1273	Computational Fluid Mechanics	3 credits
MKAG 1313		3 credits
Free Elective Courses (Total : 6 credits)		
Choose any two subjects offered by other programmes, faculties or from the above elective subjects		6 credits
Masters Project (Total : 7 credits)		
MKAG 1514	Masters Project 1	3 credits
MKAG 1526	Masters Project 2	4 credits
TOTAL CREDITS		46 credits
Duration of Study		
Full Time	:	3 – 6 semester

COURSE SYNOPSIS

CORE COURSES

MKAG 1113 - Advanced Hydraulics

This course is designed to introduce advanced concepts of fluid mechanics in relation to viscous flows. It covers laminar flows, transition to turbulence and turbulent flows and will be taught with civil engineering applications in mind. The students should understand the topics of open channel flow, friction and sediment transport from the fundamental point of view. In this course, unsteady flow in open channels and pipes - topics of specific interest to civil engineers – will also be covered.

MKAG 1123 - Hydraulic Structure

This course covers common types of hydraulic structures that are designed to control, or transmit and to maintain water levels in stream or channels. These structures include dam, dam outlet works, spillways, energy dissipators, intake structures, river diversion works, weirs, barrages, hydropower and pumping stations. It is related to fluid mechanics and hydraulics and the understanding on subject matters will be further enhanced through refined information and procedures that are detailed out in relevant standard code of practice and design manual.

MKAG 1133 - Coastal Engineering

The course covers theoretical and fundamental principles of coastal hydrodynamics and processes. It gives background knowledge of the various hydrodynamic parameters acting in the coastal region due to waves, tides and currents. Sediment transport mechanism in the littoral zone leading to the understanding of coastal morphology, erosion and accretion processes are described. Underlying principles of coastal engineering works, coastal erosion management and implications from implementing coastal structures in the coastal environment are delivered. Emphasis in solving and tackling coastal engineering problems adopts the use of established analytical techniques. The application of state-of-the-art computational techniques as a tool in several aspects of coastal engineering and management works are introduced. At the end of the course, students should be able to describe and analyse the various coastal processes and the effect of these forces on the coastal zone. The students should be able to quantify coastal environmental parameters. They should also be capable of proposing methods to manage and control the coastal processes when applied to solve coastal engineering problems.

MKAG 1213 - Advanced Hydrology

The study in hydrological processes and systems, include the rainfall, evapotranspiration, infiltration, soil water processes and overland flow. Aspect of rainfall-runoff processes and hydrologic routing are discussed and how these are modelled for use in flood estimation. Various rainfall-runoff models are reviewed. The surface water quality aspect also covered.

MKAG 1223 - Water Resources Management

This course covers an integrated water resources perspective including social, economic, environmental and reservoir management and design. Knowledge and expertise will be developed in relevant topics which include: water resources issues, water resource development, water law, policy and institutions, water resource planning, reservoir yield and

operation, river basin management, water resources system analysis, risk and reliability analysis.

MKAG 1233 - Urban Stormwater Management

The subject mainly covers the theoretical aspects and design of urban storm water drainage system. This includes drainage planning process, non-structural planning, control option for flow reduction and pollution minimization. Importance and impacts of best management practices of urban storm water management are also covered throughout the topics. At the end of the course, the students are being exposed to design elements in urban drainage and flood control systems that comply with Malaysian design criteria. The students will also realize the importance of urban storm water management and be exposed to real projects examples.

ELECTIVE COURSES

MKAG 1143 - River and Estuarine Hydrodynamics and Transport

This course is designed to expose the students to surface water modelling including an overview of the present state-of-the-art of modelling and analysis of hydrodynamics, eutrophication, and toxic materials (organic chemicals and metals) and review of recent trends in river and estuarine. This course will cover the hydrodynamics consideration as well as sediment transport.

MKAG 1153 - Fluvial Hydraulics

This course is formulated largely to give an overall view of the mechanics of sediment transport in open channel, river and coastal areas. Local erosion, particularly around bridge piers, important from the point of view of structural integrity is treated. Also included in the course is some treatment of physical modelling. The various properties of cohesive and non-cohesive soils are considered in the course where sediment motion for cohesive soils is more complicated. An element of design is added to the course to apply the various principles studied to a typical engineering problem. Report writing is given importance. Fluvial Hydraulics is basically a course for engineers who want to come to terms with the field of sediment transport.

MKAG 1163 - Computational Environmental Hydraulics

This course covers the environmental aspects in the field of hydraulics. Environmental Hydraulics is the hydrodynamic aspects of water quality management in natural body of water. This course will consist of the examination of the physical, chemical and biological attributes of flowing water, with the objective of protecting and enhancing the quality of the environment. Environmental hydraulics include coastal ecosystem, river and flood management, dam break, chemical and oil spill migration, water quality and pollutant transport, sediment transport including shoreline erosion and dredged spoil disposal, aquaculture management and environmental information systems

MKAG 1173 – Water Supply Engineering

The course discusses broad range of topics that include water uses and demand, water demand forecasting, sources of water supply, water distribution and transmission systems, water treatment processes, water quality criteria and safe drinking water act, water tariff and non-revenue water (NRW)

MKAG 1183 – Coastal Structure

The course is designed to provide a detailed understanding of the design of the design process of coastal engineering structures such as breakwaters, revetments, groynes, etc as well as an introduction to soft engineering approaches including beach drainage systems and biotechnical methods. Statistical distribution and analysis of wave data will also be highlighted in order to derive the design wave parameters

MKAG 1193 - Port and Harbour Engineering

This course introduces students to the fundamentals and functional requirements of port planning and design, ranging from small craft harbours to large commercial ports. The course will focus on both hydrodynamic concerns and construction aspects such as breakwater design, berthing layout, land reclamation and dredging. Students are also introduced to the design procedures for a variety of structure types, including bulkheads and piers, fender and mooring systems, breakwaters and revetments. Special considerations of sedimentation in navigation channels and in turning basins are also discussed. Examples of case studies are presented and students will be required to apply the knowledge gained in the class to plan and design a 'hypothetical' port.

MKAG 1243 – Ground Water Hydrology

The course has been prepared for hydrologists and engineers interested in learning groundwater exploration, exploitation, quality control and management. The course gives emphasis on basic hydrogeology and nature of groundwater, groundwater occurrence, groundwater movement, groundwater investigation and development, well hydraulics, evaluation of groundwater resources, contamination of groundwater resources, mass transport and subsurface contaminants

MKAG 1253 – Ground Water Modelling

The course introduces the methods commonly used to model groundwater flow and solute transport in the subsurface of the Earth. The course is designed to focus on the applications of finite difference and finite element methods for hydrogeological modeling. The course covers analytical and numerical procedures, one- and two-dimensional steady state and transient flow modeling, solute transport modeling, and multi-phase solute transport modeling.

MKAG 1263 – Irrigation Engineering

Presents the relevant topics on irrigation engineering that covers the soil-water relationship, factors influencing crop production. Economic analysis, crop water requirements, irrigation scheduling, planning and design procedure for surface and pressurized irrigation system, canal design and water control structures.

MKAG 1273 - Statistical Hydrology

This course has been prepared for hydrologists and engineers interested in learning how statistical models and methods can be valuable tools in the analysis and solution of many hydrologic and engineering problems. The random variability of hydrologic variables such as stream flow, precipitation, and groundwater level has been recognized for centuries. Hydrology is one of the areas of science and engineering to use statistical concepts in an effort to analyse natural phenomena. The course introduces statistics, probability, and time series, and their application to problems in hydrology. This includes parametric and non-parametric

methods of uncertainty analysis, trend analysis, hypothesis test, correlational analysis, regression analysis as well as probability distribution, frequency analysis, stochastic analysis, and time series modelling.

MKAG 1313 – Computational Fluid Mechanics

The course provides relevant topics in fundamental of matrix algebra, numerical solution of ordinary and partial differential equation, elliptic and parabolic partial differential equation, finite difference method, finite element method and application in fluid mechanics. The students will write some simple program to appreciate the method of solution

MASTER OF ENGINEERING (GEOTECHNICS)

PROGRAMME SPECIFICATIONS

The Programme is offered on full-time mode and is based on a 3-Semester Academic Session with several courses being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester, as well as Master Project. To graduate, students should attain a total of no less than 46 credit hours with minimum CPA of 3.0.

1. Programme Name	Master of Engineering (Geotechnics)
2. Final Award	Master of Engineering (Geotechnics)
3. Awarding Institution	UTM
4. Teaching Institution	UTM
5. Programme Code	MKAJ
6. Professional or Statutory Body of Accreditation	MQA
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Duration (per semester)	14 weeks
11. Study Duration (semester)	Full time
Minimum	3
Maximum	8

Course Classification

No	Classification	Credit Hours	Percentage
i.	University	6	13%
ii.	Programme Core	28	61%
iii.	Programme Electives	6	13%
iv	Free Electives	6	13%
	Total	46	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of competencies and integration of knowledge required in the profession.
PEO2	An appreciation of the value of lifelong learning and possessing enthusiasm and strong commitment to continued acquisition of new knowledge and skills.
PEO3	Advanced research skills that allow professionals to become competent in research.
PEO4	Highly developed oral and written communications skills that fit at all level, appropriate to the field of profession.
PEO5	An appreciation of the ethics and integrity in management, leadership and good governance, and responsibility to their professions and community

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduate are able to incorporate in-depth relevant knowledge in professional practices for the benefits of both national and international communities. Graduates are able to apply their knowledge and skills in the planning, analysis, design and supervision of works related to the civil engineering discipline.
PLO2	Graduate are able to formulate hypothesis, design and perform experiments/research scientifically to solve and explain observed phenomena.
PLO3	Graduate are able to manage conducive working environment qualities problem solving and higher order thinking skills. Graduate are technically competent in solving problems logically, analytically and creatively based on sound facts and ideas.
PLO4	Graduate are able to balance professional and ethical responsibilities including contemporary issues and environmental awareness
PLO5	Graduate are able to apply a wide range of relevant knowledge through effective oral and written communications. Graduates are able to communicate effectively across a range of contexts and audiences.
PLO6	Graduates are able to adopt the latest relevant knowledge and cutting-edge technologies through life-long learning process.

CURRICULUM STRUCTURE

University's General Elective Courses (Total : 6 credits)		
UABA 0013	Principle of Engineering Management	3 credits
UAPA 0013	Research Methodology	3 credits
Core Courses (Total : 18 credits)		
MKAJ 1013	Advanced Soil Mechanics	3 credits
MKAJ 1023	Advanced Geotechnical Analysis and Design	3 credits
MKAJ 1033	Advanced Foundation Engineering	3 credits
MKAJ 1043	Slope Engineering	3 credits
MKAJ 1073	Advanced Rock Mechanics and Engineering Geology	3 credits
MKAJ 1103	Geological Engineering and Environmental Hazard	3 credits
Elective Courses – Choose any two from the following list (Total : 6 credits)		
MKAM 1033	Construction Technology	3 credits
MKAJ 1063	Geotechnical Earthquake Engineering	3 credits
MKAJ 1053	Software Application in Geotechnical Engineering	3 credits
	Environmental Geotechnics	3 credits
MKAJ 1083	Unsaturated Soil Mechanics	3 credits
MKAJ 1093	Tunnel Engineering	3 credits
MKAJ 1113		
Free Elective Courses (Total : 6 credits)		
Choose any two subjects offered by other programmes, faculties or from the above elective subjects		6 credits
Masters Project (Total : 10 credits)		
MKAJ 1514	Masters Project 1	4 credits
MKAJ 1216	Masters Project 2	6 credits
TOTAL CREDITS		46 credits
Duration of Study		
Full Time	:	3 – 8 semester

COURSE SYNOPSIS

CORE COURSES

MKAJ 1013 - Advanced Soil Mechanics

This subject is one of the core subjects offered by the Department of Geotechnics and Transportation, which will provide: the knowledge on the application and principles of soil mechanics. It considers the following topics: soil and clay mineralogy, strength behaviour of cohesionless and cohesive soils. Mohr-Coulomb failure criterion, peak stresses, effective stress ratio, residual stress and critical state soil mechanics. Laboratory instrumentation for shear strength determination. Consolidation theory and pore pressure parameters. Difference between 1-D and 3-D Consolidation theory. Soil-water characteristic curve for unsaturated soils and its applications.

MKAJ 1023 - Advanced Geotechnical Analysis and Design

This course, offered by the Department of Geotechnics and Transportation, will provide advanced knowledge on the analysis and design of geotechnical engineering structures such as the earth dam, earth retaining structures, embankment on soft soils and tunneling through soils. It includes evaluating poor ground conditions and propose alternative technique(s) for ground improvement such as the sand drain, vertical drains, geosynthetics, soil reinforcement, electro-osmosis and others. Practical solution to problems which often confronted during construction in difficult ground area will also be highlighted. The course explores examples of the construction and post-construction data for the purposes of performance, safety and design compatibility. Slope and embankment stability; natural and manmade slopes, earth dams and embankments on soft clay, will be lay out in this course. Earth retaining structures for deep excavation, brace cut, gravity cantilever, buttress and reinforced earth wall and cantilever and anchored sheet pile will also be included. Besides that, the analysis and design of tunneling work through soil and the earth dam on various foundation soil types will be demonstrated. Lastly, the geotechnical instrumentation for monitoring of the geotechnical engineering structures will be explored.

MKAJ 1033 - Advanced Foundation Engineering

This subject is one of the core subjects offered by the Department of Geotechnics and Transportation, which will highlight the application of soil mechanics to foundation design in practice. Lectures will be emphasized on foundation design in Civil Engineering projects. Foundation design must be based on parameters evaluated from Site Investigation programme and make use of the soil parameters which requires the knowledge of geology and soil mechanics principles. Various types of foundation and their criteria for selection will be presented which is interpreted from site investigation related for shallow foundation, pile, raft foundation, drilled shaft, cofferdam and underpinning. Group piles, laterally loaded and uplift piles will be covered in the course. Settlement and bearing capacity considerations will be employed to select and design the appropriate foundation scheme for structures. At the end of the course the student will be able to understand and apply the principles of foundation design in terms of technical feasibility, economic viability, articulate and justify technical analyses through oral, written and graphical means. The student will also be able to appreciate the constantly evolving nature of civil engineering design and practice.

MKAJ 1043 - Slope Engineering

This course provides a comprehensive introduction to the subject of slope stability, from initial classification through assessment and analysis to remediation. It provides the student with the knowledge, strategy and capability to inspect, understand and assess slope instability. The course covers both the theory and practice of slope engineering. This course is ideal for those involved in the design, analysis or construction of civil engineering projects where the existence, creation or alteration of slope features may occur. This course considers the background to slope movements, simple classification systems and the fundamental soil mechanics that control stability. The key parameters are highlighted and discussed. The principles and assumptions of the more popular methods of analysis are introduced together with a pragmatic guide for assessing the competence of analysis software. Specific problems covered, include natural and cut slopes, earthworks and fills. It's also focusses on the practical approach to slope stability assessment and remediation. The investigation of failed slopes is considered. Remedial options to arrest or prevent movement are detailed together with a section on modeling. Techniques for the back analysis of slopes are covered and the application of stability calculations for suction assessment explored.

MKAJ 1073 - Advanced Rock Mechanics & Engineering Geology

Construction in Civil Engineering is associated with 2 types of geological materials, namely soils and rocks. This course deals with rocks, particularly on how these geological materials react to both geological and construction induced stresses. Construction of structures in or on rock mass (e.g. foundation, slope, tunnel & cavern) depends greatly on the rock mass properties and the interaction between the rock mass and the engineered structures. The term 'rock mechanics' refers to the basic science of mechanics applied to rocks, while the term 'rock engineering' refers to any engineering activities involving rocks. Basic knowledge in geology (particularly rock types, discontinuities in rock and structural geology) is essential for this course. The content is tailored to enable students to acquire knowledge on the principles of rock mechanics, and subsequently able to understand the importance of these principles in designing and construction of rock engineering structures. Week 1 - Week 6 the students are introduced to the relevant principles that include rock properties and rock mass classification. In these weeks the students learn the importance of the rock strengths and properties, and the effect of geological discontinuities on in situ rocks. Week 7 to Week 13 the application of rock mechanics principles in designing common rock engineering structures (foundation, slope and tunnel) are introduced. This enables the students to appreciate the importance of rock mechanics in designing rock engineering structures and reaction of mass to both geological and construction induced stresses. Week 14 to Week 15 cover topic on methods of stabilisation for unstable rock masses. Focus is on 2 fundamental aspects; mechanisms of stabilisation of each method and various modes of instability in rock mass. The correlation of both aspects allows student to appreciate the approach used in selecting suitable and effective method for rock stabilization. At the end of the course, students should acquire the knowledge on principles rock mechanics, and should be able to appreciate and to apply them in designing common rock engineering structures.

MKAJ 1103 - Geological Engineering and Environmental Hazard

Geological Engineering and Environment is concerned with the applications of geological knowledge to the siting, design, construction, operation and maintenance of civil engineering structures and facilities. It is one of the rapidly growing fields of engineering reflecting society's developing interest in the stewardship of the environment, managing risk, and creating a safer world. The field of Geological Engineering and Environment encompasses a wide range of activities including the geological characterization of complex foundations of major buildings and structures, development of natural resources, groundwater, the engineering safety of major infrastructure, geohazard and environment. Geological Engineering and Environment is an attractive discipline for students who wish to pursue the challenge of combining the complexity of nature and engineering design, who are interested in the physical mechanics of the earth's surface and subsurface. Students are also enlightened on the importance of geological environments on various construction works and understanding the characteristics and behavior of geological elements.

ELECTIVE COURSE

MKAM 1033 – Construction Technology

This is an elective subject emphasizing an integration of several areas related to construction. These include non-destructive tests for concrete structures, ground (site) investigation, excavation works in rocks and soils, tunnel construction, slope excavation, instrumentation and monitoring for large structures, bridge construction, and element and erection of steel and precast structures. The course content is tailored to enable students to understand, evaluate, and apply essential theories and principles for construction purposes. At the end of the course, students should acquire the fundamental knowledge in constructing typical major structures.

MKAJ 1053 - Software Application in Geotechnical Engineering

This course is designed to expose the students in analyzing geotechnical engineering problem using Plaxis 2D and Plaxis 3D, Geo-Studio Products: SEEP/W, SIGMA/W and SLOPE/W. This course will illustrate what students can do with the modern software tools now available and highlight the important/benefits of numerical modeling. The series of example which taken from the existing literature are employed in these courses, intended to provide the students some example problems that they can use to develop their modeling skills. This course also exposes the knowledge on the usage some of the notation and basic input procedures that are used in the software effectively. At the end of the course, students should be able to utilize this software, improve modeling skills and give some new ideas on how to apply numerical models related to geotechnical engineering problems.

MKAJ 1063 – Geotechnical Earthquake Engineering

This subject will present the practical aspect of geotechnical earthquake engineering. The course is separated into two parts: Part 1 provides discussion on the basic earthquake principles, common earthquake effects and calculating the earthquake by projecting earthquake rates. Part 1 also will look at the dynamic soil properties which include the field and laboratory tests. Part 2 will deal with earthquake computations for conditions commonly encountered by the engineer, such as liquefaction, settlement, slope stability and retaining wall

MKAJ 1083 - Environmental Geotechnics

This course introduces environmental awareness with respect to geotechnical engineering amongst civil engineering students. The topics covered in the course include characterization and regulatory requirements for disposal of hazardous and non-hazardous solid wastes (site selection, geo-environmental/site investigation); Liner types, materials (clay liners, geosynthetics and amended soils or composite materials) and their properties; leakage through liners; design of leachate collection systems; contaminant transport modeling; effects of pollutants on soil properties and behavior; and remediation methods for contaminated soils.

MKAJ 1093 – Unsaturated Soil Mechanics

This subject is one of the elective subjects offered by the Department of Geotechnics and Transportation, which will provide: the knowledge on the fundamental of unsaturated soil : properties, stress state variables. Measurements of suction. Seepage through unsaturated soils : steady state and unsteady state. Volume change and application: in-situ stress state, swelling pressures, heave predictions. Shear strengths and applications: compacted and residual soils, earth pressures, bearing capacity, slope stability.

MKAJ 1113 - Tunnel Engineering

This course, offered by the Department of Geotechnics and Transportation, it is the elective course offered for Civil Engineering final year students. This course deals with tunnel construction in all condition; soil, rock and mixed ground condition. The content is tailored to enable students to acquire knowledge on the tunnel construction. The first part of the module aims to equip students with the necessary knowledge; to collect, evaluate and interpret site investigation data which is frequently complex because of the variability inherent in the ground. This include the hydrological and stress condition. The second part is to instil an appreciation of the design process and design considerations, lining design and effects on existing underground structures. The application of finite element software to determine the structural integrity of underground openings and their support systems. Finally, this module outlines the strategies for managing risk and health and safety, and identifies the key hazards in tunnelling and underground works.

MASTER OF ENGINEERING (ENVIRONMENTAL MANAGEMENT)

PROGRAMME SPECIFICATIONS

The Programme is offered on full-time mode and is based on a 3-Semester Academic Session with several courses being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester, as well as Master Project. To graduate, students should attain a total of no less than 46 credit hours with minimum CPA of 3.0.

1. Programme Name	Masters of Engineering (Environmental Management)
2. Final Award	Masters of Engineering (Environmental Management)
3. Awarding Institution	UTM
4. Teaching Institution	UTM
5. Programme Code	MKAK
6. Professional or Statutory Body of Accreditation	MQA
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Scheme (Full Time/Part Time)	Full Time
11. Study Duration	Min: 3 semesters Max: 6 semesters

Course Classification

No	Classification	Credit Hours	Percentage
i.	University	6	13%
ii.	Programme Core	28	61%
iii.	Programme Electives	6	13%
iv	Free Electives	6	13%
	Total	46	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of competencies and integration of knowledge required in the profession.
PEO2	An appreciation of the value of lifelong learning and possessing enthusiasm and strong commitment to continued acquisition of new knowledge and skills.
PEO3	Advanced research skills that allow professionals to become competent in research.
PEO4	Highly developed oral and written communications skills that fit at all level, appropriate to the field of profession.

PEO5	An appreciation of the ethics and integrity in management, leadership and good governance, and responsibility to their professions and community
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Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduate are able to incorporate in-depth relevant knowledge in professional practices for the benefits of both national and international communities. Graduates are able to apply their knowledge and skills in the planning, analysis, design and supervision of works related to the civil engineering discipline.
PLO2	Graduate are able to formulate hypothesis, design and perform experiments/research scientifically to solve and explain observed phenomena.
PLO3	Graduate are able to manage conducive working environment qualities problem solving and higher order thinking skills. Graduate are technically competent in solving problems logically, analytically and creatively based on sound facts and ideas.
PLO4	Graduate are able to balance professional and ethical responsibilities including contemporary issues and environmental awareness
PLO5	Graduate are able to apply a wide range of relevant knowledge through effective oral and written communications. Graduates are able to communicate effectively across a range of contexts and audiences.
PLO6	Graduates are able to adopt the latest relevant knowledge and cutting-edge technologies through life-long learning process.

CURRICULUM STRUCTURE

University's General Elective Courses (Total : 5 credits)		
UABA 0013	Principle Engineering Management	3 credits
UAPA 0013	Research Methodology	3 credits
Core Courses (Total : 18 credits)		
MKAK 1003	Environmental Management & Sustainability	3 credits
MKAK 1053	Solid Waste Management	3 credits
MKAK 1063	Water Quality Assessment and Management	3 credits
MKAK 1083	Landuse and Environmental Planning	3 credits
MKAK 1103	Air and Noise Pollution	3 credits
MKAK 1133	Water Pollution Control	3 credits
Elective Courses – Choose any two from the following list (Total : 6 credits)		
MKAK 1013	Environmental Assessment and Management Systems	3 credits
MKAK 1043	Environmental Quality & Analysis	3 credits
MKAK 1073	Sludge Management	3 credits
MKAK 1123	Physico-chemical Treatment Processes	3 credits
MKAK 1143	Environmental Economics	3 credits
MKAK 1153	Environment and Transport Planning	3 credits
MKAK 1333	Biological Treatment Processes	3 credits
Free Elective Courses (Total : 6 credits)		
Choose any two subjects offered by other programmes, by other, faculties, or from the above elective subjects		6 credits
Masters Project (Total : 7 credits)		
MKAK 1514	Master Project 1	4 credits
MKAK 1526	Master Project 2	6 credits
TOTAL CREDITS		46 credits
Duration of Study		
Full Time	:	2 – 6 semester

COURSE SYNOPSIS

CORE COURSES

MKAK 1003 - Environmental Management and Sustainability

This course is designed to expose students to various aspects in environmental management and the concept of sustainability. Topics discussed include the principles of sustainable development, understanding the environmental sensitive areas particularly the natural water bodies, catchment management, development of coastal and inland areas. Current issues related to environmental problems especially on climate change and water supply are the main aspects to be addressed. Some methods and concepts of sustainable approaches are introduced in order to promote and achieve sustainable development goals. At the end of the course, the students should be able to understand the concept of environmental sustainability. The course enables the students to understand, plan and incorporate the concept of sustainability in environmental management.

MKAK 1053 - Solid Waste Management

This course intends to expose students with a comprehensive understanding in solid waste management. It provides the students with an overview of solid waste management, particularly municipal solid waste. The program includes discussion on the practices of municipal waste management, sources of wastes, generation rate and characteristics (physical and chemical properties), analysis of collection systems, handling of waste and disposal practices of municipal waste. Processing and recycling of wastes are also discussed. At the end of the course, students should be able to apply the theory and knowledge of managing municipal solid waste. The students should also be able to work in a team and able to present works through a written report as well as an oral presentation.

MKAK 1063 - Water Quality Assessment and Management

This course is designed to expose students to current trends and various aspects in water quality assessment and management for river catchments, lakes, reservoirs and wetlands. It tackles problems involving water pollution and its impacts on the environment and legislation. Water quality monitoring projects carried out by students will enable application of proper sampling and monitoring methods. At the end of the course students will then be able to assess water quality problems and plan mitigation and control measures for water pollution.

MKAK 1083 - Landuse And Environmental Planning

This course covers the fundamental concepts and mechanisms underlying land use and environmental planning from conceptual to its implementation. It focuses on the understanding of ecosystems, the impacts of land development activities along with the appropriate tools/techniques of environmental planning and management used to mitigate them. It provides an overview of the field, along with the fundamentals of land use planning, and presents a collaborative approach to environmental planning while explaining the principles of ecosystem management, restoration, and protection; land conservation; and the mitigation of natural hazards.

MKAK 1103 - Air and Noise Pollution

This course is designed to expose students with a comprehensive understanding in elements involved in air and noise pollution, and the practical approaches to control the pollution. In the air pollution part, topics discussed include elements and phenomena of air pollution, meteorology, control of air pollution and design considerations. In a noise pollution part, topics discussed include elements of noise pollution, effects, types of noise pollution, road traffic & aircraft/industrial noise. At the end of the course, students should acquire the fundamental knowledge related to the principles and control strategies of air and noise pollutions.

MKAK1133 - Water Pollution Control

This course introduces students to water and domestic wastewater treatment system. The content is designed to enable students to understand the processes that are involved in treating water and domestic wastewater. Students will be introduced to characterization of water and wastewater based on basic water quality parameters. This is followed by water treatment processes, which include coagulation, flocculation, sedimentation, filtration and disinfection. Topics on domestic wastewater treatment includes suspended growth processes i.e. activated sludge, oxidation pond, aerated lagoon and biofilm process i.e. biofilter. Students will be given the basic concept of each process and its conceptual design and analysis.

ELECTIVE COURSES

MKAK 1013 - Environmental Assessment and Management

This course is designed to expose the students to environmental and risk assessment. Topics discussed include the requirement of identification of environmental issues, environmental assessment during preliminary site assessment (PAT), site preparation and construction, project operational and management, and project abandonment, scope of assessment including data collection, prediction of impacts and mitigating measures. Students will also learn about the concepts of Environmental Management Plan (EMP), Environmental Management System (EMS), Environmental Management Compliance Plan (EMCP), Health Risk Assessment (HRA), as well as Quantitative and Qualitative Risk Assessment (QRA). At the end of the course, the student should be able to assess the environmental quality through environmental assessment and risk assessment. The course enables the students to realize the importance of managing the environment, through land-use projects' assessment as well as effective communication, while integrating ethical values during the assessment process.

MKAK 1043 - Environmental Quality and Analysis

This course is designed to expose and train students on analytical principles and method for analyzing environmental quality. Topics discussed will include the theory and practical approaches of analytical tools based on biological, chemical and physical properties and methods. The quality parameters are BOD, COD, TOC, DO, metals constituents, inorganic and organic impurities in air and water samples. Methods based on biological tools are also introduced to the students. Among instrumentations employed for the course are UV VIS spectrophotometer, HPLC, GC, AA spectrometer and IR spectrometer. The students are also required to conduct analysis in laboratory. At the end of the course, the student should be able to explain, determine and apply the methods for environmental analysis.

MKAK 1073 - Sludge Management

This course aimed to expose students to scientific knowledge of sludge processing and sustainable sludge management. The topics include importance of sludge management, sludge quantities and characteristics, sludge treatment and stabilization, conversion of sludge to bio-products as well as the various sludge reduction techniques. At the end of the course, the students should be able to employ and distinguish the different scientific fundamental concepts in sludge treatment processes, which are important for the students to recommend suitable treatment method for different industrial and municipal sludge characteristics for environmental sustainability.

MKAK 1123 - Physico-Chemical Treatment Processes

This course emphasizes on physico-chemical processes of water and wastewater treatment. The content is tailored to enable students to understand, analyze and apply essential theories and principles in removing various types of contaminant from water and wastewater using physico-chemical processes. Students will be introduced to process fundamentals which include thermodynamic and kinetics of reaction, mass balance concept and reactor analysis. Processes that will be discussed include aeration and air stripping, chemical oxidation, disinfection, chemical precipitation, coagulation, sedimentation, filtration, carbon adsorption, ion exchange and membrane processes. Students will be given the basic concept of each process, its applications, advantages and weaknesses. The conceptual design and analysis will be explained in detail.

MKAK 1143 - Environmental Economics

This is an elective course is design to explores the fundamental concepts of economic foundations for decision-making about environmental issues. Designed for students with no training in Economics, the modules will overview at introductory graduate level the basic principle of environmental economics, in three main areas of handling environmental resource; economics instruments of environmental policies; and valuation of cost-benefit from environmental changes. Variety of complex environmental engineering problems related to the environmental protection of water, air and soil will be introduced

MKAK1153 - Environment and Transport Planning

This course analyzes key concepts in the study of transport, energy and the environment, including sustainability. It looks at the importance of transportation-related environmental problems as well as environmental impacts of transport schemes, in the global, national, regional and with particular reference to Malaysia. The course will focus on current transport-related themes confronting many cities in the region, including: rapid motorization and suburbanization and subsequent impacts on transportation infrastructure and quality of life; public sector management and improvement of privately-owned and operated transit systems; and, transportation air pollution problems and potential solutions.

The course will consist of a series of lectures on the principal issues surrounding transportation in the developing world (including motorization, fiscal pressures, urban sprawl), concepts of sustainability as they relate to urban transportation, regional strategic planning approaches, and transportation policy and technology options and examples of successful implementation.

MKAK 1333 - Biological Treatment Processes

The course is designed to expose students to biological treatment processes in engineered wastewater system. It covers major wastewater engineering aspects, which include process analysis and design, treatment technologies, and modelling. It will include typical calculation, design and analysis of common biological treatment processes. At the end of the course, students should be able to incorporate the knowledge in the planning, design and operation and maintenance of wastewater treatment system.

MASTER OF ENGINEERING (CONSTRUCTION MANAGEMENT)

PROGRAMME SPECIFICATIONS

The Programme is offered on full-time mode and is based on a 3-Semester Academic Session with several courses being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester, as well as Master Project. To graduate, students should attain a total of no less than 46 credit hours with minimum CPA of 3.0.

1. Programme Name	Master of Engineering (Construction Management)
2. Final Award	Master of Engineering (Construction Management)
3. Awarding Institution	UTM
4. Teaching Institution	UTM
5. Programme Code	MKAM
6. Professional or Statutory Body of Accreditation	MQA
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Duration (per semester)	14 weeks
11. Study Duration (semester)	Full time
Minimum	3
Maximum	8

Course Classification

No	Classification	Credit Hours	Percentage
i.	University	6	13%
ii.	Programme Core	28	61%
iii.	Programme Electives	6	13%
iv.	Free Electives	6	13%
	Total	46	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of competencies and integration of knowledge required in the profession.
PEO2	An appreciation of the value of lifelong learning and possessing enthusiasm and strong commitment to continued acquisition of new knowledge and skills.
PEO3	Advanced research skills that allow professionals to become competent in research.
PEO4	Highly developed oral and written communications skills that fit at all level, appropriate to the field of profession.

PEO5	An appreciation of the ethics and integrity in management, leadership and good governance, and responsibility to their professions and community
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Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduate are able to incorporate in-depth relevant knowledge in professional practices for the benefits of both national and international communities. Graduates are able to apply their knowledge and skills in the planning, analysis, design and supervision of works related to the civil engineering discipline.
PLO2	Graduate are able to formulate hypothesis, design and perform experiments/research scientifically to solve and explain observed phenomena.
PLO3	Graduate are able to manage conducive working environment qualities problem solving and higher order thinking skills. Graduate are technically competent in solving problems logically, analytically and creatively based on sound facts and ideas.
PLO4	Graduate are able to balance professional and ethical responsibilities including contemporary issues and environmental awareness
PLO5	Graduate are able to apply a wide range of relevant knowledge through effective oral and written communications. Graduates are able to communicate effectively across a range of contexts and audiences.
PLO6	Graduates are able to adopt the latest relevant knowledge and cutting-edge technologies through life-long learning process.

CURRICULUM STRUCTURE

University's General Elective Courses (Total : 6 credits)		
UABA 0013	Principle of Engineering Management	3 credits
UAPA 0013	Research Methodology	3 credits
Core Courses (Total : 18 credits)		
MKAM 1013	Construction Project Management	3 credits
MKAM 1023	Construction Site Management and Safety Control	3 credits
MKAM 1043	Construction Law and Contract	3 credits
MKAM 1053	Project Planning and Scheduling	3 credits
MKAM 1103	Financial Management	3 credits
MKAM 1133	Sustainability & Environmental Management in Construction	3 credits
Elective Courses – Choose any two from the following list (Total : 6 credits)		
MKAM 1033	Construction Technology	3 credits
MKAM 1073	Project Estimating	3 credits
MKAM 1083	IT for Civil Engineers	3 credits
MKAM 1123	Construction Plants Management	3 credits
MKAE 1153	Concrete Technology	3 credits
Free Elective Courses (Total : 6 credits)		
Choose any two subjects offered by other programmes, faculties or from the above elective subjects		6 credits
Masters Project (Total : 10 credits)		
MKAM 1514	Masters Project 1	4 credits
MKAM 1526	Masters Project 2	6 credits
TOTAL CREDITS		46 credits
Duration of Study		
Full Time	:	3 – 8 semester

COURSE SYNOPSIS

CORE COURSES

MKAM 1013 - Construction Project Management

This course review contemporary issues in construction project management process. At outset it appraises issues related to construction industry background and industry practices as well as the past, present and future performance measurement. The practice of using traditional construction work process is will be evaluated in comprehensive manner and problems associated with such practice will be identified. Various contemporary management philosophies and tools from other industry will be reviewed with regard to their potential application and benefits to the construction industry. New concept of working by using the concept collaborative working environment supported by ICT tools will be analysed as a strategy to reengineer the construction industry.

MKAM 1023 - Construction Site Management and Safety Control

The course is designed to educate the student on the construction site management and occupational safety and health (OSH) concept. The course is divided into two parts namely site management and safety control. First part will emphasize on site management particularly principles of site management, site performance, site reporting, monitoring and control, site layout, workers' welfare and site resources. The second part will focus on the accident theories, prevention and investigation, risk management, OSH Management, performance and culture, occupational health such as stress and ergonomics within construction projects. Upon completion, students should be able to apply the effective site management and practice the knowledge Occupational Safety & Health Management and Accident Prevention within construction projects.

MKAM 1043 - Construction Law and Contract

This course introduces students to Malaysia laws, which will focus on the sources, and branches of law in Malaysia. The course will emphasize on private laws related to construction practice, law of contract and construction contract administration. Construction contracts and the laws underpinning them will be subjected to detailed consideration and analysis, in tandem with a comparative analysis of the approach adopted by a wide range of standard form contracts. Other topics covered include avoidance, management and resolution of construction claims and disputes. Students will be exposed to various court cases related to construction contract administration. Students will also apply the knowledge of the Malaysian legal framework and legal requirements in contract administration to resolve legal issues in construction project. More importantly, the students will be able to use their knowledge to promote ethical and better image of the construction industry.

MKAM 1053 - Project Planning and Scheduling

This course provides knowledge on contemporary practice in project planning and scheduling process in managing construction project. Major software for project planning and scheduling will be used. Student will be taught to develop project schedule and WBS then use advance technique to monitor and track project performance against baseline schedule. The concept and application of Earn Value Management system will be taught and the student will be able

to appraise project performance from time to time and recognised major delay and budget control.

MKAM 1103 - Financial Management

The course focuses on the theory and practice of financial decision making and financial management within organizations. Students are introduced to some of the challenging issues facing managers in today's global financial landscape. The combination of quantitative and qualitative management tools presented in the course offer the essentials knowledge for the successful financial management. Its subject matter includes a review of the economic logic of financial decisions, drawing on the theories of finance, economic principles and behavioral and organizational aspects. The topics covered are capital budgeting, analysing business performance, managing working capital, investment decision making. At the end of the course, students should possess a sound knowledge of the financial management and are able to apply it in their practice.

MKAM 1133 - Sustainability & Environmental Management in Construction

The developments of building and infrastructure have inherent links with the environment. Land, materials, water, energy are all consumed during the construction operation of buildings and infrastructure. The constructed facilities then become part of the new environment we have to live with. The process also generates greenhouse emissions which cause damage (e.g. global warming) to our environment. This subject offers an inter-disciplinary elective designed to promote collaboration and enhance understanding of the global challenge of sustainable development that related to construction industry. The course will emphasise on sustainability and environmental management within construction related issues as promoted by Agenda 21. The subject will cover aspects of embodied energy (renewable & non renewable), energy efficiency in building, construction waste, construction noise, water pollution, biodiversity and various sustainability control and prevention method for construction. Thus, environmental regulations & legislation; environmental Impact Assessment (EIA) and Environmental Management System (EMS) will be incorporated into the subject. At the end of the course, students are expected to able to understand the principles of sustainable development and apply knowledge to plan, design and construct using sustainable concepts and methods.

ELECTIVE COURSES

MKAM 1033 - Construction Technology

This is an elective subject emphasizing an integration of several areas related to construction. These include non-destructive tests for concrete structures, ground (site) investigation, excavation works in rocks and soils, tunnel construction, slope excavation, instrumentation and monitoring for large structures, bridge construction, and element and erection of steel and precast structures. The course content is tailored to enable students to understand, evaluate, and apply essential theories and principles for construction purposes. At the end of the course, students should acquire the fundamental knowledge in constructing typical major structures.

MKAM 1073 - Project Estimating

The course is designed to educate the student on the estimating, including the understanding of bidding, factors that affect estimates, and the understanding of cost proposal including the engineering economic is being develop with the focus on the cost benefits for the overall production rates on site is highlighted. The course is divided into two parts namely the recognition on the types of procurement and issues that cost estimates and the understanding on the principles of cost estimation. First part will emphasize on the scenario and issues involve in factors that affecting the estimates including the cost management and cash flow. The second part will focus on engineering economics, depreciation cost and the technology forecasting. Upon completion, students should be able to apply the cost proposal according to the estimation within construction projects

MKAM 1083 - IT for Civil Engineers

Instructional lecture and problem based learning through the students group project 1 and 2. Students are also requiring to do an individual project to measure his/her skills in writing and analysis of data. In problem based learning, students are guided through the real-life problem that requires to be assembled into real data for database design. In project 2, students are being guided to form a database information system using Microsoft access. Engineers required IT content such as Business System of project and Product Based, Information Security, Knowledge Management and Knowledge Management Infrastructure are the main content of the lecture. The lecture is supplemented with the real data mapping and development of real database information system.

MKAM 1123 - Construction Plants Management

This course introduces the techniques of applying engineering fundamentals and analyses to the planning, selection and utilisation of construction equipment. In general, the right selection, efficient utilization and cost-effectiveness of major construction operations have significant impacts on the overall cost and duration of construction activities. This course uses concepts from various engineering disciplines such as Engineering Economics, Geotechnical, Mechanical, Structural and Environmental Engineering, among others. At the end of this course, the students should be able to apply engineering fundamentals and analyses to the planning, selection and utilisation of construction equipment. This includes a thorough understanding on the total construction process and how construction equipment should be selected and used to produce the intended quality in the most cost-effective manner.

MKAE 1153 – Advance Concrete Technology

This course is designed for students to gain knowledge on advanced concrete technology in Civil Engineering. It will emphasize of materials properties and various mix proportions of concrete, different types of supplementary cementing materials, special concretes including high performance concrete, high strength concrete, lightweight concrete, flowable concrete, self-consolidating concrete, and polymer concrete, concrete deformations, durability aspects of concrete, causes of concrete deterioration and repair techniques, and developments in current concrete technology. At the end of the course students should be able to describe, identify, and discuss the properties and behaviour of different types of concrete materials together with the selection and applications of the materials in practice. In addition, students should also understand the current trend in concrete technology

MASTER OF ENGINEERING (TRANSPORTATION)

PROGRAMME SPECIFICATIONS

The Programme is offered on full-time mode and is based on a 3-Semester Academic Session with several courses being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester, as well as Master Project. To graduate, students should attain a total of no less than 46 credit hours with minimum CPA of 3.0.

1. Programme Name	Master of Engineering (Transportation)
2. Final Award	Master of Engineering (Transportation)
3. Awarding Institution	UTM
4. Teaching Institution	UTM
5. Programme Code	MKAQ
6. Professional or Statutory Body of Accreditation	MQA
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Duration	14 weeks
11. Study Duration (semester)	Full time
Minimum	3
Maximum	8

Course Classification

No	Classification	Credit Hours	Percentage
i.	University	6	13%
ii.	Programme Core	28	61%
iii.	Programme Electives	6	13%
iv	Free Electives	6	13%
	Total	46	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of competencies and integration of knowledge required in the profession.
PEO2	An appreciation of the value of lifelong learning and possessing enthusiasm and strong commitment to continued acquisition of new knowledge and skills.
PEO3	Advanced research skills that allow professionals to become competent in research.
PEO4	Highly developed oral and written communications skills that fit at all level, appropriate to the field of profession.
PEO5	An appreciation of the ethics and integrity in management, leadership and good governance, and responsibility to their professions and community

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduate are able to incorporate in-depth relevant knowledge in professional practices for the benefits of both national and international communities. Graduates are able to apply their knowledge and skills in the planning, analysis, design and supervision of works related to the civil engineering discipline.
PLO2	Graduate are able to formulate hypothesis, design and perform experiments/research scientifically to solve and explain observed phenomena.
PLO3	Graduate are able to manage conducive working environment qualities problem solving and higher order thinking skills. Graduate are technically competent in solving problems logically, analytically and creatively based on sound facts and ideas.
PLO4	Graduate are able to balance professional and ethical responsibilities including contemporary issues and environmental awareness
PLO5	Graduate are able to apply a wide range of relevant knowledge through effective oral and written communications. Graduates are able to communicate effectively across a range of contexts and audiences.
PLO6	Graduates are able to adopt the latest relevant knowledge and cutting-edge technologies through life-long learning process.

CURRICULUM STRUCTURE

University's General Elective Courses (Total : 5 credits)		
UAPA 0013	Research Methodology	3 credits
UABA 0013	Principle Engineering Management	3 credits
Core Courses (Total : 18 credits)		
MKAQ 1013	Highway & Infrastructure Design	3 credits
MKAQ 1023	Advanced Road Material	3 credits
MKAQ 1043	Transport Planning	3 credits
MKAQ 1053	Pavement Design and Construction	3 credits
MKAQ 1063	Public Transport System	3 credits
MKAQ 1083	Traffic Management & Analysis	3 credits
Elective Courses – Choose any two from the following list (Total : 6 credits)		
MKAQ 1033	Transport and Environmental Planning	3 credits
MKAQ 1073	Airport Planning and Design	3 credits
MKAQ 1093	Transport Safety	3 credits
MKAQ 1103	Disaster Management	3 credits
MKAQ 1113	Pavement Management System	3 credits
MKAQ 1123	GIS For Civil Engineer	3 credits
Free Elective Courses (Total : 6 credits)		
Choose any two subjects offered by other programmes, by other, faculties, or from the above elective subjects		6 credits
Masters Project (Total : 7 credits)		
MKAQ 1514	Pre-Master Project	4 credits
MKAQ 1526	Master Project	6 credits
TOTAL CREDITS		46 credits
Duration of Study		
Full Time	:	3 – 6 semester

COURSE SYNOPSIS

CORE COURSES

MKAQ 1013 - Highway & Infrastructure Design

This course provides state of art knowledge on highway and infrastructure design. Understanding of the subject will help the students to design highways and related infrastructure facilities. Topics for the subject are highway surveys and location, geometric design of roads and highway facilities, road cross section design, intersection design, intersection control system, and roundabout design. At the end of the course, students are able to analyse and apply the related theories in order to design highway and infrastructure facilities.

MKAQ 1023 - Advanced Road Material

This is one of the core subjects that will enhance the knowledge of the students on advanced road materials. The course consists of the following topics i.e., properties and test of materials in road construction, analyze the laboratory testing (Marshall mixture design, Superpave mixture design, and concrete pavement mixture), recycled aggregate in road construction, waste materials in road construction, alternative binders for sustainable asphalt pavement and nanotechnology and its impact on road construction.

MKAQ 1043 - Transport Planning

This course is one of the core courses, which discusses transport models and four steps travel demand forecasting process, land-use demographic survey design and transport planning related data collection, Trips regression and category analysis, growth factor methods, trip distribution models, logit and probit models, route choice models, Appraisal of transportation projects. Economic evaluation and priority ranking techniques, alternative analysis, Citizen participation in transport planning. This course provides an exhaustive knowledge in traffic and transport planning.

MKAQ 1053 - Pavement Design and Construction

This is one of the core subjects that will develop the knowledge and experience of the students in pavement design construction. This course comprises the following topics: Factors influencing thickness design, methods of pavement design: AASHTO, Asphalt Institute, ATJ5/85 (2013), Rigid pavement design, Interlocking block design, surface dressing design, construction of various pavement types, earthworks, cut slopes, embankments, surface drainage, subsurface drainage, erosion control, slope protection, culverts.

MKAQ 1063 - Public Transport System

This course is one of the compulsory subjects, which provides background knowledge on mass transport modes, infrastructure and operational aspects. These include public transport scheduling and operation design, service planning and its data collection techniques. Transit demand forecasting is focused to model transit traffic flows. Transit lines and networks address level of service, investment, network operating efficiency, etc. This subject will expose the students to the public transport vehicle characteristics, the planning process of public transport, facilities location analysis and layout design, transit system planning and mode selection, highway design and traffic management for buses. The use of intelligent systems in

urban mass transport modes and passengers, are elaborated. The economics of fares structure and economic evaluation of public transport plans are discussed. Transit agency organizational and financing models are critically examined with case studies

MKAQ 1083 - Traffic Management and Analysis

This course discusses urban traffic and transportation management strategies. It addresses the basic traffic and transportation data collections, analysis and the fundamental theory of traffic flow, capacity assessment of transportation facilities and the Transportation systems management (TSM) planning processes and strategies. TSM includes Advanced Traffic Management (ATM), Urban Traffic Control System (UTCS), Intelligent Transport and Traffic System (ITS) and Highway Information System.

ELECTIVE COURSES

MKAQ 1033 - Transport & Environmental Planning

This is one of the electives courses which will expose students to the fundamental aspects of environmental planning of transportation system.

Major topics include identification of environmental disturbances, traffic noise, techniques of estimation, design standard, air pollution, social impacts, transportation of hazardous and toxic material, transport and sustainability, and environmental evaluation and management.

MKAQ 1073 - Airport Planning and Design

Legislation and organization of airway industry. Airport planning and size. Airport capacity, type, size and shape of the airport. Expected air traffic volume and control system. Runway traffic management.

MKAQ 1093 - Transport Safety

This course provides state of art knowledge on road and transport safety. Understanding of the subject will help students to identify road and transport safety related interventions and preventive measures. Topics for the subject are fundamental concepts in transport safety, human factors in transportation, vehicle attributes that affect safety, traffic control devices, traffic safety measures, safety data review and assessment, safe road design concept, highway safety – data and analysis, traffic calming and other measures, pedestrian safety and road safety audit. At the end of the course, students are able to evaluate road safety engineering design and installations.

MKAQ 1103 - Disaster Management

This is one of the elective subjects that will expand the knowledge of the students in disaster management and their understanding about impacts from disasters, to produce engineers that can provide holistic engineering, design and management solutions in their roles. The course consists of the following topics: Types and causes of disaster formation, Processes and mechanisms of disaster management, Traditional and contemporary approaches of disaster management cycles, Assessment of disasters using vulnerabilities and risk assessment, needs of special organisation structures that support disaster management. Effects of disasters on natural and built-up environment. Logistical and transportation needs during

disasters, road safety auditing for anticipated disasters, sustainable construction and development efforts after disasters

MKAQ 1113 - Pavement Management System

Students will learn two major things at the end of the course. Evaluation of various steps of pavement management system and Effective selection of the methods needed for managing pavement.

Students will also acquire a comprehensive knowledge of problems associated with pavement and how to maintain the roads effectively. They will get knowledge about “Arahan Teknik Jalan, Malaysia” and also latest technologies used by developed countries.

The course consists of the following topics: Overall picture of world highways as well as Malaysian roads, Network level and project level pavement management system, evaluation of different pavement layers and other infrastructure works, such as drainage etc.

They will also acquire functional and structural failures of pavement and corresponding rehabilitation works required including life cycle cost analysis.

They will gain knowledge about the source of finance for the most important public asset of roads for their construction and maintenance.

In Malaysia, they will get the knowledge of different organizations involved in pavement such as IKRAM, PLUS Bhd, Propel Bhd, HCM etc. From these evaluations and rehabilitations, they will get a widespread knowledge to manage the roads practically.

MKAQ 1123 - GIS for Civil Engineers

This course is an elective course specially designs for post-graduate civil engineering students who always have to manipulate huge amount of spatial data. This course introduces the concept and advanced application of the Geographic Information System (GIS) theories especially in civil engineering fields. This course will emphasize on the overview and the application of GIS in civil engineering, GIS data structure, data manipulation and GIS implementation, information presentation of GIS, GIS case study in civil engineering, GIS prototype project, and future technology of spatial data storage. At the end of the course, students will be able to plan, analyse, and modeling the information for develop advanced GIS application related to civil engineering problems.

MASTER OF FORENSIC ENGINEERING

PROGRAMME SPECIFICATIONS

The course is offered on full-time mode and is based on a minimum 2-Semester Academic Session with several courses being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester. To graduate, students should attain a total of no less than 43 credit hours with minimum CPA of 3.0, as well as pass the Master Project.

1. Programme Name	Master of Forensic Engineering
2. Final Award	Master of Forensic Engineering
3. Awarding Institution	UTM
4. Teaching Institution	UTM
5. Programme Code	MEAX
6. Professional or Statutory Body of Accreditation	MQA
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional, Online Distance Learning
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Scheme (Full Time/Part Time)	Full Time
11. Study Duration	Min: 2 semesters Max: 8 semesters

Course Classification

No	Classification	Credit Hours	Percentage
i.	University	3	7 %
ii.	Programme Core	28	70 %
iii.	Programme Electives	12	23 %
iv	Free Electives	-	-
	Total	43	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of Forensic Engineering field.
PEO2	Practice and promote professionalism and high standards of ethical conducts within organization and society.
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Synthesize complex information, specialized concepts, theories, methods and practice independently in the field of Forensic Engineering.
PLO2	Solve complex problems critically and integratively using systematic approaches.
PLO3	Apply practical skills to solve problems in the field of Forensic Engineering.
PLO4	Demonstrate effective collaboration with stakeholders professionally.
PLO5	Communicate effectively the knowledge, skills and ideas using appropriate methods to peers, experts and communities.
PLO6	Use digital technologies and appropriate software competently to enhance study and practice.
PLO7	Evaluate numerical and graphical data critically using quantitative or qualitative tools in solving problems.
PLO8	Demonstrate leadership, autonomy and responsibility in managing resources.
PLO9	Engage self-advancement through continuous learning or professional development.
PLO10	Demonstrate entrepreneurial skills with relevant knowledge and expertise.
PLO11	Demonstrate respectable ethical conducts and professionalism skills in an organization and society.

CURRICULUM STRUCTURE

Code	Courses	Credits
UNIVERSITY COURSES (3 credits)- choose 1 course only		
UBSS 6013	Organization Behavior & Development	3
UBSS 6023	Business Ethics, Responsibility and Sustainability	3
UECS 6013	IT Project Management	3
UECS 6023	Introduction to Technopreneurship	3
UHS 6013	Philosophy of Science and Civilization	3
UHLM 6013	Bahasa Malaysia Penulisan Ilmiah	3
UHMZ6023	Malaysian Society and Cultur	3
UHMS 6013	Seminar on Global Development, Economic and Social Issues	3
UHPS 6013	Dynamics of Leadership	3
UMJJ 6013	Basic Japanese Language & Culture	3
URTS 6013	Environmental Ethics	3
CORE COURSES (18 credit)		
MEAU 0013	Research Methodology	3
MEAR 1013	Principles of Forensic Engineering	3
MEAR 1023	Laws in Forensic Engineering	3
MEAR 1033	Safety Engineering	3
MEAR 1043	Risk Assessment	3
MEAR 1053	Prevention through Design	3
MASTER PROJECT (10 credits)		
MEAR 1514	Master's Project I	4
MEAR 1526	Master's Project II	6
ELECTIVE COURSES (choose any 4 courses) (12 credits)		
MEAR 1063	Engineering Materials	3
MEAE 1033	Structural Assessment and Rehabilitation	3
MEAE 1213	Structural Fire Engineering	3
MEAE 1193	Design and Safety of Temporary Structures	3
MEAM 1043	Construction Law and Contract	3
MEAM 1093	Building Information Modelling in Construction Management	3
MEAJ 1053	Software Application in Geotechnical Engineering	3
MEAJ 1073	Geological and Rock Engineering	3
MEAK 1103	Air and Noise Pollution	3
MEAK 1033	Water Pollution Control	3
MEAQ 1023	Advanced Road Material	3
MEAQ 1093	Transport Safety	3
MEAK 1043	Environmental Quality and Analysis	3
MEMB 1633	Assets Integrity and Assessment	3
MEMB 2613	Advanced Materials Characterization	3
MEMB 2623	Mechanical Behaviour of Materials	3
MEEP 1003	Electrical Systems Forensic	3
MKEU 1103	Condition Assessment of High Voltage Insulation	3
MKET 1313	Communication and Computer Network	3

MEEH 1233	Digital Image Processing	3
METW 1233	Crisis and Emergency Management	3
METW 1243	Process Safety and Loss Prevention	3
METW 1263	Incident Investigation	3
TOTAL CREDITS		43

COURSE SYNOPSIS

CORE COURSES

MEAR 1013 - Principles of Forensic Engineering

This course is designed for students to understand the activities of forensic experts in the engineering professions. It covers aspects of forensic activity that are common to all disciplines such as clients, and scope and purpose of investigation, techniques, procedures and tools used in investigation and analysis. Interface with forensic specialists from other discipline. Impact of forensic activity on improved practices, products, or planning to reduce the frequency and severity of failures.

MEAR 1023 - Laws in Forensic Engineering

The aim of this course is to foster future engineer capability with laws related to the forensic engineering practices. The content of the course covers tort and statutory liabilities. It begins with a review of legal term and principle in tort such as negligence and trespass. Then, statutory liability in construction practice, common issues related to associated breach and dispute resolution approach are discussed. The role of professional engineer as expert witness is introduced in law of evidence so as the students will be familiar to the scope and responsibility of expert witness and the procedures involved during experts at trial. The focus will be on building a credible and believable testimony. Assignment on legal procedure encompassing tort and statutory liabilities will be administered throughout the semester with addition of report writing and presentation. At the end of the course, the students are expected to appreciate the legal setting in the practice and be able to analyse, apply critical reasoning and make informed judgement in addressing legal issues in engineering practice and to stand as credible expert witness.

MEAR 1033 - Safety Engineering

This subject fundamental concept of safety and health engineering, and understanding safety of equipment commonly used in engineering installation and maintenance, safety of chemicals used in engineering processes, and implementation of safety engineering programs in engineering installations and plants.

MEAR 1043 - Risk Assessment

This courses aims to give students a comprehensive exposure to structural safety, risk assessment and reliability engineering concept related to civil engineering system. The course contents consist of four different module named Systems Reliability, Safety & Risk, Data Analysis & Simulation and Risk Assessment & Safety Management. Safety & Risk leads to an understanding of the principles of structural reliability theory and its application to risk and reliability engineering. Data Analysis & Simulation is designed to develop knowledge of statistical data analysis and its application in engineering and science and introduces the concepts of using simulation techniques for analysis of complex systems. It also teaches linear optimization techniques and the ability to apply them to solve simple problems. In Systems Reliability, this section gives an understanding of the qualitative and quantitative techniques that are used in the reliability, availability and maintainability analysis of all types of engineering systems. The final part of this course, Risk Assessment & Safety Management gives student an appreciation of risk from individual and societal perspectives as well as

understanding the basic principles of risk assessment and modelling and how safety management works in practice.

MEAR 1053 – Prevention Through Design

Prevention through design (PtD) is a concept of applying methods to minimize occupational hazards early in the design process. It is a concept that encourages construction or product designers to design out risks as early as in a design development. This course conveys the concept of prevention through design through Occupational Safety and Health in Construction Industry Management (OSHCIM). Students will be familiarized to the concept of safety by design to design out hazard during the design stages which also known as [1] concept design, [2] detail design, maintenance and repair and [3] pre-construction review. At the end of the course, students will be able to conduct a design decision for a safer work method.

MEAU 0013 – Research Methodology

This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Amongst topics that will be covered are introduction to research and its philosophy, problem formulation and research objective, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

MASTER OF PROJECT MANAGEMENT

PROGRAMME SPECIFICATIONS

The Programme is offered on full-time mode and is based on a 3-Semester Academic Session with several courses being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester, as well as Master Project. To graduate, students should attain a total of no less than 46 credit hours with minimum CPA of 3.0.

1. Programme Name	Master of Project Management
2. Final Award	Master of Project Management
3. Awarding Institution	UTM
4. Teaching Institution	UTM
5. Programme Code	MKAZ
6. Professional or Statutory Body of Accreditation	MQA
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Duration (per semester)	14 weeks
11. Study Duration (semester)	Full time
Minimum	3
Maximum	8

Course Classification

No	Classification	Credit Hours	Percentage
i.	University	6	13%
ii.	Programme Core	28	61%
iii.	Programme Electives	6	13%
iv	Free Electives	6	13%
	Total	46	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of competencies and integration of knowledge required in the profession.
PEO2	An appreciation of the value of lifelong learning and possessing enthusiasm and strong commitment to continued acquisition of new knowledge and skills.
PEO3	Advanced research skills that allow professionals to become competent in research.
PEO4	Highly developed oral and written communications skills that fit at all level, appropriate to the field of profession.
PEO5	An appreciation of the ethics and integrity in management, leadership and good governance, and responsibility to their professions and community

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Graduate are able to incorporate in-depth relevant knowledge in professional practices for the benefits of both national and international communities. Graduates are able to apply their knowledge and skills in the planning, analysis, design and supervision of works related to the civil engineering discipline.
PLO2	Graduate are able to formulate hypothesis, design and perform experiments/research scientifically to solve and explain observed phenomena.
PLO3	Graduate are able to manage conducive working environment qualities problem solving and higher order thinking skills. Graduate are technically competent in solving problems logically, analytically and creatively based on sound facts and ideas.
PLO4	Graduate are able to balance professional and ethical responsibilities including contemporary issues and environmental awareness
PLO5	Graduate are able to apply a wide range of relevant knowledge through effective oral and written communications. Graduates are able to communicate effectively across a range of contexts and audiences.
PLO6	Graduates are able to adopt the latest relevant knowledge and cutting-edge technologies through life-long learning process.

CURRICULUM STRUCTURE

University's General Elective Courses (Total : 6 credits)		
UABA 0013	Principle of Engineering Management	3 credits
UAPA 0013	Research Methodology	3 credits
Core Courses (Total : 18 credits)		
MKAB 2203	Fundamentals of Project Management	3 credits
MKAB 2213	Planning & Scheduling	3 credits
MKAB 2233	Business Planning & Financial Management	3 credits
MKAB 2253	Communication & Stakeholder Management	3 credits
MKAB 2303	Innovation & Problem Solving	3 credits
MKAB 2373	Project Quality Management	3 credits
Elective Courses – Choose any two from the following list (Total : 12 credits)		
MKAB 2223	Life Cycle & Project Delivery Methodologies	3 credits
MKAB 2243	Client Needs Determination, Design Management & Sustainability	3 credits
MKAB 2263	Performance Measurement & Reporting	3 credits
MKAB 2273	Interpersonal Skills, Cross Culture Management & Leadership	3 credits
MKAB 2283	Strategic & Change Management	3 credits
MKAB 2293	Organizational Design & Governance	3 credits
MKAB 2313	Quantitative Analysis	3 credits
MKAB 2363	System Thinking	3 credits
MKAB 2383	Business Law & Ethics	3 credits
Masters Project (Total : 10 credits)		
MKAB 2394	Masters Project I	4 credits
MKAB 2406	Masters Project II	6 credits
TOTAL CREDITS		46 credits
Duration of Study		
Full Time	:	4 – 8 semester

COURSE SYNOPSIS

CORE COURSES

MKAB 2203 - Fundamentals of Project Management

This course aims to provide a thorough understanding on the fundamental knowledge of project management theory and principles. It begins with the reviewing of the evolution of the management theory and the influence of the various schools of thought in management. The issues and challenges faced by the contemporary managers will be discussed within the current business environment context. Then the focus will be shifted to the project management environment. This course is conducted within the context of nine areas of knowledge as stipulated in PMBOK. The course will relate how the underlying principles of management theory are being applied to the project management perspective at the various phases of its life cycle. Major constraints of time cost quality in project management environment will be elaborated. The elements of project management critical to the success of a project also are identified and explained. The specific focus will also be given on applying the contemporary management in managing current project. The principles and tools are integrated and clarified through case studies from a variety of project organizational settings and through creation of project management plans developed by students working in teams. Discussions will also emphasize on the importance of the global and environmental impacts on the project.

MKAB 2213 - Planning & Scheduling

This course provides knowledge on contemporary practice in project planning and scheduling process in managing construction project. The main focus of this course is to develop the knowledge and skill to enable the student to use contemporary planning and scheduling software that are available in the market. Prior to that the candidate will be given comprehensive understanding and skill on the basic fundamental of scheduling techniques particularly using network diagram technique. The importance of the technique, the advantages and disadvantages as well as their practical application in construction project will be analysed. Major software in project planning and scheduling MS Project and Primavera Project Planner will be taught. The student will be able to used major software available in the market software to solve planning and scheduling problems. Advance application particularly related to project monitoring and tracking also included in this course. The concept and application of Earn Value Management system will be taught and the student will be able to appraise project performance from time to time and recognised major delay and overbudget problems. Issue related to project delay and EOT will be also addressees as well as contractual implication due to schedule changed. Finally, the issue related to project schedule information exchange will be highlighted in this course.

MKAB 2233 - Business Planning & Financial Management

The course focuses on the theory and practice of financial decision making and financial management within organizations. Students are introduced to some of the challenging issues facing managers in today's global financial landscape. The combination of quantitative and qualitative management tools presented in the course offer the essentials knowledge for the successful financial management. Its subject matter includes a review of the economic logic of financial decisions, drawing on the theories of finance, economic principles and behavioral

and organizational aspects. The topics covered are capital budgeting, analysing business performance, managing working capital, investment decision making. At the end of the course, students should possess a sound knowledge of the financial management and are able to apply it in their practice.

MKAB 2253 - Communication & Stakeholder Management

This course focuses on project personnel building and maintaining robust project relationships by using appropriate tools to identify key stakeholders and then to manage the relationships between their unique stakeholders community and the project. The course is designed to expose students to both the methodology and the supporting theory to provide students with a thorough understanding of both stakeholder and communication theory and practice in a project environment and how effective management of these factors will contribute to a successful project outcome.

MKAB 2303 - Innovation & Problem Solving

Ideas are the currency in the current era of the mind. Ideas are the starting point of problem solving and innovation in organization. This course focusses on the tools and techniques for problem identification, problem analysis and creative problem solving. Students are required to analyse and creatively solve real problem in their workplace

MKAB 2373 - Project Quality Management

This course provides students with a firm grasp on concepts of quality management and how it affects the whole process of project and operations management. It also provides students on wide spectrum of quality management from strategic to operational level considering internal and external working environment.

ELECTIVES COURSES

MKAB 2263 - Performance Measurement & Reporting

The main reasons for measuring performance for a company are to pursue opportunities for performance improvement and respond to internal business pressures for reporting performance. The board of directors and senior management team usually want to know how the company was performing globally on specific issues in particular. Performance data is needed to help managers identify opportunities to reduce impact, risk & costs and share their successes around the world. Performance data are both financial and non-financial

MKAB 2273 - Interpersonal Skills, Cross Culture Management & Leadership

In this course students will be introduced to interpersonal skills competencies and cross cultural management. Topics discuss in the interpersonal skills including stages of interpersonal relationship, social penetration theory, perception, listening skills, verbal and non-verbal communication skills and elements in interpersonal relationship skills. Among issues discuss in cross cultural management are nature of culture, culture values, dimension of culture and Hofstede cultural dimensions, cross culture in Project Management and managing conflict. In addition, this course also discusses topics related to leadership namely leadership styles and power and politics.

MKAB 2283 - Strategic & Change Management

In this course, participants are given a foundation of basic strategy concepts for knowledge and applications both at the organizational and the strategic business unit (SBU) levels.

MKAB 2293 - Organizational Design & Governance

In this course students will study how organizations are social entities that are goal-orientated and which have coordinated activity systems linked to the organization's working environment and exposed to business strategies integrated to an organizational design which interacts successfully with the internal/external environments

MKAB 2313 - Quantitative Analysis

This course is one of the elective subjects offered by the Department of Geotechnics and Transportation. The course exposes the student to practical quantitative approach to mathematical decision-making. The emphasis in this course will be on statistics and selected methods of using statistics to make inferences and judgments about phenomena. Knowledge about statistics and statistical analysis can help students interpret data for the purpose of providing meaningful insights about the problem being investigated. It is hoped that this course will support the ability of students to make sense of statistics in both theoretical and practical term

MKAB 2363 - System Thinking

This subject covers the basic concepts, models, methodologies and implementation issues in Systems Thinking. The systems approach distinguishes itself from the traditional analytic approach by emphasizing the interactions and connectedness of the different components of a system. Students will learn essential concepts in hard systems approaches to decision making such as in Systems Engineering and Cybernetics versus the Soft System Methodology (SSM), the Fifth Discipline and Swarm Intelligence. Systems Thinking include holistic model building and distinguishing between conceptual models and reality; thinking in feedback loops and interrelated structures; recognizing patterns over time such as oscillations and delays as well as in chaotic systems. Students will learn to visualize various system dynamics through diagramming methods like Causal Loop Diagrams, Influence Diagrams and Rich Pictures. Using systems thinking tools and framework such as the Cynefin Framework and Blue Ocean Strategy Scenario Planning, work groups will conduct sense making analysis about the complexities of systems and transform them into implementation models.

MKAB 2383 - Business Law & Ethics

Businesses and managers are expected to behave ethically within the ethical and legal boundaries. Dealings of managers with internal and external parties are against the backdrop of the country's legal system. This course introduces the student to the aspects of legal system in Malaysia that is relevant to businesses and managers. It covers courts and the legal system in Malaysia as well as laws dealing with the following; Elements of Contract, Types of Contract, Consumer Protection, Legal Issues in Business Organizations, Law of Tort and public laws relating to business.



SCHOOL OF COMPUTING

DOCTOR OF PHILOSOPHY

FIELD: COMPUTER SCIENCE

PROGRAMME SPECIFICATIONS

The Doctor of Philosophy, Field: Computer Science is offered on a full-time basis. The programme is offered only at the UTM Main Campus in Johor Bahru. The duration of study for the programme is subjected to the student's entry qualifications and lasts between three (3) years to a maximum of six (6) years.

The programme is offered on full-time only and are based on a 2-Semester per academic session. This is a full research programme. The candidate is supervised by a qualified academic staff. The directed research work introduces candidates to the process by which new knowledge is developed and applied accordingly. Assessment is done by examining first assessment reports (research proposal), each semester's progress reports, and thesis examination (viva-voce).

General Information

1. Awarding Institution		Universiti Teknologi Malaysia		
2. Teaching Institution		Universiti Teknologi Malaysia		
3. Programme Name		Doctor of Philosophy in Computer Science		
4. Final Award		Doctor of Philosophy in Computer Science		
5. Programme Code		PCSSA2AJA		
6. Professional or Statutory Body of Accreditation		Ministry of Higher Education		
7. Language(s) of Instruction		English		
8. Mode of Study (Conventional, distance learning, etc)		Conventional		
9. Mode of operation (Franchise, self-govern, etc)		Self-governing		
10. Study Scheme		Full Time		
11. Study Duration		Minimum : 6 semesters Maximum:12 semesters		
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	6	-	12	-

Short	-	-	-	-
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Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses	3	100%
ii.	Core Courses	0	0%
iii.	Research	0	0%
	Total	3	100%
Total Credit Hours to Graduate		3 credit hours	

COURSE MENU

Doctor of Philosophy students are required to register and pass the following courses before their first assessment (proposal defense).

- i. Research Methodology course (course code UCSP0010).
- ii. One University Elective Course (course code U*** **3).

YEAR 1: SEMESTER 1			
Code	Course	Credit	Pre-requisite
UCSM1263	IT Project Management	3	
UHAP6013	Seminar on Development, Economics and Global		
UICW6023	Philosophy Science and Civilization		
UHAZ6123	Malaysian Society and Culture		
UCSP0010	Research Methodology	0	
MCSS1100	* Research	0	
	TOTAL CREDIT	3	
	CUMULATIVE CREDITS	3	

YEAR 1: SEMESTER 2			
Code	Course	Credit	Pre-requisite
MCSS1200	* Research	0	
	TOTAL CREDIT	0	
	CUMULATIVE CREDITS	3	

* Research (course code PCSS**00), to be taken every semester until the submission of thesis. The progress of a candidate in any semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website <http://spsapp3.utm.my:8080/gsmsv4/>.

RESEARCH CODE

Semester	Research Course Code
1	PCSS1100
2	PCSS1200
3	PCSS2100
4	PCSS2200
5	PCSS3100
6	PCSS3200
7	PCSS4100
8	PCSS4200

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Competent in computer science and digital technologies that foster research and development of new knowledge in specific areas.
PEO2	Has good character, ethics and high integrity and demonstrate behavior that is consistent to professional ethics.
PEO3	Has promote the technological, social and cultural progress in a knowledge based society in the academic and professional contexts.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to identify various computer science theories suitable for particular research context, and justify and verify the proposed solution using computer science theories creatively
PLO2	Ability to conduct computer science research in a systematic and scientific way independently
PLO3	Ability to give suggestion on computer science solutions to the society
PLO4	Ability to demonstrate behaviour that is consistent with the Code of Professional Ethics and Responsibilities
PLO5	Ability to defend critically technical solutions and research findings to a range of audience orally and in writing
PLO6	Ability to identify and analyse real problems critically related to organisational, governmental and social
PLO7	Ability to undertake lifelong learning and actively participate in change
PLO8	Ability to turn ideas into innovative computer science solution to meet the real world needs

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO	CODE	COURSE	CRED IT EARN ED (JKD)	CREDIT COUNT ED (JKK)	TICK (√) IF PASS ED
CORE COURSES (0 CREDITS)					
1	UCSP0010	Research Methodology	0	0	
TOTAL CREDIT OF CORE COURSES (a)			0	0	
UNIVERSITY ELECTIVE COURSES					
1	UCSM1263	IT Project Management	3	3	
	UHAP6013	Seminar on Development, Economics and Global			
	UICW 6023	Philosophy Science and Civilization			
	UHAZ 6123	Malaysian Society and Culture			
TOTAL CREDIT of UNIVERSITY GENERAL COURSES (b)			3	3	
TOTAL CREDIT TO GRADUATE (a + b)			3	3	
RESEARCH					
1	Hard-Bound Thesis endorsed by supervisor – 3 copies				
2	Copy of CD for Each Thesis – Extra 1 unit				
3	Copy of All Semester Results (Pre-Transcript)				
4	Copy of Registration Slip (current semester)				
5	Abstract and Title Page Approval Form (original copy)				
6	Course Checklist (endorsed by coordinator)				
7	Copy of IC (local student) / first page of Passport (international student)				
8	Fee Release Letter (UTM Bendahari)				
9	Exit Survey				
10	Submission of Thesis Form – 3 copies				
11	Verification of Graduate Information Form – 1 copy				

COURSE SYNOPSIS

CORE COURSES

UCSP0010 - Research Methodology

This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Amongst topics that will be covered are introduction to research and its philosophy, problem formulation and research objective, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

UNIVERSITY ELECTIVE COURSES

UCSM 1263 - IT Project Management

This course presents a hands-on perspective to Information Technology project management. This course will assist post-graduate students to plan and implement their post-graduate projects as well as other IT projects effectively. The subject is organized into three main sections, that covers I) Basic concepts, life cycle and framework of project management II) Detailed description of each project management knowledge areas under the Project Management Institute (PMI) Body of Knowledge (PMBOK) and its applications, and III) Real Project Initiation, Planning, Executing, Monitoring and Closing. The Project Management areas include – project integration, scope, time, cost, quality, human resource, communications, risks and procurement management. Students are expected to perform real projects with teams and achieve agreed Key performance Indicators (KPI)

UHAP 6013 - Seminar on Development, Economics and Global

Discussion on this subject includes issues related to globalization and development, economic and social crisis that has become a global concern. It aims in developing skills in understanding and analyzing global issues and recommending relevant solutions. Issues will be discussed in details.

UICW 6023 - Philosophy Science and Civilization

This course is offered to international students in advanced scholar and doctoral programs from Malay societies such as Indonesia, Brunei, South Thailand and Malay-Singapore. This course contains two sections. This subject discusses the world view of its role and importance in shaping the culture of life and civilization; The concepts of revelation, science, humanity, nature and happiness; and Comparative Studies in the Philosophy of Science: Epistemology, Ontology and Axiology in Education. Discussions on current issues and challenges, among others; the challenge of civilization between the West and the East; Development and the environment; Economy and trade; National administration and management; Scientific research; Communication and information technology; Ethics and morals; Crime and violence; and Family education.

UHAZ 6123 - Malaysian Society and Culture

This course is designed for international postgraduates from countries of non-Malay origins. Students will be exposed to various aspects of the Malaysian culture such as belief system, religious festivals, customs and etiquettes of different ethnic groups in Malaysia. Emphasis will be given to the Malay culture as it makes the core for the Dasar Kebudayaan Kebangsaan. Students will also be briefly introduced to basics of Malay language as the national language of Malaysia.

DOCTOR OF PHILOSOPHY

FIELD: INFORMATICS ENGINEERING

PROGRAMME SPECIFICATIONS

The Doctor of Philosophy, Field: Informatics Engineering is offered on a full-time basis. The full-time programme is offered only at the UTM Main Campus in Johor Bahru. The duration of study for the full-time programme is subjected to the student's entry qualifications and lasts between three (3) years to a maximum of eight (8) years.

The programme is offered on full-time basis and is based on a 2-Semester per academic session. This is a full research programme. The candidate is supervised by a lecturer. The directed research work introduces candidates to the process by which new knowledge is developed and applied accordingly. Assessment is done by examining first assessment reports (research proposal), each semester's progress reports, and thesis examination (viva-voce).

General Information

1. Awarding Institution		Universiti Teknologi Malaysia		
2. Teaching Institution		Universiti Teknologi Malaysia		
3. Programme Name		Doctor of Philosophy		
4. Final Award		Doctor of Philosophy		
5. Programme Code		PCSA3AJA		
6. Professional or Statutory Body of Accreditation		Ministry of Higher Education		
7. Language(s) of Instruction		English		
8. Mode of Study (Conventional, distance learning, etc)		Conventional		
9. Mode of operation (Franchise, self-govern, etc)		Self-governing		
10. Study Scheme		Full Time		
11. Study Duration		Minimum : 6 semesters Maximum:12 semesters		
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	6	-	12	-
Short	-	-	-	-

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses	3	100%
ii.	Core Courses	0	0%
iii.	Research	0	0%
	Total	3	100%
Total Credit Hours to Graduate		3 credit hours	

COURSE MENU

Doctor of Philosophy students are required to register and pass the following courses before their first assessment (proposal defense).

- iii. Research Methodology course (course code UCSP0010).
- iv. One University Elective Course (course code U*** **3).

YEAR 1: SEMESTER 1			
Code	Course	Credit	Pre-requisite
UCSM1263	IT Project Management	3	
UHAP6013	Seminar on Development, Economics and Global		
UICW 6023	Philosophy Science and Civilization		
UHAZ 6123	Malaysian Society and Culture		
UCSP0010	Research Methodology	0	
MCSS 1100	*Research	0	
	TOTAL CREDIT	3	
	CUMULATIVE CREDITS	3	

YEAR 1: SEMESTER 2			
Code	Course	Credit	Pre-requisite
MCSS 1200	* Research	0	
	TOTAL CREDIT	0	
	CUMULATIVE CREDITS	3	

* Research (course code PCSI **00), to be taken every semester until the submission of thesis. The progress of a candidate in any semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website <http://spsapp3.utm.my:8080/gsmsv4/>.

RESEARCH CODE

Semester	Research Course Code
1	PCSI 1100
2	PCSI 1200
3	PCSI 2100
4	PCSI 2200
5	PCSI 3100
6	PCSI 3200
7	PCSI 4100
8	PCSI 4200

RESEARCH AREAS

- Information Systems Application and Development
- Information Retrieval
- Data Mining and Knowledge Discovery
- Text Mining and Sentiment Analysis
- Web Mining
- Natural Language Processing
- Information and Knowledge Management
- Database Management
- Business Intelligence Application and Development
- Data Engineering
- Social Media Analytics
- Enterprise Information Systems

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Competent in computer science and digital technologies that foster research and development of new knowledge in specific areas.
PEO2	Has good character, ethics and high integrity and demonstrate behavior that is consistent to professional ethics.
PEO3	Has promote the technological, social and cultural progress in a knowledge based society in the academic and professional contexts.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to identify various computer science theories suitable for particular research context, and justify and verify the proposed solution using computer science theories creatively
PLO2	Ability to conduct computer science research in a systematic and scientific way independently
PLO3	Ability to give suggestion on computer science solutions to the society
PLO4	Ability to demonstrate behaviour that is consistent with the Code of Professional Ethics and Responsibilities
PLO5	Ability to defend critically technical solutions and research findings to a range of audience orally and in writing
PLO6	Ability to identify and analyse real problems critically related to organisational, governmental and social
PLO7	Ability to undertake lifelong learning and actively participate in change
PLO8	Ability to turn ideas into innovative computer science solution to meet the real world needs

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTE D (JKK)	TICK (√) IF PASSE D
CORE COURSES (0 CREDITS)					
1	UCSP0010	Research Methodology	0	0	
TOTAL CREDIT OF CORE COURSES (a)			0	0	
UNIVERSITY ELECTIVE COURSES					
1	UCSM1263	IT Project Management	3	3	
	UHAP6013	Seminar on Development, Economics and Global			
	UICW 6023	Philosophy Science and Civilization			
	UHAZ 6123	Malaysian Society and Culture			
TOTAL CREDIT of UNIVERSITY GENERAL COURSES (b)			3	3	
TOTAL CREDIT TO GRADUATE (a + b)			3	3	
RESEARCH					
1	Hard-Bound Thesis endorsed by supervisor – 3 copies				
2	Copy of CD for Each Thesis – Extra 1 unit				
3	Copy of All Semester Results (Pre-Transcript)				
4	Copy of Registration Slip (current semester)				
5	Abstract and Title Page Approval Form (original copy)				
6	Course Checklist (endorsed by coordinator)				
7	Copy of IC (local student) / first page of Passport (international student)				
8	Fee Release Letter (UTM Bendahari)				
9	Exit Survey				
10	Submission of Thesis Form – 3 copies				
11	Verification of Graduate Information Form – 1 copy				

COURSE SYNOPSIS

CORE COURSES

UCSP0010 - Research Methodology

This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Amongst topics that will be covered are introduction to research and its philosophy, problem formulation and research objective, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

UNIVERSITY ELECTIVE COURSES

UCSM 1263 - IT Project Management

This course presents a hands-on perspective to Information Technology project management. This course will assist post-graduate students to plan and implement their post-graduate projects as well as other IT projects effectively. The subject is organized into three main sections, that covers I) Basic concepts, life cycle and framework of project management II) Detailed description of each project management knowledge areas under the Project Management Institute (PMI) Body of Knowledge (PMBOK) and its applications, and III) Real Project Initiation, Planning, Executing, Monitoring and Closing. The Project Management areas include – project integration, scope, time, cost, quality, human resource, communications, risks and procurement management. Students are expected to perform real projects with teams and achieve agreed Key performance Indicators (KPI)

UHAP 6013 - Seminar on Development, Economics and Global

Discussion on this subject includes issues related to globalization and development, economic and social crisis that has become a global concern. It aims in developing skills in understanding and analyzing global issues and recommending relevant solutions. Issues will be discussed in details.

UICW 6023 - Philosophy Science and Civilization

This course is offered to international students in advanced scholar and doctoral programs from Malay societies such as Indonesia, Brunei, South Thailand and Malay-Singapore. This course contains two sections. This subject discusses the world view of its role and importance in shaping the culture of life and civilization; The concepts of revelation, science, humanity, nature and happiness; and Comparative Studies in the Philosophy of Science: Epistemology, Ontology and Axiology in Education. Discussions on current issues and challenges, among others; the challenge of civilization between the West and the East; Development and the environment; Economy and trade; National administration and management; Scientific research; Communication and information technology; Ethics and morals; Crime and violence; and Family education.

UHAZ 6123 - Malaysian Society and Culture

This course is designed for international postgraduates from countries of non-Malay origins. Students will be exposed to various aspects of the Malaysian culture such as belief system, religious festivals, customs and etiquettes of different ethnic groups in Malaysia. Emphasis will be given to the Malay culture as it makes the core for the Dasar Kebudayaan Kebangsaan. Students will also be briefly introduced to basics of Malay language as the national language of Malaysia.

DOCTOR of PHILOSOPHY

FIELD: SOFTWARE ENGINEERING

PROGRAMME SYNOPSIS

The Doctor of Philosophy, Field: Software Engineering is offered on a full-time basis. The full-time programme is offered only at the UTM Main Campus in Johor Bahru. The duration of study for the full-time programme is subjected to the student's entry qualifications and lasts between three (3) years to a maximum of eight (8) years.

The programme is offered on full-time basis and is based on a 2-Semester per academic session. This is a full research programme. The candidate is supervised by a lecturer. The directed research work introduces candidates to the process by which new knowledge is developed and applied accordingly. Assessment is done by examining first assessment reports (research proposal), each semester's progress reports, and thesis examination (viva-voce).

General Information

1. Awarding Institution		Universiti Teknologi Malaysia		
2. Teaching Institution		Universiti Teknologi Malaysia		
3. Programme Name		Doctor of Philosophy		
4. Final Award		Doctor of Philosophy		
5. Programme Code		PCSQA3AJA		
6. Professional or Statutory Body of Accreditation		Ministry of Higher Education		
7. Language(s) of Instruction		English		
8. Mode of Study (Conventional, distance learning, etc)		Conventional		
9. Mode of operation (Franchise, self-govern, etc)		Self-governing		
10. Study Scheme		Full Time		
11. Study Duration		Minimum : 6 semesters Maximum:12 semesters		
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	6	-	12	-

Short	-	-	-	-
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Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses	3	100%
ii.	Core Courses	0	0%
iii.	Research	0	0%
	Total	3	100%
Total Credit Hours to Graduate		3 credit hours	

COURSE MENU

Doctor of Philosophy students are required to register and pass the following courses before their first assessment (proposal defense).

- v. Research Methodology course (course code UCSP0010).
- vi. One University Elective Course (course code U*** **3).

YEAR 1: SEMESTER 1			
Code	Course	Credit	Pre-requisite
UCSM1263	IT Project Management	3	
UHAP6013	Seminar on Development, Economics and Global		
UICW 6023	Philosophy Science and Civilization		
UHAZ 6123	Malaysian Society and Culture		
UCSP0010	Research Methodology	0	
MCSS 1100	* Research	0	
	TOTAL CREDIT	3	
	CUMULATIVE CREDITS	3	

YEAR 1: SEMESTER 2			
Code	Course	Credit	Pre-requisite
MCSS 1200	*Research	0	
	TOTAL CREDIT	0	
	CUMULATIVE CREDITS	3	

* Research (course code PCSQ **00), to be taken every semester until the submission of thesis. The progress of a candidate in any particular semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website <http://spsapp3.utm.my:8080/gsmv4/>.

RESEARCH CODE

Semester	Research Course Code
1	PCSQ 1100
2	PCSQ 1200
3	PCSQ 2100
4	PCSQ 2200
5	PCSQ 3100
6	PCSQ 3200
7	PCSQ 4100
8	PCSQ 4200

RESEARCH AREAS

- Software Modeling and Specification
- Software Quality and Testing
- Software Usability and Reusability
- Software as Service
- Dependable Embedded Real-Time Systems
- Agile Software Development
- Intelligent Software Systems
- Model Driven Architecture
- Software Product Line
- Software Maintenance and Evolution.
- Human Computer Interaction
- Intelligent System

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Competent in computer science and digital technologies that foster research and development of new knowledge in specific areas.
PEO2	Has good character, ethics and high integrity and demonstrate behavior that is consistent to professional ethics.
PEO3	Has promote the technological, social and cultural progress in a knowledge based society in the academic and professional contexts.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to identify various computer science theories suitable for particular research context, and justify and verify the proposed solution using computer science theories creatively
PLO2	Ability to conduct computer science research in a systematic and scientific way independently
PLO3	Ability to give suggestion on computer science solutions to the society
PLO4	Ability to demonstrate behaviour that is consistent with the Code of Professional Ethics and Responsibilities
PLO5	Ability to defend critically technical solutions and research findings to a range of audience orally and in writing
PLO6	Ability to identify and analyse real problems critically related to organisational, governmental and social
PLO7	Ability to undertake lifelong learning and actively participate in change
PLO8	Ability to turn ideas into innovative computer science solution to meet the real world needs

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNT-ED (JKK)	TICK (✓) IF PASSED
CORE COURSES (0 CREDITS)					
1	UCSP0010	Research Methodology	0	0	
TOTAL CREDIT OF CORE COURSES (a)			0	0	
UNIVERSITY ELECTIVE COURSES					
1	UCSM1263	IT Project Management	3	3	
	UHAP6013	Seminar on Development, Economics and Global			
	UICW 6023	Philosophy Science and Civilization			
	UHAZ 6123	Malaysian Society and Culture			
TOTAL CREDIT of UNIVERSITY GENERAL COURSES (b)			3	3	
TOTAL CREDIT TO GRADUATE (a + b)			3	3	
RESEARCH					
1	Hard-Bound Thesis endorsed by supervisor – 3 copies				
2	Copy of CD for Each Thesis – Extra 1 unit				
3	Copy of All Semester Results (Pre-Transcript)				
4	Copy of Registration Slip (current semester)				
5	Abstract and Title Page Approval Form (original copy)				
6	Course Checklist (endorsed by coordinator)				
7	Copy of IC (local student) / first page of Passport (international student)				
8	Fee Release Letter (UTM Bendahari)				
9	Exit Survey				
10	Submission of Thesis Form – 3 copies				
11	Verification of Graduate Information Form – 1 copy				

COURSE SYNOPSIS

CORE COURSES

UCSP0010 - Research Methodology

This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Amongst topics that will be covered are introduction to research and its philosophy, problem formulation and research objective, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

UNIVERSITY ELECTIVE COURSES

UCSM 1263 - IT Project Management

This course presents a hands-on perspective to Information Technology project management. This course will assist post-graduate students to plan and implement their post-graduate projects as well as other IT projects effectively. The subject is organized into three main sections, that covers I) Basic concepts, life cycle and framework of project management II) Detailed description of each project management knowledge areas under the Project Management Institute (PMI) Body of Knowledge (PMBOK) and its applications, and III) Real Project Initiation, Planning, Executing, Monitoring and Closing. The Project Management areas include – project integration, scope, time, cost, quality, human resource, communications, risks and procurement management. Students are expected to perform real projects with teams and achieve agreed Key performance Indicators (KPI)

UHAP 6013 - Seminar on Development, Economics and Global

Discussion on this subject includes issues related to globalization and development, economic and social crisis that has become a global concern. It aims in developing skills in understanding and analyzing global issues and recommending relevant solutions. Issues will be discussed in details.

UICW 6023 - Philosophy Science and Civilization

This course is offered to international students in advanced scholar and doctoral programs from Malay societies such as Indonesia, Brunei, South Thailand and Malay-Singapore. This course contains two sections. This subject discusses the world view of its role and importance in shaping the culture of life and civilization; The concepts of revelation, science, humanity, nature and happiness; and Comparative Studies in the Philosophy of Science: Epistemology, Ontology and Axiology in Education. Discussions on current issues and challenges, among others; the challenge of civilization between the West and the East; Development and the environment; Economy and trade; National administration and management; Scientific research; Communication and information technology; Ethics and morals; Crime and violence; and Family education.

UHAZ 6123 - Malaysian Society and Culture

This course is designed for international postgraduates from countries of non-Malay origins. Students will be exposed to various aspects of the Malaysian culture such as belief system, religious festivals, customs and etiquettes of different ethnic groups in Malaysia. Emphasis will be given to the Malay culture as it makes the core for the Dasar Kebudayaan Kebangsaan. Students will also be briefly introduced to basics of Malay language as the national language of Malaysia.

MASTER OF PHILOSOPHY

FIELD: SOFTWARE ENGINEERING

PROGRAMME SPECIFICATIONS

The Master of Philosophy, Field: Software Engineering is offered on a full-time basis. The full-time programme is offered only at the UTM Main Campus in Johor Bahru. The duration of study for the full-time programme is subjected to the student's entry qualifications and lasts between two (2) years to a maximum of four (4) years.

The programme is offered on full-time basis and is based on a 2-Semester per academic session. This is a full research programme. The candidate is supervised by a lecturer. The directed research work introduces candidates to the process by which new knowledge is developed and applied accordingly. Assessment is done by examining first assessment reports (research proposal), each semester's progress reports, and thesis examination (viva-voce).

General Information

1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Programme Name	Master of Philosophy			
4. Final Award	Master of Philosophy			
5. Programme Code	MCSQA3AJA			
6. Professional or Statutory Body of Accreditation	Ministry of Higher Education			
7. Language(s) of Instruction	English			
8. Mode of Study (Conventional, distance learning, etc)	Conventional			
9. Mode of operation (Franchise, self-govern, etc)	Self-governing			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Minimum : 2 yrs (4 semesters) Maximum : 4 yrs (8 Semesters)			
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	4	-	8	-
Short	-	-	-	-

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses	3	33%
ii.	Core Courses	6	67%
iii.	Research	0	0%
	Total	9	100%
Total Credit Hours to Graduate		9 credit hours	

COURSE MENU

Master of Philosophy students are required to register and pass the following courses before their first assessment (proposal defense)

- vii. One University Elective Course (course code U*** ***)
- viii. Software Engineering Research Methodology
- ix. Advanced Software Engineering

YEAR 1: SEMESTER 1			
Code	Course	Credit	Pre-requisite
UCCM1263	IT Project Management	3	
UHAP6013	Seminar on Development, Economics and Global		
UICW 6023	Philosophy Science and Civilization		
UHAZ 6123	Malaysian Society and Culture		
MCSQ1103	Software Engineering Research Methodology	3	
MCSQ1203	Advanced Software Engineering	3	
MCSQ1100	* Research	0	
	TOTAL CREDIT	9	
	CUMULATIVE CREDITS	9	

YEAR 1: SEMESTER 2			
Code	Course	Credit	Pre-requisite
MCSQ1200	* Research	0	
	TOTAL CREDIT	0	
	CUMULATIVE CREDITS	9	

* Research (course code MCSQ **00), to be taken every semester until the submission of thesis. The progress of a candidate in any particular semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website <http://spsapp3.utm.my:8080/gsmv4/>.

RESEARCH CODE

Semester	Research Course Code
1	MCSQ1100
2	MCSQ1200
3	MCSQ2100
4	MCSQ2200
5	MCSQ3100
6	MCSQ3200
7	MCSQ4100
8	MCSQ4200

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Competent in software engineering and digital industry and contribute to national development.
PEO2	Has character and ethics, as well as high professionalism and contributes to current and future needs.
PEO3	Creative, innovative, entrepreneurial and able to become leader or team member in an organisation and society.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to integrate and acquire in-depth knowledge in professional practices for the benefits of Software Engineering discipline.
PLO2	Ability to formulate hypothesis, design and perform scientific research in Software Engineering using appropriate methods and tools.
PLO3	Ability to evaluate and make decision taking into consideration social responsibilities related to organization, society and individual to fulfill needs of mankind.
PLO4	Ability to demonstrate behaviours that are consistent with the code of Professional Ethics and Responsibilities.
PLO5	Ability to communicate technical solutions and research findings to a range of audience orally and in writing.
PLO6	Ability to explore in solving scientific problem to produce an innovative software solution.
PLO7	Ability to adapt current knowledge and manage information effectively through the life long learning process.
PLO8	Ability to identify commercial value in software solution.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNT-ED (JKK)	TICK (√) IF PASSED
CORE COURSES (6 CREDITS)					
1	MCSQ1103	Software Engineering Research Methodology	3	3	
2	MCSQ1203	Advanced Software Engineering	3	3	
TOTAL CREDIT OF CORE COURSES (a)			6	6	
UNIVERSITY ELECTIVE COURSES					
1	UCSM1263	IT Project Management	3	3	
	UHAP6013	Seminar on Development, Economics and Global			
	UICW6023	Philosophy Science and Civilization			
	UHAZ6123	Malaysian Society and Culture			
TOTAL CREDIT of UNIVERSITY GENERAL COURSES (b)			3	3	
TOTAL CREDIT TO GRADUATE (a + b)			9	9	
RESEARCH					
1	Hard-Bound Thesis endorsed by supervisor – 3 copies				
2	Copy of CD for Each Thesis – Extra 1 unit				
3	Copy of All Semester Results (Pre-Transcript)				
4	Copy of Registration Slip (current semester)				
5	Abstract and Title Page Approval Form (original copy)				
6	Course Checklist (endorsed by coordinator)				
7	Copy of IC (local student) / first page of Passport (international student)				
8	Fee Release Letter (UTM Bendahari)				
9	Exit Survey				
10	Submission of Thesis Form – 3 copies				
11	Verification of Graduate Information Form – 1 copy				

COURSE SYNOPSIS

CORE COURSES

MCSQ1103 - Software Engineering Research Methodology

This course explores the roles of empiricism in software engineering research, and prepares students for advanced research in software engineering by examining how to plan, conduct, and report on empirical investigations. The course covers all of the principal methods applicable to SE: controlled experiments, case studies, surveys, archival analysis, action research, and ethnographies, and relates these methods to relevant meta-theories in the philosophy and sociology science. The course critically reviews published examples of work that use each of the principal methods, both from within SE and from other disciplines. The course also covers techniques applicable to each of the steps of a research project, including formulating research questions, theory building, data analysis (using both qualitative and quantitative methods), building evidence, assessing validity, and publishing. Having successfully completed the module, students will be able to demonstrate knowledge and understanding on the process of creating engineering and scientific knowledge.

MCSQ1203 - Advanced Software Engineering

This course will expose students to the concepts, principles, and state-of-the-art methods and approaches in the main knowledge areas in software engineering. It includes software process, software quality, domain & requirements engineering, architectural & detailed design, software measurement & testing, and software maintenance & evolution. It also provides opportunities for the students to explore and systematically evaluate the currently available approaches.

UNIVERSITY ELECTIVE COURSES

UCSM 1263 - IT Project Management

This course presents a hands-on perspective to Information Technology project management. This course will assist post-graduate students to plan and implement their post-graduate projects as well as other IT projects effectively. The subject is organized into three main sections, that covers I) Basic concepts, life cycle and framework of project management II) Detailed description of each project management knowledge areas under the Project Management Institute (PMI) Body of Knowledge (PMBOK) and its applications, and III) Real Project Initiation, Planning, Executing, Monitoring and Closing. The Project Management areas include – project integration, scope, time, cost, quality, human resource, communications, risks and procurement management. Students are expected to perform real projects with teams and achieve agreed Key performance Indicators (KPI)

UHAP 6013 - Seminar on Development, Economics and Global

Discussion on this subject includes issues related to globalization and development, economic and social crisis that has become a global concern. It aims in developing skills in understanding and analyzing global issues and recommending relevant solutions. Issues will be discussed in details.

UICW 6023 - Philosophy Science and Civilization

This course is offered to international students in advanced scholar and doctoral programs from Malay societies such as Indonesia, Brunei, South Thailand and Malay-Singapore. This course contains two sections. This subject discusses the world view of its role and importance in shaping the culture of life and civilization; The concepts of revelation, science, humanity, nature and happiness; and Comparative Studies in the Philosophy of Science: Epistemology, Ontology and Axiology in Education. Discussions on current issues and challenges, among others; the challenge of civilization between the West and the East; Development and the environment; Economy and trade; National administration and management; Scientific research; Communication and information technology; Ethics and morals; Crime and violence; and Family education.

UHAZ 6123 - Malaysian Society and Culture

This course is designed for international postgraduates from countries of non-Malay origins. Students will be exposed to various aspects of the Malaysian culture such as belief system, religious festivals, customs and etiquettes of different ethnic groups in Malaysia. Emphasis will be given to the Malay culture as it makes the core for the Dasar Kebudayaan Kebangsaan. Students will also be briefly introduced to basics of Malay language as the national language of Malaysia.

MASTER OF PHILOSOPHY

FIELD: COMPUTER SCIENCE

PROGRAMME SPECIFICATIONS

The Master of Philosophy, Field: Computer Science is offered on a full-time basis. The full-time programme is offered only at the UTM Main Campus in Johor Bahru. The duration of study for the full-time programme is subjected to the student's entry qualifications and lasts between two (2) years to a maximum of four (4) years.

The programme is offered on full-time basis and is based on a 2-Semester per academic session. This is a full research programme. The candidate is supervised by a lecturer. The directed research work introduces candidates to the process by which new knowledge is developed and applied accordingly. Assessment is done by examining first assessment reports (research proposal), each semester's progress reports, and thesis examination (viva-voce).

General Information

1. Awarding Institution		Universiti Teknologi Malaysia		
2. Teaching Institution		Universiti Teknologi Malaysia		
3. Programme Name		Master of Philosophy		
4. Final Award		Master of Philosophy		
5. Programme Code		MCSSA3AJA		
6. Professional or Statutory Body of Accreditation		Ministry of Higher Education		
7. Language(s) of Instruction		English		
8. Mode of Study (Conventional, distance learning, etc)		Conventional		
9. Mode of operation (Franchise, self-govern, etc)		Self-governing		
10. Study Scheme (Full Time/Part Time)		Full Time		
11. Study Duration		Minimum : 2 yrs (4 semesters) Maximum : 4 yrs (8 Semesters)		
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	4	-	8	-
Short	-	-	-	-

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses	3	100%
ii.	Core Courses	0	0%
iii.	Research	0	0%
	Total	3	100%
Total Credit Hours to Graduate		3 credit hours	

COURSE MENU

Master of Philosophy students are required to register and pass the following courses before their first assessment (proposal defence).

- x. Research Methodology course (course code UCSP0010).
- xi. One University Elective Course (course code U*** **3).

YEAR 1: SEMESTER 1			
Code	Course	Credit	Pre-requisite
UCSM1263	IT Project Management	3	
UHAP6013	Seminar on Development, Economics and Global		
UICW 6023	Philosophy Science and Civilization		
UHAZ 6123	Malaysian Society and Culture		
UCSP0010	Research Methodology	0	
MCSS1100	* Research	0	
	TOTAL CREDIT	3	
	CUMULATIVE CREDITS	3	

YEAR 1: SEMESTER 2			
Code	Course	Credit	Pre-requisite
MCSS1200	* Research	0	
	TOTAL CREDIT	0	
	CUMULATIVE CREDITS	3	

* Research (course code MCSS **00), to be taken every semester until the submission of thesis. The progress of a candidate in any particular semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website <http://spsapp3.utm.my:8080/gsmsv4/>.

RESEARCH CODE

Semester	Research Course Code
1	MCSS 1100
2	MCSS 1200
3	MCSS 2100
4	MCSS 2200
5	MCSS 3100
6	MCSS 3200
7	MCSS 4100
8	MCSS 4200

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Competent in computer science and digital industry and contribute to national development.
PEO2	Has character and ethics, as well as high professionalism and contributes to current and future needs.
PEO3	Creative, innovative, entrepreneurial and able to become leader or team member in an organisation and society.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Ability to demonstrate a mastery of knowledge in the field of computer science
PLO2	Ability to conduct Computer Science research in a systematic and scientific way with minimal supervision
PLO3	Ability to demonstrate ability to contribute idea in solving problems related to computer science to society
PLO4	Ability to demonstrate behaviours that are consistent with the code of Professional Ethics and Responsibilities
PLO5	Ability to communicate technical solutions and research findings to a range of audience orally and in writing
PLO6	Ability to generate solutions to problems using scientific and critical thinking skills
PLO7	Ability to manage information for lifelong long learning
PLO8	Ability to identify commercial value in the research output

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNT-ED (JKK)	TICK (✓) IF PASSED
CORE COURSES (0 CREDITS)					
1	UCSP0010	Research Methodology	0	0	
TOTAL CREDIT OF CORE COURSES (a)			0	0	
UNIVERSITY ELECTIVE COURSES					
1	UCSM1263	IT Project Management	3	3	
	UHAP6013	Seminar on Development, Economics and Global			
	UICW 6023	Philosophy Science and Civilization			
	UHAZ 6123	Malaysian Society and Culture			
TOTAL CREDIT of UNIVERSITY GENERAL COURSES (b)			3	3	
TOTAL CREDIT TO GRADUATE (a + b)			3	3	
RESEARCH					
1	Hard-Bound Thesis endorsed by supervisor – 3 copies				
2	Copy of CD for Each Thesis – Extra 1 unit				
3	Copy of All Semester Results (Pre-Transcript)				
4	Copy of Registration Slip (current semester)				
5	Abstract and Title Page Approval Form (original copy)				
6	Course Checklist (endorsed by coordinator)				
7	Copy of IC (local student) / first page of Passport (international student)				
8	Fee Release Letter (UTM Bendahari)				
9	Exit Survey				
10	Submission of Thesis Form – 3 copies				
11	Verification of Graduate Information Form – 1 copy				

COURSE SYNOPSIS

CORE COURSES

UCSP0010 - Research Methodology

This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Amongst topics that will be covered are introduction to research and its philosophy, problem formulation and research objective, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

UNIVERSITY ELECTIVE COURSES

UCSM 1263 - IT Project Management

This course presents a hands-on perspective to Information Technology project management. This course will assist post-graduate students to plan and implement their post-graduate projects as well as other IT projects effectively. The subject is organized into three main sections, that covers I) Basic concepts, life cycle and framework of project management II) Detailed description of each project management knowledge areas under the Project Management Institute (PMI) Body of Knowledge (PMBOK) and its applications, and III) Real Project Initiation, Planning, Executing, Monitoring and Closing. The Project Management areas include – project integration, scope, time, cost, quality, human resource, communications, risks and procurement management. Students are expected to perform real projects with teams and achieve agreed Key performance Indicators (KPI)

UHAP 6013 - Seminar on Development, Economics and Global

Discussion on this subject includes issues related to globalization and development, economic and social crisis that has become a global concern. It aims in developing skills in understanding and analyzing global issues and recommending relevant solutions. Issues will be discussed in detail.

UICW 6023 - Philosophy Science and Civilization

This course is offered to international students in advanced scholar and doctoral programs from Malay societies such as Indonesia, Brunei, South Thailand and Malay-Singapore. This course contains two sections. This subject discusses the world view of its role and importance in shaping the culture of life and civilization; The concepts of revelation, science, humanity, nature and happiness; and Comparative Studies in the Philosophy of Science: Epistemology, Ontology and Axiology in Education. Discussions on current issues and challenges, among others; the challenge of civilization between the West and the East; Development and the environment; Economy and trade; National administration and management; Scientific research; Communication and information technology; Ethics and morals; Crime and violence; and Family education.

UHAZ 6123 - Malaysian Society and Culture

This course is designed for international postgraduates from countries of non-Malay origins. Students will be exposed to various aspects of the Malaysian culture such as belief system, religious festivals, customs and etiquettes of different ethnic groups in Malaysia. Emphasis will be given to the Malay culture as it makes the core for the Dasar Kebudayaan Kebangsaan. Students will also be briefly introduced to basics of Malay language as the national language of Malaysia.

MASTER OF COMPUTER SCIENCE

PROGRAMME SPECIFICATIONS

The Master of Science, Field: Computer Science is offered on a full-time basis. The full-time programme is offered only at the UTM Main Campus in Johor Bahru. The duration of study for the full-time programme is subjected to the student's entry qualifications and lasts to a maximum of four (4) years.

The programme is offered on full-time and is based on a 2-Semester per academic session. This is a mixed-mode master programme. Academic load for each semester depends on total number of credits. Students can take a minimum of one course (equivalent to 3-4 credits) up to a maximum of twenty (20 credits) for full-time. Students are required to finish all course works before starting dissertation. Students with a minimum CGPA of 3.5 can register one (1) elective course together with dissertation. Students who register courses with UM status can also register dissertation. Assessment method for academic achievement is the combination of two (2) parts, that is based on GPA/CGPA and research progress report. The research progress report needs to be submitted by week 12 of the semester through GSMS. Dissertation evaluation is graded based on three categories i.e. satisfactory (MM), Unsatisfactory (TM) and Fail (GG).

General Information

1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Programme Name	Master of Computer Science			
4. Final Award	Master of Computer Science			
5. Programme Code	MCSSA2AJA			
6. Professional or Statutory Body of Accreditation	Ministry of Higher Education			
7. Language(s) of Instruction	English			
8. Mode of Study (Conventional, distance learning, etc)	Conventional			
9. Mode of operation (Franchise, self-govern, etc)	Self-governing			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Full-time : Minimum - 3 semesters : Maximum - 8 semesters			
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	3	-	8	-
Short	-	-	-	-

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses	3	6.7%
ii.	Programme Core Courses	12	26.7%
iii.	Programme Electives	6	13.3%
iii.	Research	24	53.3%
	Total	45	100%
Total Credit Hours to Graduate		45 credit hours	

COURSE MENU

Master of Computer Science students are required to register and pass the following courses before their first assessment (proposal defense).

- i. **FOUR** Core Courses
- ii. **TWO** Elective Courses
- iii. **ONE** University Elective Course (course code M*** **3).
- iv. Research (course code MECS xx80)

COURSE MENU 1

YEAR 1: SEMESTER 1			
Code	Course	Credit	Pre-requisite
MECS1023	Advanced Data Structure and Algorithm	3	
MECS1033	Advanced Artificial Intelligence		
MECS1043	Research Methodology in Computer Science (Dissertation I)		
Mxxx xxx3	Elective I	3	
Uxxx xxx3	University Common Elective	3	
	TOTAL CREDIT	15	
	CUMULATIVE CREDITS	15	

YEAR 1: SEMESTER 2			
Code	Course	Credit	Pre-requisite
MECS1013	Advanced Theory of Computer Science	3	
Uxxx xxx3	Elective II	3	
MECSxx80	Dissertation II	9	
	TOTAL CREDIT	15	
	CUMULATIVE CREDITS	30	

YEAR 2: SEMESTER 1			
Code	Course	Credit	Pre-requisite
MECSxx80	Dissertation III	15	
	TOTAL CREDIT	15	
	CUMULATIVE CREDITS	45	

COURSE MENU 2

YEAR 1: SEMESTER 1			
Code	Course	Credit	Pre-requisite
MECS1023	Advanced Data Structure and Algorithm	3	
MECS1033	Advanced Artificial Intelligence		
MECS1043	Research Methodology in Computer Science (Dissertation I)		
	TOTAL CREDIT	9	
	CUMULATIVE CREDITS	9	

YEAR 1: SEMESTER 2			
Code	Course	Credit	Pre-requisite
MECS1013	Advanced Theory of Computer Science	3	
Mxxx xxx3	Elective I	3	
Uxxx xxx3	University Common Elective	3	
	TOTAL CREDIT	9	
	CUMULATIVE CREDITS	18	

YEAR 2: SEMESTER 1			
Code	Course	Credit	Pre-requisite
Mxxx xxx3	Elective II	3	
MECSxx80	Dissertation II	9	
	TOTAL CREDIT	12	
	CUMULATIVE CREDITS	30	

YEAR 2: SEMESTER 2			
Code	Course	Credit	Pre-requisite
MECSxx80	Dissertation III	15	
	TOTAL CREDIT	15	
	CUMULATIVE CREDITS	45	

* Research (course code MECS **80), to be taken every semester until the submission of thesis. The progress of a candidate in any particular semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website <http://spsapp3.utm.my:8080/gsmstv4/>.

RESEARCH CODE

Semester	Research Course Code
1	MECS xx80
2	MECS xx80

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Acquire mastery and competency in advanced computing knowledge
PEO2	Become computer scientists who are effective communicators, professional and imbued with high standards of ethical conducts within their organization and society
PEO3	Be analytical thinkers who are responsive to the changing environment and practice lifelong learning

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Apply advanced knowledge to solve critical issues in the field of Computer Science. (Knowledge and Understanding)
PLO2	Manage and solve complex problems efficiently using systematic and standard approaches. (Cognitive Skills)
PLO3	Adapt technical and scientific skills to solve real world problems. (Practical Skills)
PLO4	Perform effective collaboration with stakeholders professionally. (Interpersonal Skills)
PLO5	Use a broad range of information, media and technology to support study or research findings. (Communication Skills)
PLO6	Use digital technologies and software competently to support study or research works. (Digital Skills)
PLO7	Analyse numerical or graphical data using quantitative or qualitative methods for solving problems. (Numeracy Skills)
PLO8	Demonstrate leadership, autonomy and responsibility in a team by managing resources and tasks fairly. (Leadership, Autonomy and Responsibility)
PLO9	Perform independent studies for self-advancement through continuous academic or professional development. (Personal Skills)
PLO10	Propose entrepreneurial project based on relevant knowledge and expertise. (Entrepreneurial Skills)
PLO11	Conduct respectable, ethical and professional practices in organization and society. (Ethics and Professionalism Skills)

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNT-ED (JKK)	TICK (✓) IF PASSED
(a) CORE COURSES (12 CREDITS) - ALL					
1	MECS1013	Advanced Theory of Computer Science	3	3	
	MECS1023	Advanced Data Structure and Algorithm			
	MECS1033	Advanced Artificial Intelligence			
	MECS1043	Research Methodology in Computer Science (Dissertation I)			
TOTAL CREDIT OF CORE COURSES (a)			12	12	
(b) ELECTIVE COURSES (6 CREDITS) – CHOOSE 2 ONLY					
2	MCSD2213	Advanced Analytics for Data Science	3	3	
	MCSD1233	Big Data Management			
	MCSD2123	Massive Data Mining and Streaming			
	MECH1063	Cryptographic Engineering			
	MECH2213	Cyber Threat Intelligence			
	MECH1023	Information Security Governance and Risk Management			
	MECS2423	Virtual and Augmented Reality Environment			
	MECS2433	Advanced Computer Graphics and Image Processing			
	MECS2413	Advanced Human Computer Interaction			
	MECS2323	Advanced Computer Network and Cloud Computing			
	MECS2313	Advanced Computer System & Architecture			
	MECS2343	Blockchain Technology			
	MEEH1293	Intelligent Engineering Solution			
	MKET1423	Wireless Communication systems			
MKET1523	Internet of Things Technology				

TOTAL CREDIT OF ELECTIVE COURSES (b)			6	6	
(c) UNIVERSITY GENERAL COURSES (3 CREDITS) – CHOOSE 1 ONLY					
1	UBSS6013	Organization Behavior and Development	3	3	
	UBSS6023	Business Ethics, Responsibility and Sustainability			
	UHMS6013	Seminar on Global Development, Economic and Social Issues			
	UHMZ6023	Malaysian Society and Culture			
	UHS6013	Philosophy of Science and Civilization			
	UHPS6013	Dynamics of Leadership			
	UHLM6013	Malay Language for Postgraduates			
	URTS6013	Environmental Ethics			
	UECS6013	IT Project Management			
	UECS6023	Introduction to Technopreneurship			
	UMJJ6013	Basic Japanese Language and Culture			
TOTAL CREDIT OF UNIVERSITY GENERIC COURSES (c)			3	3	
(d) RESEARCH (24 CREDITS)					
1	MECS xx80	Dissertation II	9	9	
2	MECS xx80	Dissertation III	15	15	
TOTAL CREDIT OF CORE COURSES (d)			24	24	
TOTAL CREDIT TO GRADUATE (a + b + c + d)			45	45	
RESEARCH					
1	Binded Thesis endorsed by supervisor – 1 copy				
2	Copy of CD for Each Thesis – Extra 1 unit				
3	Copy of All Semester Results (Pre-Transcript)				
4	Copy of Registration Slip (current semester)				
5	Copy of Publication				
6	Course Checklist (endorsed by coordinator)				
7	Copy of IC (local student) / first page of Passport (international student)				
8	Fee Release Letter (UTM Bendahari)				
9	Exit Survey				
10	Verification Correction Form (Dissertation III)				
11	Verification of Graduate Information Form – 1 copy				

COURSE SYNOPSIS

CORE COURSES

MECS1013 – Advanced Theory of Computer Science

The course presents the most fundamental theories and concepts that provide a mathematical sense to answer some of the basic question as can the given problems be solved by computation and how efficiently can a given problem be solved by computation. The course provides an in-depth study to the main models and concepts of the mathematical theory of computation, including automata and languages, computability and complexity. The emphasis of the course will be on the ability to move from a concrete problem to a mathematical model, and after proving things about the mathematical model to correctly interpret what we have learned about the concrete problem.

MECS1023 – Advanced Data Structure and Algorithm

This course provides a solid or advanced understanding to theory and practice of data structure and the study of algorithms analysis. Students will learn the most common data structures and the advanced concepts of the data structure such as B-trees, heaps and priority queues. Further, students will be exposed to the techniques used in the development and analysis of data structures and its algorithms. The analytical abilities of the students in this course are to analyze the performance of data structures and algorithms. At the end of the course, students should be able to implement and apply the theory and concepts of the advanced data structure in assignments.

MECS1033 – Advanced Artificial Intelligence

Increasing practical implementation of several Soft Computing approaches in real world problems has grounded this course to explore the intensity of SC techniques. As such, Neural Computing, Nature Inspired Computing and Granular Computing provide foundations for the conception, design and development of the intelligent systems. By hybridizing such paradigms, it has been possible to create a number of successful and sophisticated solutions to complex real-world problems. The aim of this course is to provide the student with knowledge of the principles, mechanisms and theory behind SC and their applications. The theory of each SC techniques is given in a conceptual and in a mathematical way; the practice is discussed with stress on the outcomes of successful applications and on the intricacies of the actual implementations

MECS1043 – Advanced Computer System and Architecture

This course covers the general principles of Research Methodology that are applicable to Computing and Digital Technology discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Among topics that will be covered are introduction to research and its philosophy, problem formulation and research objectives, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

ELECTIVE COURSES

MCSD2213 – Advanced Analytics for Data Science

This course provides a solid or advanced understanding on the use of analytics approach in the examination of data or content to discover deeper insights, make predictions or generate recommendations using sophisticated techniques and tools on real world problems. Students will learn descriptive analytics using advance tools to gain insight into the past. Students will also acquire understanding of predictive analytics using statistical and machine learning techniques to understand future outcome. The prescriptive analytics provides knowledge in simulation and optimization to quantify the effect of future decision to advise possible outcomes before decision is made. The analytical abilities to be acquired by students in this course are to reliably select analytic techniques or method and specify steps involve in the analysis process and to interpret analytically the results obtained from data analytics techniques or tools. At the end of the course, students should be able to implement and apply the knowledge on analytical techniques or tools in real world problems and able to make an informed decisions or recommendation through analytical interpretations of results.

MCSD1233 – Big Data Management

This course provides a basic fundamental of big data architecture and management. Students will learn the big data processes and the current big data technologies that are available. Further, students will be exposed to the big data platform ecosystem for big data manipulation. The big data management will be explored for the best practice in managing and manipulating large amount of data. At the end of the course, students should be able to understand the architecture and management of big data and also can develop simple application of big data handling using particular platform in assignment.

MCSD2123 – Massive Data Mining and Streaming

This course aims to introduce students to basic principles and methods of machine learning algorithms that are typically used for mining large data sets. This course also will provide students with the skill and knowledge to build system and capable of analysing huge amount of data. It explains the principle of distributed file systems and shows Map reduce as a tool for creating parallel algorithms. Typically, it covers the algorithms that used for analysing networks, fundamental principles of techniques such as decision trees and support vector machines and finally neural network architecture. The students will gain practical understanding through a coding exercise where they will implement and apply one machine learning algorithm on a particular large dataset.

MECS1063 – Cryptographic Engineering

This is a survey and seminar course that gives an overview on the concepts of advanced database topics such as databases to handle objects, unstructured data, semi-structured data; distributed databases and data warehouses. The course opens with a sequence of lectures by the instructor to provide background on post relational database systems. This sets the stage for student review paper on their topic of interest and a practical group project in databases to expose them to issues and research solutions regarding emerging database technologies.

MECS2213 – Cyber Threat Intelligence

With the rapid increase of cyber attacks, accurate security information is becoming more difficult to obtain. This course exposes the students to a complete cycle of CTI which includes hunting, behavioral patterns extraction, clustering and correlation, threat actor attribution until taking it down. Besides, it also explains the Cyber Kill Chain process in launching an attack. Understanding CKC is important in detecting cyberthreat. CTI will be explained in 3 different levels; strategic, tactical and operational.

MECS1023 – Information Security Governance and Risk Management

The subject is aimed at imparting knowledge and skill sets required to assume the overall responsibilities of administration and management of security of an information system. This subject covers issues related to administration, management and governance of security of information systems. Topics include auditing and data management, risk management (risk identification, risk analysis, risk control), contingency planning, incident handling and risk governance. The subject will study in detail principles and tools related to these topics. The subject will also cover security standards, evaluation and certification process, security planning, ethical and legal issues in information and privacy.

MECS2423 – Virtual and Augmented Reality Environment

This course focuses on Virtual and Augmented Reality (AR) systems, algorithms, and applications. With the proliferation of powerful, always-on, Internet-connected mobile devices such as smartphones, tablets and newer head-worn displays, sophisticated applications that combine location-specific content with the current user view are becoming more possible. Application developers for these devices require a broad set of technical and design skills to create effective interactive AR experiences. Topics will include vision-based marker and feature tracking, model-to-view space transformations, mobile application development, and AR interaction techniques

MECS2433 – Advanced Computer Graphics and Image Processing

The aim of the course is to give understanding of sound knowledge and theory of Computer Graphics & Image Processing. First part of the lecture will cover basic and advanced theory of Computer Graphics. Second part of the lecture will deal with Image Processing and Pattern Recognition.

MECS2413 – Advanced Human Computer Interaction

This course provide the students with advanced topics in Human Computer Interaction (HCI). The course give students practice and theoretical knowledge of the use of HCI methodologies for both design and evaluation, different types of HCI experimentation, including both quantitative and qualitative methods. Students are expected to participate in group activities, student-led presentations and discussion of several research papers in HCI.

MECS2323 – Advanced Computer Network and Cloud Computing

This course focuses on advanced topics in the computer network. Topics covered include the technical knowledge of IPv6, concept of SDN, and implementation of wireless, sensed, Adhoc and 5G network. The second part is Students will have an opportunity to perform research in these and other areas of computer network and cloud computing.

MECS2413 – Advanced Computer System & Architecture

This course focuses on advanced topics in the design and analysis of computer architectures. Topics covered include instruction set design, pipelining, instruction-level parallelism, high-speed memory systems, storage systems, interconnection networks, and multiprocessor architectures. Students will have an opportunity to perform research in these and other areas in the field of computer architecture.

MECS2343 – Blockchain Technology

This course focuses on the introduction to blockchain technology and its applications. Blockchain is a technology which will lead majority of data storage and information sharing for upcoming many industries. In this course students will understand about fundamentals of blocks, blockchain protocol as well as the fundamental of cryptographic primitives used in the Blockchain and smart contract. The protocol behind the chain formation of blocks with data stored will be understood with practical implementations. Consensus Protocol creation for blockchain formation will be created using python script to understand blockchain from very core. As a hands on, students will be introduced with a development of blockchain application through Solidity Smart Contract platform.

MEEH1293 – Intelligent Engineering Solution

In an increasingly competitive world where more and more data is becoming available from web documents, digital media, financial markets, and wireless sensors, there is a great need for new intelligent systems that can analyse the huge amounts of data and make the right decisions. These intelligent systems can analyse the stock markets and make robust predictions, control and optimize factory productions in an uncertain environment, improve transportation safety, improve the quality of life of the elderly or entertain the children. This course provides students a solid theoretical foundation, a set of practical tools and project that allow the understanding and the design of intelligent systems and services that fulfils the needs for a dynamic and everchanging industry and offer exciting opportunities for research.

MKET1423 – Wireless Communication Systems

This course introduces students to introductory and advanced level of wireless communication technologies. In the beginning students will be presented with the concept of wireless communication systems and mobile radio propagation. Students will then be illuminated on MIMO technology in mobile communication. Next, the course will describe on cellular concepts that will include small cell networks. This is followed by details on the overall evolution of mobile communication system. Finally, this course will cover on different multiple access techniques used in wireless communication systems.

MKET1523 – Internet of Things Technology

The course provides students with a technical background to the Internet of Things (IoT) which includes its concept, architecture and applications. It also gives the underlying communication protocols and technologies. The course has a significant practical element that will be delivered during lab sessions in which students are expected to complete exercises involving system design, device programming and cloud development.

RESEARCH

MECS XX80 – Dissertation II

This is the initial part of a 2-part Master dissertation that every student must fulfil successfully. Students are required to propose a suitable research topic under the supervision of a lecturer as a supervisor. Students must meet regularly with supervisor who will monitor their continuous progress. At the end of this course, students are required to prepare a report and present their proposal.

MECS XX80 – Dissertation III

This is the second part of a 2-part Master dissertation that every student must fulfil successfully. In this installation, students are required to execute the next phases of their development plan from Part 1. Students are now required to code and integrate the different modules that make up the proposed project. Students will test the developed modules and the final fully-integrated project following software development and research testing practices. Students must meet regularly with supervisor(s) who will monitor their continuous progress. Students are required to prepare a report and present their final work.

MASTER OF SCIENCE (DATA SCIENCE)

PROGRAMME SPECIFICATIONS

The Master of Science (Data Science) is a coursework programme offered on a full-time basis at the UTM Main Campus in Johor Bahru. The duration of study for the full-time programme is subjected to the student's entry qualifications and lasts between one and half (1 1/2) years to a maximum of four (4) years.

The coursework programme is offered based on a 2-Semester per academic session. In this programme, the candidate will learn not only to apply data science, but they will acquire insight into how and why methods work so they will be able to construct solutions to new challenges in data science. Furthermore, student will also be able to work on problems specific to a scientific discipline and to combine knowledge domain with the latest data analysis methods and tools.

General Information

1. Awarding Institution		Universiti Teknologi Malaysia		
2. Teaching Institution		Universiti Teknologi Malaysia		
3. Programme Name		Master of Science (Data Science)		
4. Final Award		Master of Science (Data Science)		
5. Programme Code		MCSDA1AJA		
6. Professional or Statutory Body of Accreditation		<i>Malaysian Qualification Agency (MQA)</i>		
7. Language(s) of Instruction		English and Bahasa Melayu		
8. Mode of Study (Conventional, Distance Learning, etc)		Conventional		
9. Mode of Operation (Franchise, Self-govern, etc)		Self-governing		
10. Study Scheme (Full Time/Part Time)		Full Time		
11. Study Duration		Minimum : 1 year 6 months (3 semesters) Maximum : 4 years (8 semesters)		
Type of Semester	No. of Semesters		No of Weeks/Semesters	
	Full Time	Part Time	Full Time	Part Time
Normal	3	-	8	-
Short	-	-	-	-

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses	3	6.66%
ii.	Core Courses	21	46.67%
iii.	Elective Courses	9	20.00%
iv.	Master Project	12	26.67%
	Total	45	100%
Total Credit Hours to Graduate		45 credit hours	

COURSE MENU

SYLLABUS	SEM 1	SEM 2	SEM 3	TOTAL
University Elective Course			UHAP 6013 UHAW 6023 UCSM 1263 UHAZ 6123	3
Faculty Compulsory Courses	MCS D 1113 MCS D 1013 MCS D 1123 MCS D 1043 MCS D 1053	MCS D 2123 MCS D 2213		21
Faculty's Elective Courses	MCS D 1103	MCS D 1133	MCS D 1143	9
Master Project		MCS D 6215	MCS D 6227	12
Total Credits	18	14	13	45

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of Data Science field.
PEO2	Practice professionalism and high standards of ethical conducts within organization and society.
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Synthesize complex information, specialized concepts, theories, methods and practice independently in the field of Data Science. (Knowledge and Understanding)
PLO2	Solve complex problems critically and integratively using systematic approaches. (Cognitive Skills)
PLO3	Apply practical skills to solve problems in the field of Data Science. (Practical Skills)
PLO4	Demonstrate effective collaboration with stakeholders professionally. (Interpersonal Skills)
PLO5	Communicate effectively the knowledge, skills and ideas using appropriate methods to peers, experts and communities. (Communications Skills)
PLO6	Use digital technologies and appropriate softwares competently to enhance study and practice. (Digital Skills)
PLO7	Evaluate numerical and graphical data critically using quantitative or qualitative tools in solving problems. (Numeracy Skills)
PLO8	Demonstrate leadership, autonomy and responsibility in managing resources. (Leadership, Autonomy and Responsibility)
PLO9	Engage self-advancement through continuous learning or professional development. (Personal Skills)
PLO10	Initiate entrepreneurial projects supported by relevant knowledge and skills. (Entrepreneurial Skills)
PLO11	Demonstrate respectable ethical conducts and professionalism skills in an organization and society. (Ethics and Professionalism Skills)

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

*Please attach a copy of results for previous semesters and a copy of registration slip for current semester.				
University Common Elective (Choose 1 course)		Credit	Grade	Pass
UHAP 6013	Seminar on Global Development, Economics and Social Issues	3		
UHAW 6023	Philosophy of Science and Civilization	3		
UCSM 1263	IT Project Management	3		
UHAZ 6123	Malaysian Society and Culture	3		
Core Subject (Compulsory)				
MCS D 1013	Business Intelligence and Analytics	3		
MCS D 1043	Research Design and Analysis in Data Science	3		
MCS D 1053	Data Science Governance	3		
MCS D 1113	Statistic for Data Science	3		
MCS D 1123	Big Data Management	3		
MCS D 2123	Massive Data Mining and Streaming	3		
MCS D 2213	Advanced Analytics for Data Science	3		
Elective Subject (Choose 3 courses)				
MCS D 1103	Data Visualization	3		
MCS D 1133	Operational Research and Optimization	3		
MCS D 1143	Supply Chain Analytic	3		
MCS D 1153	Human Based Computing	3		
MCS D 1123	Big Data Computing	3		
Master Projects				
MCS D 6215	Master Project I	5		
MCS D 6227	Master Project II	7		
Total		45		

COURSE SYNOPSIS

CORE COURSES

MCSD1013 - Business Intelligence and Analytics

Business intelligence and analytics refers to the solutions implemented by enterprises such as businesses, non-profits and governments using data to gain insights for making better decisions. Business intelligence and analytics is applied in operations, marketing, finance and strategic planning among other functions. The ability to use data effectively to drive rapid, precise and profitable decision has been critical strategic advantages for companies. With the increasing availability of broad and deep sources of information-so called “Big data”-business intelligent and analytics are becoming an even more critical capability for enterprises of all types and all sizes to identify trends and understand the information that can drive business change and support sustained successful business practices.

MCSD1043 - Research Design and Analysis in Data Science

This course will cover the fundamental steps and implementation on developing the initial ideas to formal academic writing accordingly. Students will be given the mechanisms on how to transform and digest the literature reviews that leads to the proposed title. The theoretical and practical aspects of implementing draft project proposal will be the milestone of this course. Ordered, Critical and Reasoning Exposition of knowledge through student efforts.

MCSD1053 - Data Science Governance

Data governance is a mandatory requirement for a successful organization which aims to be data driven, achieve master data management, build business intelligence, improve data quality or efficiently manage documents. This course provides an overview of the data governance life cycle. Students will learn why data governance is needed, how to design, initiate, and execute a program and how to keep the program sustainable. The governance in the aspect of big data will be explored for the best practice in managing and manipulating large amount of data. At the end of the course, students should be able to understand the design and the implementation of data governance and its importance to an organization

MCSD1113 - Statistic for Data Science

This course provides a fundamental concept in statistics for data science. Students will learn statistical inference including estimation, hypothesis testing and nonparametric tests. Further, students will be introduced to Bayesian inference, linear regression and classification. R will be used to apply these statistical methods. At the end of the course, students should be able to apply the statistical methods to real large data sets.

MCSD1123 - Big Data Management

This course provides a basic fundamental of big data architecture and management. Students will learn the big data processes and the current big data technologies that are available. Further, students will be exposed to the big data platform ecosystem for big data manipulation. The big data management will be explored for the best practice in managing and manipulating large amount of data. At the end of the course, students should be able to understand the architecture and management of big data and also can develop simple application of big data

handling using particular platform in assignment.

MCSD2123 - Massive Data Mining and Streaming

This course aims to introduce students to basic principles and methods of machine learning algorithms that are typically used for mining large data sets. This course also will provide students with the skill and knowledge to build system and capable of analyzing huge amount of data. It explains the principle of distributed file systems and shows map reduce as a tool for creating parallel algorithms. Typically, it covers the algorithms that used for analyzing networks, fundamental principles of techniques such as decision trees and support vector machines and finally neural network architecture. The students will gain practical understanding through a coding exercise where they will implement and apply one machine learning algorithm on a particular large dataset.

MCSD2213 - Advanced Analytics for Data Science

This course provides a basic yet solid understanding on the use of analytics approach in the examination of data or content to discover deeper insights and make predictions using sophisticated techniques and tools on real world problems. Students will learn descriptive analytics using analytics tools to gain insight into the past. Students will also acquire understanding of predictive analytics using statistical and machine learning techniques to understand future outcome. The prescriptive analytics provides knowledge in simulation and optimization to quantify the effect of future decision to advise possible outcomes before decision is made. The analytical abilities to be acquired by students in this course are to reliably select analytic techniques or method and specify steps involve in the analysis process for descriptive and predictive analysis. At the end of the course, students should be able to apply the knowledge on analytical techniques or tools in real world problems to be able to make an informed decision through analytical interpretations of results.

ELECTIVE COURSES

MCSD1103 - Data Visualization

This course is an introduction to the principles and techniques for visualization to transform and visualize the large datasets to aid knowledge discovery and decision-making. Students will learn the principles, techniques, and practical skill necessary to communicate information about data clearly and effectively through data visualization. Further, students will be exposed to techniques for visualizing different types of data including categorical, time series, spatial, and multiple variables data. Additionally, students will utilize available tools to visualize the dataset. At the end of the course students should be able to implement and apply the theory and use tools to communicate information out of the data clearly and effectively through graphical means.

MCSD1133 - Operational Research and Optimization

The aim of the course is to introduce students to some applications of data science that can be formulated and solved by operational research and optimization techniques. Students will learn the theory and how to practice it for modeling (formulate, analyze and solve) optimization problems arising in data intensive environments. Further, students will be exposed to use appropriate operational research or optimization software

MCS1143 - Supply Chain Analytics

The course aims to improve operational efficiency and effectiveness by enabling data-driven decisions at strategic, operational and tactical levels. The student will be able to perform analysis using data analytics methods and analytical tools necessary in the areas of predictive, descriptive and prescriptive analytics to efficiently manage demand and supply networks. Through the analysis and discussion of case studies they will discover business insights in order to optimize the value of supply chain processes and operations. The topics covered include designing the supply chain network, planning demand and supply in a supply chain, retail analytics, inventory management and transport analytics. Software packages such as R, Python and Tableau will be utilized.

MCS1153 - Human-based Computing

This course offers students a new perspective on the study of human biological systems to human computing system. This course will emphasize on the theoretical of human computing aspect which includes dendrite, immune, membrane and cell computing. The fundamental concept of this course will be designed to come out with algorithmic computing based for solving meta complex data in chaotic environment.

MCS1163 - Big Data Computing

This course is designed to be suitable for an introductory course at master levels. This course covers intensive exploration on GPU computing with CUDA programming. The foundations of the CUDA programming will be addressed in terms of the concept, design, architecture and programming model to deal with the needs of big data computing. Students will also be exposed to the current needs of big data era in which the big data computing accessory will be given especially on the implementation of high-performance computing in executing GPU Machine Learning Library (GPULib).

UNIVERSITY COURSES

UCSM1263 - IT Project Management

This course presents a hands-on perspective to Information Technology Project Management. This course will assist postgraduate students to plan and implement their postgraduate projects as well as other IT projects effectively. The subject is organized into three main sections, that covers I) Basic concepts, life cycle and framework of project management II) Detailed description of each project management knowledge areas under the Project Management Institute (PMI) Body of Knowledge (PMBOK) and its applications, and III) Real Project Initiation, Planning, Executing, Monitoring and Closing. The Project Management areas include – project integration, scope, time, cost, quality, human resource, communications, risks and procurement management. Students are expected to perform real projects with teams and achieve agreed Key Performance Indicators (KPI).

UHAP6013 - Seminar on Global Development, Economics and Social Issues

Discussion on this subject includes issues related to globalization and development, economic and social crisis that has become a global concern. It aims in developing skills in understanding and analyzing global issues and recommending relevant solutions. Issues will be discussed in detail.

UHAW6023 Philosophy of Science and Civilization

This course contains two sections. This subject discusses the world view of its role and importance in the formation of a living culture and civilization; The concept of revelation, knowledge, humanity, nature and happiness; Comparative Study in Philosophy of Science: Epistemology, Ontology and Axiology in education. Discussion on current issues and challenges, among others; civilizational challenges between the West and the East; Development and the environment; Economy and trade; State Administration and management; Scientific research; Communications and information technology; Ethics and morals; Crime and terrorism; Family education

UHAZ6123 - Malaysia Society and Culture

This course is designed for international postgraduates from countries of non-Malay origins. Students will be exposed to various aspects of the Malaysian culture such as belief system, religious festivals, customs and etiquettes of different ethnic groups in Malaysia. Emphasis will be given to the Malay culture as it makes the core for the *Dasar Kebudayaan Kebangsaan*. Students will also be briefly introduced to basics of Malay language as the national language of Malaysia.

MASTER PROJECT

MCSD6215 - Master Project 1

This is the initial part of a 2-part Master project that every student must fulfill successfully. Students are required to propose a suitable research topic under the supervision of a lecturer as a supervisor. Students must meet regularly with supervisor who will monitor their continuous progress. At the end of this course, students are required to prepare a report and present their proposal.

MCSD6227 - Master Project 2

This is the second part of a 2-part Master project that every student must fulfill successfully. In this phase, students are required to execute the next phases of their development plan from Part 1 (Project 1). Students are now required to code and integrate the different modules that make up the proposed project. Students will test the developed modules and the final fully-integrated project following programming code development and research testing practices. Students must meet regularly with supervisor(s) who will monitor their continuous progress. Students are required to prepare a report and present their final work.

MASTER OF CYBER SECURITY

PROGRAMME SPECIFICATIONS

The Master of Cyber Security is offered on a full-time basis. The full-time mode is offered only at the UTM main campus in Johor Bahru. The duration of study for the full-time programme is 3 semesters (1.5 years), subjected to the student's entry qualifications with total number of credits is 45.

This programme bridges the gap between those cyber security aspects with the real world requirements. The aim of this programme is to support the global need in producing professional, dedicated and ethical cyber security experts who will effectively plan, design, manage and practice reliable cyber security mechanisms and technologies. The programme is designed based on top cyber security professional certifications such as CISSP (Certified Information Systems Security Professional), CPT (Certified Penetration Tester), CSAP (Certified Secure Application Professional), CDSP (Certified Data Security Professional) and CHFI (Computer Hacking and Forensic Investigation).

General Information

1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Programme Name	Master of Cyber Security			
4. Final Award	Master of Cyber Security			
5. Programme Code	MECRA1AJA			
6. Professional or Statutory Body of Accreditation	Ministry of Higher Education			
7. Language(s) of Instruction	English			
8. Mode of Study (Conventional, distance learning, etc)	Conventional, Open Distance Learning (ODL).			
9. Mode of operation (Franchise, self-govern, etc)	Self-governing			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Full Time Minimum : 1.5 years Maximum : 4 years			
Type of Semester	No. of Minimum Semesters		No. of Maximum Semesters	
	Full Time	Part Time	Full Time	Part Time
Normal	3	-	8	-
Short	-	-	-	-

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Common Elective Course	3	6%
ii.	Core Faculty Course	3	6%
iii.	Core Courses	18	41%
iv.	Elective Courses	9	20%
v.	Project (1 and 2)	12	27%
	Total	45	100%
Total Credit Hours to Graduate		45 credit hours	

COURSE MENU

Additional Courses (for Non CS background)	
MECR 0013	Cryptography
MECR 0023	Computer Security

University Common Elective Courses (Choose 1 Only)	
UECS 6013	IT Project Management
UHis 6013	Philosophy of Science and Civilization
UHLM 6013	Malay Language for Post Graduates
UHMS 6013	Seminar on Global Development, Economic and Social Issues
UHMZ 6023	Malaysian Society and Culture
UBSS 6013	Organization Behavior and Development
UBSS 6023	Business Ethics, Responsibility and Sustainability
UHPS 6013	Dynamics of Leadership
URTS 6013	Environmental Ethics
UECS 6023	Introduction to Technopreneurship
UMJJ 6013	Basic Japanese Language and Culture
Core Faculty Course (Compulsory)	
MECR 1013	Research Methodology
Core Courses (Compulsory)	
MECR 1023	Information Security Governance and Risk Management
MECR 1033	Digital Forensics
MECR 1043	Cloud Computing Security
MECR 1053	Secure Software Engineering
MECR 1063	Cryptographic Engineering
MECR 1073	Penetration Testing
Elective Courses (Choose 3 only)	
MECR 2113	Business Continuity Planning
MECR 2123	Security Audit & Assessment
MECR 2213	Cyber Threat Intelligence
MECR 2223	Security Data Exploration
MECR 2233	Security Data Analytics & Visualization
MECR 2313	Software Exploitation

MECR 2323	Malware Analysis
Projects (Compulsory)	
MECR 2415	Project 1
MECR 2427	Project 2

Programme Structure (Full Time)

SYLLABUS	SEMESTER 1	SEMESTER 2	SEMESTER 3	TOTAL CREDITS
University Common Elective Courses		(Choose 1) U*** 6**3		3
Core Faculty Course	MECR 1013			3
Core Courses	MECR 1023 MECR 1033 MECR 1043 MECR 1053	MECR 1063 MECR 1073		18
Elective Courses		(Choose 1) MECR 2113 MECR 2123 MECR 2213 MECR 2223 MECR 2233 MECR 2313 MECR 2323	(Choose 2) MECR 2113 MECR 2123 MECR 2213 MECR 2223 MECR 2233 MECR 2313 MECR 2323	9
Project 1		MECR 2415		5
Project 2			MECR 2427	7
Total Credits	15	17	13	45

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of Cyber Security field.
PEO2	Practice professionalism and high standards of ethical conducts within organization and society.
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Synthesize complex information, specialized concepts, theories, methods and practice independently in the field of Cyber Security. (Knowledge and Understanding)
PLO2	Solve complex problems critically and integratively using systematic approaches. (Cognitive Skills)
PLO3	Apply practical skills to solve problems in the field of Cyber Security. (Practical Skills)
PLO4	Demonstrate effective collaboration with stakeholders professionally. (Interpersonal Skills)
PLO5	Communicate effectively the knowledge, skills and ideas using appropriate methods to peers, experts and communities. (Communications Skills)
PLO6	Use digital technologies and appropriate softwares competently to enhance study and practice. (Digital Skills)
PLO7	Evaluate numerical and graphical data critically using quantitative or qualitative tools in solving problems. (Numeracy Skills)
PLO8	Demonstrate leadership, autonomy and responsibility in managing resources. (Leadership, Autonomy and Responsibility)
PLO9	Engage self-advancement through continuous learning or professional development. (Personal Skills)
PLO10	Initiate entrepreneurial projects supported by relevant knowledge and skills. (Entrepreneurial Skills)
PLO11	Demonstrate respectable ethical conducts and professionalism skills in an organization and society. (Ethics and Professionalism Skills)

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

*Please attach a copy of results for previous semesters and a copy of registration slip for current semester.				
Courses		Credit	Grade	Pass
Additional Courses (for Non-CS background)				
MECR 0013	Cryptography	3		
MECR 0023	Computer Security	3		
University Common Elective Courses (Choose 1 only)				
UECS 6013	IT Project Management	3		
UHS 6013	Philosophy of Science and Civilization	3		
UHLM 6013	Malay Language for Post Graduates	3		
UHMS 6013	Seminar on Global Development, Economic and Social Issues	3		
UHMZ 6023	Malaysian Society and Culture	3		
UBSS 6013	Organization Behavior and Development	3		
UBSS 6023	Business Ethics, Responsibility and Sustainability	3		
UHPS 6013	Dynamics of Leadership	3		
URTS 6013	Environmental Ethics	3		
UECS 6023	Introduction to Technopreneurship	3		
UMJJ 6013	Basic Japanese Language and Culture	3		
Core Faculty Course (Compulsory)				
MECR 1013	Research Methodology	3		
Core Courses (Compulsory)				
MECR 1023	Information Security Governance and Risk Management	3		
MECR 1033	Digital Forensics	3		
MECR 1043	Cloud Computing Security	3		
MECR 1053	Secure Software Engineering	3		
MECR 1063	Cryptographic Engineering	3		
MECR 1073	Penetration Testing	3		
Elective Courses (Choose 3 only)				
MECR 2113	Business Continuity Planning	3		
MECR 2123	Security Audit & Assessment	3		
MECR 2213	Cyber Threat Intelligence	3		
MECR 2223	Security Data Exploration	3		
MECR 2233	Security Data Analytics & Visualization	3		
MECR 2313	Software Exploitation	3		
MECR 2323	Malware Analysis	3		

Projects (Compulsory)				
MECR 2415	Project 1	5		
MECR 2427	Project 2	7		
	TOTAL CREDITS:			

CAREER OPPORTUNITIES

Security Specialist/ Administrator/ Architect/ Analyst/ Auditor/ Director/ Consultant/ Engineer/ Manager; Cryptographer; Cryptanalyst; Chief Information Security Officer; Vulnerability Assessor; Incident Responder; Forensic Expert; Penetration Tester; Source Code Auditor.

COURSE SYNOPSIS

ADDITIONAL COURSES

MECR 0013 Cryptography

Cryptography addresses the principles, means, and methods of disguising information to ensure its integrity, confidentiality and authenticity. This course provides the background for the application and implementation of security mechanisms covered in the other courses. It deals with both theoretical and practical aspects of cryptography, to give an insight to the problems that arise in cryptography and the tools used to solve them. It introduces both symmetric key cipher system and public key cryptography, covering methods of obtaining the objectives of CIA (Confidentiality, Integrity and Availability).

MECR 0023 Computer Security

This course covers the body of knowledge on technologies, processes, and practices designed to protect networks, devices, programs, and data from attack, damage, or unauthorized access. The types of computer security that will be covered are application security, network security, internet security, data security, information security and end user security.

CORE FACULTY COURSE

MECR 1013 Research Methodology

This course covers the fundamental steps and implementation on developing the initial ideas to formal academic writing accordingly. Students will be given the mechanisms on how to transform and digest the literature reviews that leads to the proposed research title. This course helps students to prepare the research proposal for Projects. The theoretical and practical aspects of implementing the proposal will be the milestone of this course.

CORE COURSES

MECR 1023 Information Security Governance and Risk Management

The course is aimed at imparting knowledge and skill sets required to assume the overall responsibilities of administration and management of security of an information system. This course covers issues related to administration, management and governance of security of information systems. Topics include auditing and data management, risk management (risk identification, risk analysis, risk control), contingency planning, incident handling and risk governance. The course will study in detail principles and tools related to these topics. The course will also cover security standards, evaluation and certification process, security planning, ethical and legal issues in information and privacy.

MECR 1033 Digital Forensics

This course takes a detailed approach to the use of computers and computer technology in the investigation of incidents, both criminal and civil, in which computer technology play a significant or interesting role. Students completing this course will be familiar with the core computer science theory and practical skills necessary to perform elementary computer/digital

forensic investigations, understand the role of technology in investigating computer-based crime, and be prepared to deal with investigative bodies at an elementary level.

MECR 1043 Cloud Computing Security

In this course, we are going to learn about common cloud misconfigurations, how to perform a risk assessment and verify compliance for various Cloud Services. Further, we will delve deeper into identifying security risks in these cloud services and to implement best practices to mitigate the common cloud misconfigurations. Other topics include topics of data ownership, privacy protections, data mobility, quality of service and service levels, bandwidth costs, data protection, and support.

MECR 1053 Secure Software Engineering

This course provides the principles of Secure Software Engineering and practical methods to secure requirements, design, implementation, testing, deployment and maintenance in software development. Students will also review policy specific requirements necessary to implement a secure development program within enterprise organizations. The students will also be able to understand software vulnerability, and how to evaluate, and address security risks to software.

MECR 1063 Cryptographic Engineering

This course is a continuation from the introductory cryptography. All networked computers and devices must have cryptographic layers implemented, and must be able to access to cryptographic functions in order to provide security features. In this context, efficient (in terms of time, area, and power consumption) hardware and software structures will have to be designed, implemented, and deployed. Discussion and analysis on how to resist cryptanalytic attacks by protecting access to primary (communication) and secondary (power, electromagnetic, acoustic) channels. Learn the algorithms, methods, and techniques in order to create latest cryptographic embedded software and hardware using common platforms and technologies. In addition to that, ethical issues in cryptography is discussed as well.

MECR 1073 Penetration Testing

This course will discuss issues pertaining to penetration testing which covers areas like finding vulnerabilities in various computer systems, exploiting them in an ethical manner. Emphasis is given on the fundamental theory and as well as hands on practice. Topics covered include information reconnaissance, web application pentesting, wireless pentesting, network pentesting, and current issues in pentesting.

ELECTIVE COURSES

MECR 2113 Business Continuity Planning

The course is aimed at imparting knowledge and skill sets required to prepare to respond to a disaster and restore normal operations afterward. This subject covers issues related to administration and management of disaster recovery program. The important plan for disaster recovery includes the contingency plans: i) the Incident Response Planning (IRP), ii) Disaster Recovery Planning (DRP), iii) Business Impact Analysis (BIA) and iv) Business Continuity Planning (BCP). Topics include preparing to develop disaster recovery plan, assessing risk,

prioritizing system and functions for recovery, developing plans and procedure and organizational relationships in disaster recovery. The subject will study in detail principles and tools related to these topics. The subject will also cover procedures to response to attacks on computer, implementing disaster recovery plans, testing and rehearsal, assessment of needs, threats and solutions and living through a disaster.

MECR 2123 Security Audit & Assessment

The aim of this course is to provide students with knowledge of how security audits and assessment are being performed against company's information security system. Security audits are often used to determine regulatory compliance, in the wake of legislation (such as HIPAA, the Sarbanes-Oxley Act or etc.) that specifies how organizations must deal with information. The purpose is to evaluate, assess and measure how well the security conforms to a set of established criteria. Within the broad scope of auditing information security there are multiple types of audits, multiple objectives for different audits. Most commonly the controls being audited can be categorized to technical, physical (e.g. system's physical configuration) and administrative (e.g. information handling processes and user practices). Also, auditing information security covers topics from auditing the physical security of data centers to auditing the logical security of databases and highlights key components to look for and different methods for auditing these areas.

MECR 2213 Cyber Threat Intelligence

With the rapid increase of cyber attacks, accurate security information is becoming more difficult to obtain. This course exposes the students to a complete cycle of CTI which includes hunting, behavioral patterns extraction, clustering and correlation, threat actor attribution until taking it down. Besides, it also explains the Cyber Kill Chain process in launching an attack. Understanding CKC is important in detecting cyberthreat. CTI will be explained in 3 different levels; strategic, tactical and operational.

MECR 2223 Security Data Exploration

This course is essential to help the CTI analyst to dissect data to find clues in detecting the cyberthreats. It covers techniques commonly used to explore and understand data obtained from various sources. Exploratory Data Analysis in general is an approach to analyzing data sets to summarize their main characteristics, usually visual methods are used. Primarily, data is explored to see what the data can tell us beyond the formal modeling or hypothesis testing task. It ranges from pre-processing techniques for detection, validation, error correction, and filling up of missing or incorrect data. Emphasis on finding the relationship among variables and Clustering to find patterns and associations among groups of data is also covered.

MECR 2233 Security Data Analytics & Visualization

This course consists of security analytics and visual analytics. Security analytics is an approach to cyber security focused on the analysis of data to produce proactive security measures. For example, monitored network traffic could be used to identify indicators of compromise before an actual threat occurs. Classification, regression and clustering we will be explored in analysing security data. Model evaluation is also covered. Data visualization is the only approach that scales to the ever-changing threat landscape and infrastructure configurations. Using data visualization techniques, we can gain a far deeper understanding

of what's happening on our network. We can uncover hidden patterns of data, identify emerging vulnerabilities and attacks, and respond decisively with countermeasures that are far more likely to succeed than conventional methods. Visual analytics and its concept and design will be covered. Security data will be visualized using selected visualization tool.

MECR 2313 Software Exploitation

This course will discuss issues pertaining to software exploitation, finding vulnerabilities in various computer programs and exploiting them in an ethical manner. Topics covered include vulnerability discovery, stack overflow exploitation, format string exploitation, head overflow exploitation, shellcoding, and current issues in exploitation.

MECR 2323 Malware Analysis

This course will discuss issues pertaining to analysis of malicious software code. Emphasis is given on the fundamental theory and as well as hands on practice. Topics covered include static analysis, dynamic analysis, defensive mechanism of malware, and some topics on malware research.

PROJECTS

MECR 2415 Project 1

This is the initial part of a 2-parts Master project that every student must fulfil successfully. Students are required to propose a suitable research topic under the supervision of a lecturer as a supervisor. Students must meet regularly with supervisor who will monitor their continuous progress. At the end of this course, students are required to prepare a report to be evaluated and present their proposal.

MECR 2427 Project 2

This is the second part of a 2-parts Master project that every student must fulfil successfully. Students are required to execute the next phases of their development plan in Project 1. Students are now required to code and integrate the different modules that make up the proposed project. Students will test the developed modules and the final fully-integrated the project following software development and research testing practices. Students must meet regularly with supervisor(s) who will monitor their continuous progress. Students are required to prepare a report to be evaluated and present their final work. The corrected report will be printed as a Master's thesis.

UNIVERSITY COMMON ELECTIVE COURSES

UECS 6013 IT Project Management

This course presents a hands-on perspective to Information Technology project management. This course will assist post-graduate students to plan and implement their post-graduate projects as well as other IT projects effectively. The subject is organized into three main sections, that covers: i) Basic concepts, life cycle and framework of project management, ii) Detailed description of each project management knowledge areas under the Project Management Institute (PMI) Body of Knowledge (PMBOK) and its applications, and iii) Real Project Initiation, Planning, Executing, Monitoring and Closing. The Project Management

areas include – project integration, scope, time, cost, quality, human resource, communications, risks and procurement management. Students will also be utilizing latest tools for understanding, reviewing, communicating and developing Business Model for a project. Teams of students are expected to perform real projects and achieve agreed Key Performance Indicators (KPI).

UHS 6013 Philosophy of Science and Civilization

This course discusses the meaning and nature of the philosophy of science and civilization. It seeks first to explore the different denotation, connotation, and cognitive substance of philosophy, science, and civilization, as independent concepts. It then seeks to understand these terminologies individually in their historical perspectives and their relationship to each other. Understanding the meaning and import of culture is necessary to our understanding of civilization. The study of the nature and meaning of religion is therefore significant in our appreciation of culture and civilization. Historically, Islam and the Muslims have always been intricately connected to the Western world. Thus, the discussion also includes comparative studies of Islamic and western philosophy and universal values. The final discussion is about the contribution of Islam to the world's civilization, education, culture and scientific development.

UHLM 6013 Malay Language for Post Graduates

This course is offered to international students of the Masters and PhD programmes, from Indonesia, Brunei, Southern Thailand and Singapore. In this course students are given exposure on how to write scientific works (in Malay). The focus of this course is the spelling aspect, punctuation, sentence variety, language adjustment, paragraph writing and writing style. In addition, students will be exposed on writing formats such as literature writing, citations, bibliographies, abstracts and editing.

UHMS 6013 Seminar on Global Development, Economic and Social Issues

This course focuses on different approaches to economic development with reference to economic growth. Discussion on this course also includes issues related to globalization, technology and digital divides as well as the social crisis that has become a global concern. It aims in developing skills in understanding and analyzing global issues and recommending relevant solutions. Issues will be discussed in detail.

UHMZ 6023 Malaysian Society and Culture

This course is designed for international postgraduates. This course discusses on the various aspects of the Malaysian culture and society. Topics on belief system, religious festivals, customs and etiquettes of different ethnic groups in Malaysia will be introduced to the students. In addition, students will also be introduced to the Malay Language. At the end of the course students should be able to understand the cultures practiced among Malaysians and adapt themselves to these new cultures.

UHPS 6013 Dynamics of Leadership

This course is intended to encourage students discover and develop their personal leadership qualities. Students will be exposed to leadership theories so that they could develop an insight that leadership itself is a dynamic relationship based on mutual influence and common

purpose between leaders and followers. Topics covered include Introduction to Leadership, Leadership Traits & Ethics, Leadership Behaviour and Motivation, Influencing: Power, Politics, Networking and Negotiation, Contingency Leadership Theories, Communication, Coaching, and Conflict Skills, The Leader-Follower Relationship, Team Leadership, Leading Self-Managed Teams, Transformational and Level 5 Leadership. Students will be evaluated based on their class leadership role, short talk and personal learning portfolios.

URTS 6013 Environmental Ethics

Environmental ethics is the discipline in philosophy that studies the moral relationship of human beings to, and also the value and moral status of, the environment and its nonhuman contents. It covers the challenge of environmental ethics to the anthropocentrism (i.e., human-centeredness) embedded in traditional western ethical thinking; the early development of the discipline in the 1960s and 1970s; the connection of deep ecology, feminist environmental ethics, and social ecology to politics; and the attempt to apply traditional ethical theories, and virtue ethics, to support contemporary environmental concerns. It focus on environmental literature on wilderness, and possible future developments of the discipline.

UMJJ 6013 Basic Japanese Language and Culture

At this course, students will be introduced to a simple yet useful familiar everyday expressions and very basic phrases using basic grammars to develop oral communication skills for social purposes. This course is suitable for beginners who wish to develop basic conversational skills in a short period. E-learning will be introduced and students must complete some Kana and communication courses within the time frame by self-learning. After this course, students are expected to speak common phrases in different situations and make simple conversation in Japanese language.

UECS 6023 Introduction to Technopreneurship

This course provides an overview of the basic concepts on entrepreneurship focusing on the nature, environment, and risks of new venture formation and building of businesses with IT in the Malaysian context. Students will learn on how to analyse and evaluate the business opportunities using knowledge and skills taught in this course and suggest innovative business ideas, business planning, self-assessment and operating strategies required to start a new small business. Students will also be exposed to current case studies of existing companies involved in the IT business. Active participation by students during class discussions and activities is encouraged & expected so that students can gain hands on experience with conducting research, develop, write, evaluate, presenting and defending segments of a business plan.

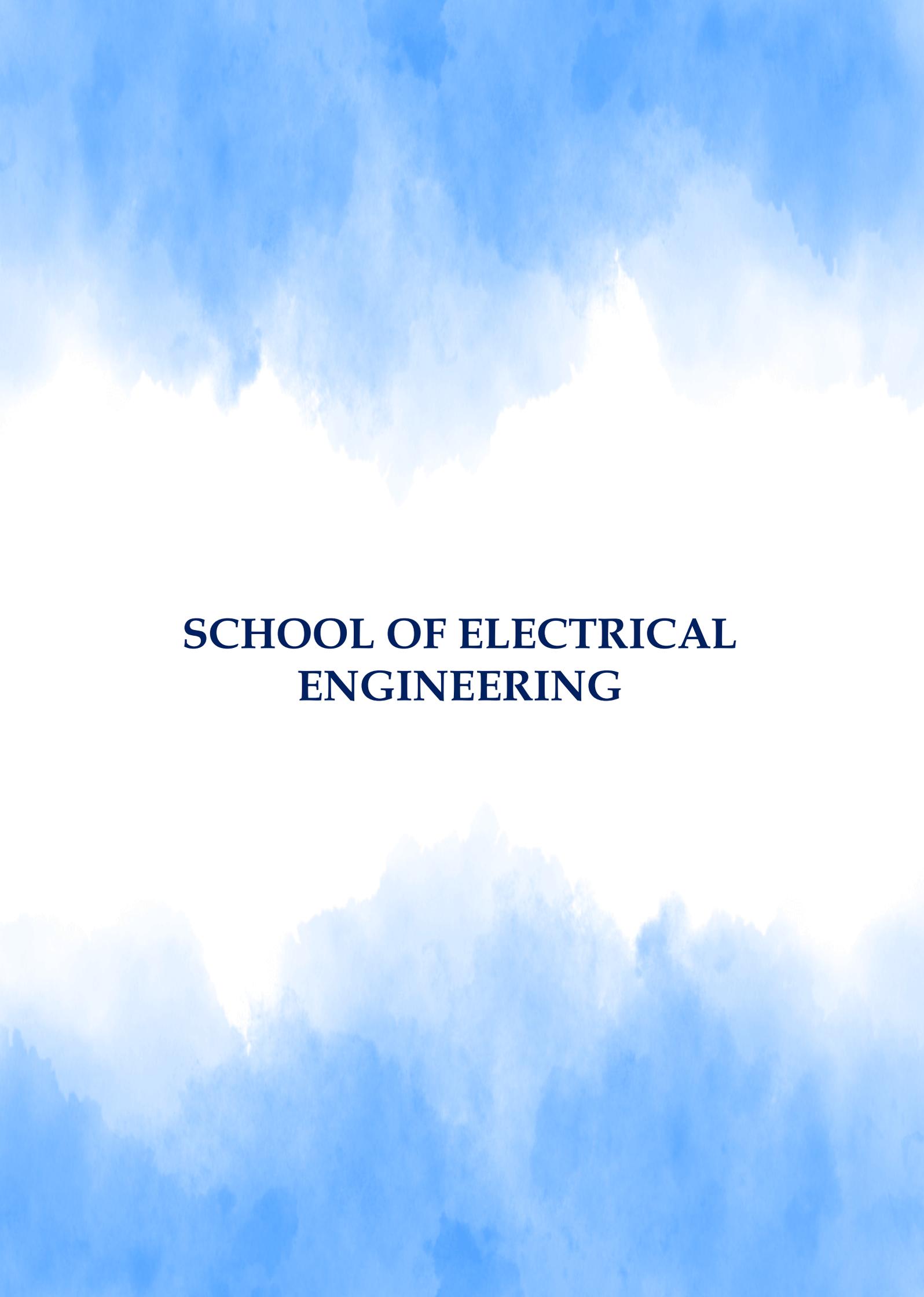
UBSS 6023 Business Ethics, Responsibility and Sustainability

Business plays a significant role in societal and environmental well-being. Private and public organizations are no longer responsible to shareholders and those inside the organizations, but to external parties including consumers, politicians, regulators, communities and ordinary citizens. To fulfil the conflicting needs of these stakeholders, business leaders and managers often encounter complex situations that require them to make difficult decisions whereby the lines between right and wrong are blurry. This course aims to provide students the fundamental knowledge about the role of organizations in a society and to develop their skills

to sustainably manage organizations that integrate legal, ethical, economic, environmental, and social dimensions into their decision-making. The course intends to develop responsible managers who have high integrity, professionalism and interpersonal skills. The course will also teach strategies on how managers can promote responsible conducts in their companies. The course objectives will be achieved through various teaching and learning methods specifically through critical examination of case studies involving ethical issues and dilemmas on complex and controversial business problems. This course is integrative in nature built upon the understanding and reflection of the main disciplines covered in the core courses in the MBA program.

UBSS 6013 Organization Behavior and Development

This course helps students integrate behavioural science theories, tools, concepts, and techniques learned in the lab to an OB application in a "real" organization. Students are expected to conceptualize and apply Organization Behaviour three-level of analysis and synthesize it with the theory and practice of Planned Change for individuals, groups and organizations. Throughout the course, participants are exposed to the important topics central to behaviours of organization and its holistic process for development and change. Some of the topics include multiple views of organizations that influence organizational change, the evolution of organizational development and its challenges. The course also covers the nature of planned change, theories and types of change, the role of values and ethics in organizational change, and the concept of emergent change to enable participants to have an overall view of how available approaches to planned change management can be applied in organizational settings.



**SCHOOL OF ELECTRICAL
ENGINEERING**

DOCTOR OF PHILOSOPHY

Degrees granted: Ph.D. in Electrical Engineering [Program code: PKEE]

The Doctor of Philosophy (Ph.D.) at the School of Electrical Engineering was introduced to complement the existing research master's program. This program is a multi-disciplinary research award degree for those who already hold a master's degree (in Master of Electrical Engineering or equivalent) and would like to expand and upgrade their knowledge.

This program produces human capital, which is not only intellectual and competent in modern and advanced technology but also versatile and capable of handling problems in real-life situations. Successful completion of the program will prove that candidates have successfully gone through comprehensive and rigorous research training. The Ph.D. thesis is expected to make a major contribution to the discipline by way of new knowledge.

The degree is awarded based on a comprehensive oral examination (*viva voce*) of the thesis submitted by the candidate on the completion of the study. Prospective graduate students should prepare themselves adequately, both in the fundamental subject matter necessary for advanced work and other branches of learning, so they may conduct quality research and successfully complete their programs.

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of electrical engineering field.
PEO2	Professionalism and high standards of ethical conducts within organization and society
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Attain advanced knowledge on theories, methods and applications related to electrical engineering field.
PLO2	Demonstrate mastery in conducting research independently in solving problems related to electrical engineering through relevant analytical methods, simulations and/or experiments.
PLO3	Synthesize engineering knowledge through design and development.
PLO4	Plan and perform research undertakings responsibly, professionally and ethically.
PLO5	Communicate and express knowledge and ideas effectively.

PLO6	Continue life-long learning and apply technology for the betterment of humanity.
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Program Duration

The Doctor of Philosophy degree takes typically 3.5 years (7 semesters) with the maximum duration of 8 years (16 semesters). Ph.D. students are supervised by a graduate faculty member or a panel of supervisors. Co-supervisors may be appointed from the industry. The progress of a candidate is assessed through research progress reports submitted at the end of each semester.

M.Phil.-to-Ph.D. Conversion

First class Bachelor Graduates (CGPA \geq 3.70/4.00) may apply for fast-track Ph.D. M.Phil. students may also apply for conversion to Ph.D. program when they have demonstrated excellent achievement in Master-level research and the project can be extended in scope for Ph.D.-level research (terms & conditions apply).

Program Structure

Ph.D. students are required to register and pass the following courses

- Research Methodology course (course code UKEP0010), to be taken once during study. Students are advised to take this course in the first semester of study.
- One University Elective Course (course code U*** **3), to be taken once during study.
- Research (course code PKEE **00), to be taken every semester until the submission of thesis. The progress of a candidate in any particular semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website <http://spsapp3.utm.my:8080/gsmsv4/>.

Thesis Submission and Examination

In the 3rd semester, Ph.D. students will undergo the first stage evaluation process. The objective of this evaluation process is to assist and ensure the research they are conducting is in the right direction and eventually meet the expectation of the research program. Students will receive a copy of the panel report containing suggestion and recommendation that will guide and improve the undertaken work.

At the end of the study, students will submit a thesis for the purpose of an oral examination. Prior to submission of the thesis for the oral examination (viva), students must submit the Notice for Thesis Submission at least 3 months in advance. This is to ensure that approved internal and external examiners have been appointed by the university before the oral examination can take place. Failure to do so may delay the viva process.

MASTER OF PHILOSOPHY

PROGRAMME SPECIFICATIONS

The Master of Philosophy (M.Phil.) offered at SKE is a research degree program for those holding a Bachelor's degree in Electrical Engineering of the equivalent field who would like to expand and upgrade their knowledge. This multi-disciplinary program assists candidates to develop skills in high-level analysis and presentation, as well as integrate academic and professional concerns. Successful completion of the program will indicate that candidates have completed a course of research training. The M.Phil. thesis is expected to make an invaluable contribution of new knowledge or to the existing body of knowledge in the field. The degree is awarded based on a comprehensive oral examination (viva voce) of the thesis submitted by the candidate on the completion of the study. Prospective graduate students should prepare themselves adequately, both in the fundamental subject matter necessary for advanced work and other branches of learning, so they may conduct quality research and complete their programs excellently.

GENERAL INFORMATION

1. Awarding Institution	Universiti Teknologi Malaysia
2. Teaching Institution	Universiti Teknologi Malaysia
3. Programme Name	Master of Philosophy
4. Final Award	M.Phil. in Electrical Engineering
5. Programme Code	MKEE
6. Professional or Statutory Body of Accreditation	Kementerian Pendidikan Malaysia
7. Language(s) of Instruction	English and Bahasa Melayu
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-governing
10. Study Scheme (Full Time/Part Time)	Full Time
11. Study Duration	Minimum : 2 yrs Maximum : 4 yrs

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of Electrical Power, Electronics, Instrumentation, Control, and Telecommunication engineering field.
PEO2	Professionalism and high standards of ethical conducts within organization and society.
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Attain advanced knowledge on theories, methods, and applications related to Electrical Power, Electronics, Instrumentation, Control, and Telecommunication engineering field.
PLO2	Demonstrate mastery in conducting research independently in solving problems related to Electrical Power, Electronics, Instrumentation, Control, and Telecommunication Engineering through relevant analytical methods, simulations and/or experiments.
PLO3	Synthesize engineering knowledge through design and development.
PLO4	Plan and perform research undertakings responsibly, professionally and ethically.
PLO5	Communicate and express knowledge and ideas effectively.
PLO6	Continue life-long learning and apply technology for the betterment of humanity.

PROGRAM DURATION

The Master of Philosophy program takes typically two years (4 semesters) with a maximum duration of 4 years (8 semesters). M.Phil. students are supervised by graduate faculty members or a panel of supervisors. Co-supervisors may be appointed from the industry. The progress of a candidate is assessed through research progress reports submitted at the end of each semester.

COURSE LIST

No.	Course	Code	Credit Hours
1.	Research Methodology	UKEP0010	0
2.	University Elective Course	U*** **3	3
3.	Research	MKEE **00	0

GRADUATION CHECKLIST

M.Phil. students are required to register and pass the following courses:

Research Methodology course (course code UKEP0010)

To be taken once during the study. Students are advised to take this course in the first semester of study.

University Elective Course (course code U* ***)**

One course is to be taken once during the study.

Research (course code MKEE **00)

To be taken every semester until the submission of the thesis. The progress of a candidate in each semester is assessed through research progress reports submitted at the end of the semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website <http://spsapp3.utm.my:8080/gsmsv4/>.

THESIS SUBMISSION AND EXAMINATION

In the 2nd semester of the Masters' program, research students will undergo the first stage evaluation process. The objective of this evaluation process is to assist and ensure the research they are conducting is in the right direction and eventually meet the expectation of the research program. Students will receive a copy of the panel report containing suggestion and recommendation that will guide and improve the undertaken work.

At the end of the study, students will submit a thesis for an oral examination. Before submission of the thesis for the oral examination (viva), students must submit the Notice for Thesis Submission at least three months in advance. This is to ensure that approved internal and external examiners have been appointed by the university before the oral examination can take place. Failure to do so may delay the viva process.

MASTER OF ENGINEERING BY TAUGHT COURSE

Degrees granted:

M. Eng. (Computer and Microelectronic Systems) - [Program code MKEH]

M. Eng. (Mechatronics and Automatic Control) - [Program code MEEM]

M. Eng. (Electrical Power) - [Program code MKEP]

M. Eng. (Wireless Communication and Network) - [Program code MKET]

School of Electrical Engineering (SKE) offers Master program by taught course that provides students to study in one of our five specialized Masters programs. At SKE, we offer a range of specialized courses founded on a unified philosophy of engineering teaching, which ensures the breadth of technical knowledge demanded of a professional engineer. Our curricular are in-line with industry needs.

Mode of Study:

Graduate students can pursue an on-campus or off-campus taught course program. On-campus taught course programs are offered at UTM's main campus in Johor Bahru. Select off-campus programs are available at the UTM Kuala Lumpur campus or other centres.

- **On-campus (PERDANA):** The on-campus study requires a minimum duration of 1.5 years (three semesters). The student may register a maximum of twenty (20) credits in the normal semester. The class sessions take place during weekdays. International students on study visa can only register for this mode of study.
- **Off-campus (PESISIR):** Off-campus study normally takes 2 years (4 normal semesters and one 8-week short semester) to complete. The student may register a maximum of twelve (12) credits in the normal semester and maximum of six (6) credits in short semester. Classes are scheduled on weekends to suit working professionals. Expatriates on working visa and permanent residents may register in this mode of study.

Teaching Methods: A taught module takes the following forms: formal lectures, tutorials, assignment and/or laboratory work as well as industrial exposure. Each 3-credit module is delivered in 42 hours of lectures. Teaching/learning is student-centered; hence it should be complemented with adequate self-study and self-learning by the students.

Assessment and Grading: Students' progress is assessed (continuously) throughout the semester by a coursework assessment component and a final examination for each module. The coursework component may consist of set written assignments, practical work/lab assignments, and short tests. Passing mark for each taught module is 60% or equivalent to B-. Any failed core course must be repeated with that same course, while failed elective course can be replaced with another elective course approved by the Postgraduate office.

Students must obtain at least 2.67 *cumulative grade point average* (CGPA) or equivalently a B- average for each semester to continue the study. For a Masters degree to be awarded, candidates must complete a minimum of 43 credits and achieve a final CGPA ≥ 3.00 . Table IV in the appendix shows the academic standing and students' status.

Students may also register a course under *HS* (attendance only). In order for this module to appear in the transcript, students' attendance must be at least 80% and fulfill other coursework requirements.

Master Project: Students must undertake a 10-credit master's project. This 1 year (2-semester) project will be supervised by a graduate faculty member of FKE. Towards the end of the 1st semester, students will defend their project proposal. At the end of the project in the second semester, students must defend their Masters project and a comprehensive project report must be submitted. The Masters project could be industry-related although must still meet academic requirements, defined by the academic supervisor. An industry co-supervisor may be appointed from persons with appropriate academic standing or experience, subject to approval of the Faculty's Academic Committee.

OFF-CAMPUS (PESISIR) MODE OF STUDY

Our off-campus programs offer flexible solutions for working engineers and professionals to advance their career through our industry-driven curricula. All of our Masters programs are accredited by the Malaysian Qualification Agency (MQA).

Classes taught by Universiti Teknologi Malaysia faculty members at our PESISIR centres. The fees are affordable and competitive. Our PESISIR program can be completed within 2 years (four normal semesters and one short semester). Classes are conducted on Saturday and Sunday at all study centres.

- **Johor Bahru** : Universiti Teknologi Malaysia Main Campus
- **Kuala Lumpur** : Universiti Teknologi Malaysia City Campus
- **Pulau Pinang** : Penang Skills Development Centre
- **Kuching** : Technology College Sarawak

Programs	Study Centers			
	Johor Bahru	Kuala Lumpur	Pulau Pinang	Kuching
MKEH	–	–	MKEHA1BPA	–
MKEL	MKELA1BJA	MKELA1BKA	–	–
MEEM	–	MEEMA1BKA	–	–
MKEP	MKEPA1BJA	MKEPA1BKA	–	MKEPA1BQA

* Other programs may be offered in other centres depending on demand.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Programme Name	Master in Electrical Engineering			
4. Final Award	Master of Engineering (Computer and Microelectronic Systems)			
	Master of Engineering (Mechatronics and Automatic Control)			
	Master of Engineering (Electrical Power)			
	Master of Engineering (Wireless Communication and Network)			
5. Programme Code	MKEH/MEEM/MKEP/MKET			
6. Professional or Statutory Body of Accreditation	Kementerian Pendidikan Malaysia			
7. Language(s) of Instruction	English and Bahasa Melayu			
8. Mode of Study (Conventional, distance learning, etc)	Conventional			
9. Mode of operation (Franchise, self-govern, etc)	Self-governing			
10. Study Scheme (On-campus/Off-campus)	On-Campus/Off-Campus			
11. Study Duration	Minimum : 1.5 yrs Maximum : 4 yrs			
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	3	4	14	14
Short	0	1	8	8

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses a. Non- technical subject b. Introduction to Research Methodology in Electrical Engineering c. Co-Curriculum	3 3	14%
ii.	Programme Core (MKEH,MEEM,MKEP) / (MKET)	12 / 15	27.9% / 34.9%
iii.	Programme Electives (MKEH,MEEM,MKEP) / (MKET)	12 / 9	27.9% / 20.9%
iv.	Master Project	10	23.2%
v.	Free Elective Course	3	7%
	Total Credit Hours	43	100%
Total Credit Hours to Graduate		43 credit hours	

MASTER OF ENGINEERING (COMPUTER & MICROELECTRONIC SYSTEMS)

PROGRAMME SPECIFICATIONS

The program is an advanced degree program that exposes and updates students to cutting-edge technologies and techniques in computer engineering, IC microchip design, microelectronics system and advanced electronics in new generation technologies. With the ever-increasing demand in digital devices, semiconductor-based companies are facing the challenges of producing higher performance, cost-effective, but smaller microchips. This program covers both the theoretical and practical aspects of computer engineering and microelectronics system. It is designed especially for engineers to complement their industrial expertise and enhance their knowledge skills. This program was formed from our close collaboration with our industry partners (such as Intel). The curriculum and some of the courses were developed based on the technical needs for upskilling and advancing the knowledge of their engineers.

Our programme is offered in full-time and part-time basis. Full-time classes are conducted at our Johor Bahru main campus. Part-time classes are currently conducted in INTEL, Penang. The fees are affordable and competitive. Our off-campus program can be completed within 2 years (four normal semesters and one short semester). Classes are conducted on Saturday and Sunday at the study centre.

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of Computer Engineering and Microelectronic field.
PEO2	Practice professionalism and high standards of ethical conducts within organization and society.
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Attain advanced knowledge on theories, methods and applications related to Computer Engineering and Microelectronic field.
PLO2	Demonstrate mastery in conducting research independently in solving problems related to Computer Engineering and Microelectronic through relevant analytical methods, simulations and/or experiments.
PLO3	Synthesize engineering knowledge through design and development.
PLO4	Plan and perform research undertakings responsibly, professionally and ethically.
PLO5	Communicate and express knowledge and ideas effectively.
PLO6	Continue life-long learning and apply technology for the betterment of

	humanity.
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GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
MASTER OF ENGINEERING (COMPUTER & MICROELECTRONIC SYSTEM)					
SCHOOL COMPULSORY-12 CREDITS (4 COURSES)					
1	MKEL 1113	Nanoelectronic Devices	3	3	
2	MKEL 1123	Advanced Microprocessor Design	3	3	
3	MKEL 1173	Advanced Digital System Design	3	3	
4	MKEL 1193	Analogue CMOS Design	3	3	
SCHOOL ELECTIVES-12 CREDITS (4 COURSES)					
5	MKEL 1133	Integrated Circuit Testing	3	3	
6	MKEL 1143	Advanced Digital Signal Processing	3	3	
7	MKEL 1163	VLSI Circuits & Design	3	3	
8	MKEL 1183	Advanced Computer Architecture	3	3	
9	MKEL 1223	Random Process	3	3	
10	MKEL 1233	Image Processing	3	3	
11	MKEL 1243	Software Engineering	3	3	
12	MKEL 1253	Speech Processing	3	3	
13	MKEL 1263	Special Topic in Electronic Engineering	3	3	
14	MKEL 1273	VLSI Design Automation	3	3	
15	MKEL 1283	Hardware and Software Co-Design	3	3	
FREE ELECTIVES FROM MKEL/MKEM/MKEP/MKET-3 CREDITS (1 COURSE)					
16	MKEx 1xxx		3	3	
MASTER'S PROJECT-10 CREDITS (2 COURSES)					
17	MKEH 1814	Research Project Proposal	4	4	
18	MKEH 1826	Research Project Report	6	6	
TOTAL CREDIT OF ELECTRICAL ENGINEERING COURSES (a)			37	37	
SCHOOL/UNIVERSITY COMPULSORY- 6 CREDITS (2 COURSES)					
19	MKEU 0013	Introduction to Research Methodology in Electrical Engineering	3	3	
20	Uxxx xxx3	Non-technical subject	3	3	
TOTAL CREDIT OF UNIVERSITY COMPULSORY COURSES (b)			6	6	
TOTAL CREDIT TO GRADUATE (a + b)			43	43	

COURSE SYNOPSIS

CORE COURSES

MKEL 1113 - Nano-electronic Devices

Semiconductors form the basis of most modern electronics systems. This course is designed to provide a basis for understanding the characteristics, operation, and limitations of semiconductor devices. In order to gain this understanding, it is essential to have a thorough knowledge of the physics of the semiconductor material. The goal is to bring together quantum mechanics, the quantum theory of solids, semiconductor material physics, and semiconductor device physics. All of these components are vital to the understanding of both the operation of present day devices and any future development in the field. This course is a continuation to Microelectronics at the undergraduate level and introduces advanced device concepts.

MKEL 1123 - Advanced Microprocessor System

This course is about microprocessors in embedded systems. This course extends the students' knowledge of microprocessors by investigating embedded systems design and state-of-the-art 32-bit embedded processors. The student will be familiarized with problems associated with producing hardware and software in high-level language and assembly language for embedded systems. The topics covered include high-level and assembly language programming for embedded microprocessors, memory and peripherals for embedded systems, system development, and achieving high-performance in embedded systems.

MKEL 1173 - Advanced Digital System Design

This course is designed for students to learn and be able to design and verify complex digital synchronous systems – towards becoming an RTL digital hardware designer in the industry. This is a course that goes beyond the introductory course on digital basic principles and techniques. This course introduces digital circuit modelling with hardware description languages (HDLs), which is the key technique to the modern design of integrated circuits (ICs). The technique involves a CAD approach in which a high-level, text-based, abstract description of the circuit is created, then synthesized to a hardware implementation on a selected technology, and finally verified for its functionality and timing.

MKEL 1193 - Analog CMOS Design

In this course, students will be taught the characteristics of MOSFET transistor as a prerequisite of CMOS analog design. It highlights the nonlinearity as an imperfection that will limit the performance of analog circuits. The course will then proceed to analyse CMOS single ended as well as differential amplifiers. The advantages and disadvantages between different architectures will be discussed which designers could choose to fit their design requirements. The trademark of analog design, which is the design challenge to fulfil design matrix, will be highlighted. Students will be guided on design principles to meet design specifications with acceptable accuracy. Other important sub-modules such as differential amplifier, op amps, and switch capacitor amplifiers will be addressed towards the end of the course.

ELECTIVE COURSES

MKEL 1133 - Integrated Circuit Testing

This course introduces students to the techniques of testing a circuit and designing a testable circuit. Several fault models including single stuck-at fault model will be analyzed in details. Fault simulation methods are covered as well in this course. Test pattern generation and design-for-testability are also introduced to students. In order to facilitate the learning process, computer-aided design (CAD) software is used throughout the course. Some practical or almost actual environment problems and solutions are provided.

MKEL 1143 - Advanced Digital Signal Processing

This course introduces students to advanced concepts in digital signal processing. Basic concepts in signal processing will be first reviewed that covers continuous and discrete-time signals and systems with the relevant transformations and operations. Random signal principles are presented with the definition of stationarity and ergodicity, correlation and covariance functions and their estimates. The power spectrum of signals is defined together with the relationship with to the correlation function. Linear systems with random inputs are defined in terms of autocorrelation and cross correlation function and power spectrum. Optimum filtering techniques such as matched filter and wiener filter are presented with examples of applications. Basic constraints in non-parametric power spectrum estimation are described with the appropriate solutions. Linear estimation techniques deal with parameter identification and estimation of signals. Linear prediction is used for signal modelling and prediction. Towards the end of the course, signal analysis and representation techniques for time varying signals are presented such as the short-time Fourier transform, Gabor transform, and wavelet transform.

MKEL 1163 - VLSI Circuits & Design

In this course, students learn about VLSI design, with emphasis on designing circuits to meet certain performance criteria. Important issues when designing a VLSI circuit are discussed. MOS transistors are reviewed, including their characteristics, structure, switch-level behaviour, and current equation. SPICE model of MOS transistors is also described. The inverter circuit is studied in detail. This course emphasizes circuit design for speed and power performances. Factors that affect speed are explained. Logical effort concept is introduced to explain how to design a fast circuit. Similarly, the effect of input signal transitions on power dissipation is explained

MKEL 1183 - Advanced Computer Architecture

This course covers hardware structure of a modern programmable computer, including the basic laws underlying performance evaluation. Students will learn design of control and data path hardware for RISC processor, how to make machine instructions execute simultaneously through pipelining and parallel execution, and how to design fast memory and storage systems.

MKEL 1223 - Random Process

This course introduces students to the concepts in random processing. This course introduces students to the introductory level of random variables and random process. In the beginning, students will be introduced to the concept of probability and its axioms, Bayes theorem, combinations, and permutations. Then the concept of random variable which includes probability density and cumulative functions will be given. This topic will be extended to operations on random variable such as expectation and moments. The topic of multiple random variables which consists of joint distribution and joint density along with conditional distribution and density will be discussed next. This topic will also include operations on multiple random variables. Finally, the topic on random process from the perspective of both the temporal and spectral domains will be given. This topic will cover wide sense stationary, ergodicity and independence, correlation functions, power density spectrum and cross-power density spectrum.

MKEL 1233 - Image Processing

This course introduces students to introductory and intermediate levels of image processing techniques. The area of coverage would be the digitization process as a mean to acquire the digital image. Next would be the enhancement and restoration processes which are to improve the quality of the image for next stage processing. Both the spatial domain and frequency domain approaches will be covered. The next stage would be the segmentation process. This is an important step towards advanced level processing. Another important topic that will also be discussed is the morphological processing. Wavelet transform and multi-resolution analysis have been pivotal in many image processing applications and thus the introduction to this area will be given. Finally, the topic of compression and coding will be covered. MATLAB will be used extensively for better understanding.

MKEL 1243 - Software Engineering

This course introduces various issues of system and software engineering. This course attempts to cover a vast field covering all aspects of system and software development work from analysis, design, implementation, operation, maintenance, support, cost, management, and risk analysis. Focuses will be given on software development process, programming, testing, and maintenance, which are the fundamental aspect of software engineering. Special emphasis will be given to the process of object oriented design as well as the use of UML in the design activities.

MKEL 1253 - Speech Processing

This course introduces students to introductory and intermediate levels of speech processing techniques. The area of coverage would be speech production mechanism, classification of speech, sounds, nature of speech signal, models of speech production, speech signal processing: the purpose of speech processing, digital models of speech signal, digital processing of speech signals, Significance, short time analysis. Next would be the time domain parameters of speech, methods for extracting the parameters, zero crossings, auto correlation function, pitch estimation. The next stage would be the short time Fourier analysis, filter bank analysis, spectrographic analysis, format extraction, pitch extraction, analysis – synthesis systems. Another important topic that will also be discussed is the formulation of linear prediction problem in time domain,

solution of normal equations, interpretation of linear prediction in auto correlation and spectral domains. MATLAB will be used extensively for better understanding

MKEL 1263 - Special Topic in Electronic Engineering

The aim of the Special Topic course is to provide a mechanism for one-off topic to be offered by any graduate faculty or visiting professor. The topic of any Special Topic course has to be vetted and endorsed by the Faculty's Academic Committee.

MKEL 1273 - VLSI Design Automation

In this course, students learn about computing methodologies and algorithms for VLSI design automation. The course covers fundamental techniques in VLSI physical design automation flow; from system partitioning and chip floorplanning; placement and routing with global, detailed and specialized techniques, to timing closure. Students will also explore, study, and implement some of the advanced techniques used in EDA tools.

MKEL 1283 - Hardware and Software Co-Design

The course covers the design and development aspects of heterogeneous (hardware/software) digital systems. This course explores the process involved in defining system specification and how design space exploration can be done. Special focus is given on design quality and cost estimation, partitioning source description into different implementation domains, target code generation, interface synthesis and co-verification.

MASTER OF ENGINEERING (MECHATRONICS AND AUTOMATIC CONTROL)

PROGRAMME SPECIFICATIONS

Mechatronics and Control Engineering is a multi-disciplinary subject, with applications across a wide range of industrial sectors. The M.Eng. (Mechatronics and Automatic Control) program aims to equip graduates, with both the theoretical and the practical skills necessary to apply modern control techniques to a wide range of industrial problems and/or embark on further research. The curriculum is designed based on IR 4.0 in the 21st century and covers all the major aspects of control theory and mechatronics including adaptive and robust control, artificial intelligence, process control, industrial instrumentation, robotics and control applications in mechatronic systems and its application to the design of control systems. The curriculum also includes courses such as Rapid Prototyping and Simulation, Smart Manufacturing, Cyber Physical System, Embedded Systems for Innovative Product Design, Deep Learning and Intelligence Vision System. Students will also acquire expertise in the use of computer packages for control design. This program can be completed with a minimum study of one year and 43 credit. Outstanding students on this program may continue with research leading to a Ph.D.

Option for double-degree: This program also offers option for double-degree mode with University of Burgundy (UoB), where upon completing an extra semester in UoB, students are eligible for conferment two Master degrees from UTM and UoB. This study option takes a minimum of 4 semesters to complete.

- Semesters 1 and 2 in UTM
- Semester 3 in UoB
- Semester 4 in either UTM or UoB

This study option would require students to apply for admission to UoB themselves. Students must complete the first two semesters of study in UTM, followed by one semester in UoB. The final semester can be done either in UTM or UoB.

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of Mechatronics and Automatic Control Engineering field.
PEO2	Practice professionalism and high standards of ethical conducts within organization and society.
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Synthesize complex information, specialized concepts, theories, methods and practice independently in the field of Mechatronics and Automatic Control Engineering.
PLO2	Solve complex problems critically and integratively using systematic approaches.
PLO3	Apply practical skills to solve problems in the field of Mechatronics and Automatic Control Engineering.
PLO4	Demonstrate effective collaboration with stakeholders professionally.
PLO5	Communicate effectively the knowledge, skills and ideas using appropriate methods to peers, experts and communities.
PLO6	Use digital technologies and appropriate softwares competently to enhance study and practice.
PLO7	Evaluate numerical and graphical data critically using quantitative or qualitative tools in solving problems.
PLO8	Demonstrate leadership, autonomy and responsibility in managing resources.
PLO9	Engage self-advancement through continuous learning or professional development.
PLO10	Initiate entrepreneurial projects supported by relevant knowledge and skills.
PLO11	Demonstrate respectable ethical conducts and professionalism skills in an organization and society.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
MASTER OF ENGINEERING (MECHATRONICS AND AUTOMATIC CONTROL)					
SCHOOL COMPULSORY-12 CREDITS (4 COURSES)					
1	MEEM 1703	Control Systems Engineering	3	3	
2	MEEM 1753	Advanced Instrumentation and Measurement	3	3	
3	MEEM 1713	Artificial Intelligence and Applications	3	3	
4	MEEM 1803	Embedded Control Systems	3	3	
SCHOOL ELECTIVES-12 CREDITS (4 COURSES)					
5	MEEM 1783	Nonlinear and Robust Control Systems	3	3	
6	MEEM 1763	System Identification and Adaptive Control	3	3	
7	MEEM 1723	Advanced Process Control	3	3	
8	MEEM 1943	Model Predictive Control	3	3	
9	MEEM 1953	Linear Control System Design	3	3	
10	MEEM 1893	Embedded Systems for Innovative Product Design	3	3	
11	MEEM 1883	Autonomous Mobile Robotics	3	3	
12	MEEM 1823	Advanced Robotics	3	3	
13	MEEM 1913	Mechatronic Design	3	3	
14	MEEM 1923	Sensors and Actuators	3	3	
15	MEEM 1813	Smart Manufacturing	3	3	
16	MEEM 1903	Rapid Prototyping and Simulation	3	3	
17	MEEM 1933	Cyber Physical System	3	3	
18	MEEM 1963	Deep Learning	3	3	
19	MEEM 1973	Intelligent Vision System	3	3	

FREE ELECTIVES FROM MKEL/MKEM/MKEP/MKET-3 CREDITS (1 COURSE)					
19	MEEEx 1xxx		3	3	
MASTER'S PROJECT-10 CREDITS (2 COURSES)					
20	MEEM 1814	Master Project 1	4	4	
21	MEEM 1826	Master Project 2	6	6	
TOTAL CREDIT OF ELECTRICAL ENGINEERING COURSES (a)			37	37	
SCHOOL/UNIVERSITY COMPULSORY- 6 CREDITS (2 COURSES)					
22	MEEU 0013	Introduction to Research Methodology in Electrical Engineering	3	3	
23	Uxxx xxx3	Non-technical subject	3	3	
TOTAL CREDIT OF SCHOOL/UNIVERSITY COMPULSORY COURSES (b)			6	6	
TOTAL CREDIT TO GRADUATE (a + b)			43	43	

COURSE SYNOPSIS

CORE COURSES

MEEM 1703 - Control System Engineering

This course introduces the students to the fundamental concepts of control systems engineering. Students will be exposed with techniques of modelling of physical systems involving linear and non-linear systems including mechanical, electrical, and mechatronic systems. Both the frequency domain and time domain (state-space) are covered. Several criteria for performance and stability analyses of control systems will be taught. Modelling and analysis of control system in discrete time for digital control will also be introduced. Student will also be exposed with MATLAB for design, development and analysis of simulation models. Finally, a feedback control system with controller to achieve control system objectives are described. Several case studies of the applications of controllers will be used to enhance the student understanding.

MEEM 1713 - Artificial Intelligence and Applications

Artificial intelligence (AI) involves the development of algorithms derived from human & animal intelligence that have capabilities such as learning, reasoning, generalization, adaptation, reproduction, etc. Nowadays, these techniques are getting popular due to the large number of successful reports of implementations. AI techniques have also made their way into many domestic & industrial products & provided solutions to many difficult engineering problems. In this course, students are exposed to several AI techniques i.e. Artificial Neural Network (ANN), Fuzzy Logic, Genetic Algorithm (GA) & Particle Swarm Optimization (PSO), & how they are used in solving engineering & non-engineering problems.

MEEM1753 - Advanced Instrumentation and Measurement

This course is an introduction to the advanced instrumentation and measurement. Key components studied in details are a review of powerful measurement techniques and basic principles and typical problems of sensor elements, detailed up-to-date reviews of the features of temperature sensors, displacement sensors, flow sensors, level sensors, position sensors, motion sensors and biometrics. This course also provides a detailed knowledge on error and determination of uncertainties in measurement. Besides that, this course introduces the multi sensor, Fusion application, wireless sensor network and Internet of Things. Finally, the basic concepts of safety instrumented system, standards and risk analysis techniques will be discussed.

MEEM 1803 - Embedded Control Systems

This course introduces the principles and applications of embedded system. The topics emphasized are the microcontroller system architecture, software programming using C and the system design. The content covers internal peripherals such as general input and output, analogue to digital converter, serial communication interface, timer/counter and interrupt. Emphasis on the software will include interrupt servicing, multi-tasking and task communication and scheduling. The relation of system sampling time related to closed-loop control will also be covered. At the end of the course, the students will learn the technique to interface the microcontroller system with other devices in the embedded system for real world application.

ELECTIVE COURSES

MEEM 1783 - Nonlinear and Robust Control Systems

This course covers the analysis and design of nonlinear control systems using Lyapunov Theory. The contents of the course include the introduction to nonlinear dynamical systems, behaviours and properties of solutions of nonlinear dynamical systems, Lyapunov stability analysis techniques and nonlinear control design tools for stabilization using state feedback and output feedback linearization, integral control and gain scheduling.

MEEM 1763 - System Identification and Adaptive Control

This course is an introduction to the system identification and adaptive control. In the first part, the course covers an introduction to system identification, acquiring and pre-processing data, nonparametric model estimation methods, parametric model estimation methods, partially known estimation methods, model estimation methods in closed loop systems, recursive model estimation methods, analysing, validating, and converting models and system identification case study. This requires an in-depth understanding of control system engineering, modern control system and digital control system. The emphasis will be on the theoretical basis as well as practical implementations. Key components studied in details are time response analysis, frequency response analysis, correlation analysis, power spectrum density analysis, model structure, parametric model, parameter estimation method, test signals and model validation methods. In the second part of this course introduces the students to adaptive and self-tuning control. The students will firstly learn the real-time parameter estimation technique, which will provide them with the key concepts required to understand many aspects of adaptive and self-tuning control. The students will then be exposed to the main techniques in Self-Tuning Control (STC), in particular the Pole Assignment and Minimum Variance Control. For the adaptive control, the students will be exploring the Model Reference Adaptive Control (MRAC) design using Gradient Approach/MIT Rule and Lyapunov method. Finally, some practical issues on implementation, applications and perspectives of adaptive and self-tuning control will be discussed.

MEEM 1723 - Advanced Process Control

This course introduces the implementation of various control system designs and strategies in industries. The first part provides introduction to the classical and modern control systems, the mathematical formulation of dynamic behavior of systems using theoretical and empirical principals. Then, discussion on how to identify the control structure to handle different control problem formulation such as feedback control system, cascade control system, feed-forward control system and internal model control. This course covers SISO and MIMO control systems, which analysed the robust stability and performance of these systems. In enhancing performance of the system, advanced control techniques are utilized such as adaptive control and model predictive control. At the end of the course, several case studies related to real plant-wide control in specific applications are introduced to reflect the various control ideas. The used of intelligent control and soft computing are also embedded in the specific case studies.

MEEM 1943 - Model Predictive Control

This course introduces the theory and practice of Model Predictive Control (MPC). The course syllabus begins with the philosophical thinking behind predictive control and continues with modelling assumptions as a fundamental part in MPC. Then, the procedure of prediction using mathematical models is introduced with a state-space and transfer function models. The unbiased prediction is introduced to address the predictions accuracy. For measuring the control performance, a performance index is constructed. At the end of the course, several types of linear predictive control algorithm are introduced to demonstrate the predictive application. The course will make use of the MPC Toolbox for MATLAB developed by The MathWorks, Inc.

MEEM 1953 - Linear Control System Design

This course is an introduction to the linear control system design. It is intended to give a good background for designing the performance of a linear control system. Students will learn how to use the mathematical equations of system to analyse its dynamic performance in terms of stability, controllability and observability. This course will cover the design of controllers using pole placement and Linear Quadratic Regulator (LQR).

MEEM 1893 - Embedded Systems for Innovative Product Design

This course emphasizes on the engineering knowledge and skills in the design of embedded system for the development for innovative product. As the continuation of Embedded Control System, the materials covered in the course will further address the problems of designing electronics/embedded systems for mechatronic systems that meet customised user demand specification. Real time and safety criticalness, design constraints, hardware-software partitioning and time-to-market element will be the main elements to be addressed. Efficient coding techniques for embedded system, basic operation of real-time operating system (RTOS), schedulable of a periodic task sets and design refinement are the among the main contents of the courses. Design Thinking (DT) approach will be adapted for the proposal of product development. At the end of the course, students will be able to integrate the components of the software and hardware to form efficient embedded system for specific product design. Embedded system design tools will be used to facilitate the design process. At the end of the course, students in group will develop an embedded system based product as a testimony of the knowledge and skill acquired during the course.

MEEM 1883 - Autonomous Mobile Robotics

This course gives the students an in-depth treatment of main aspects of autonomous mobile robotics namely mechanism & locomotion, intelligence in mobile robotics and sensor fusion for autonomous decision-making capability. The course delivery is not limited to lectures, tutorials only but also personal reading, research-based assignments on frontier knowledge materials and actual experimental research carried out in UTM's mobile robotics laboratory. The course blends knowledge derived in-house with actual physical world autonomous mobile robotics, hence providing the unique experimental learning geared towards carrying out research.

MEEM 1823 - Advanced Robotics

As technology advances, it has been envisioned that in the very near future, robotic systems will become part and parcel of our everyday lives. Even at the current stage of development, semi-autonomous or fully automated robots are already indispensable in a staggering number of applications. To bring forth a generation of truly autonomous and intelligent robotic systems that will meld effortlessly into the human society involves research and development on several levels, from robot perception, to control, to abstract reasoning. This course tries for the first time to provide a comprehensive treatment of autonomous mobile systems and examines the fundamental constraints, technologies, and algorithms of autonomous robotics. The focus of this course will be on computational aspects of autonomous wheeled mobile robots. The following topics will be covered: major paradigms in robotics, methods of locomotion, kinematics, simple control systems, sensor technologies, stereo vision, feature extraction, modelling uncertainty of sensors and positional information, localization, SLAM, obstacle avoidance and 2-D path planning.

MEEM 1913 - Mechatronic Design

This course introduces mechatronics as an integrated design approach with the synergistic combination of mechanical, electronics, control and computer engineering. It provides insight into advantages and challenges of mechatronics design approach. The course introduces the various aspects in mechatronics design including physical system modelling, simulation, sensors and actuators selection, computer interfacing and real-time control implementation. This course tries to balance between theoretical and practical aspects, and hardware implementation is emphasized. Several case-study from industrial project and problem-solving approach of real systems are used throughout the course.

MEEM 1923 - Sensors and Actuators

This course introduces the working principle of sensor and actuators and its application in mechatronics systems. This course covers the fundamental of sensors and actuators, the details of its functionality, the characteristic, the fabrication, and materials used, numerical study and the system integration of sensors and actuators in mechatronics system. Various case studies are introduced and discussed during classes to help further understanding of the diversity of mechatronics system in multidisciplinary fields.

MEEM 1813 - Smart Manufacturing

Industry 4.0 is the new wave in manufacturing that involves a combination of cyber-physical systems, automation and the Internet of Things (IoT) which is often called as Smart Manufacturing. This course is to introduce what is Smart Manufacturing and also to actually learn some of the important components in smart manufacturing such as industrial automation, robotics, machine vision, AI and Big Data. This course also studies several real industries case studies.

MEEM 1903 - Rapid Prototyping and Simulation

This course introduces rapid prototyping technologies that can help to speed up the process of designing and verifying a mechatronic system. The participants gain hands-on experience of the required skills in computer aided design and knowledge on machine element to model and verify a mechatronic system. In the hands-on project, the participants learn how to interface input-output (IO) devices to control a model of mechatronic system. Lastly, the

participants learn how to generate the code of the model and deploy it on an embedded controller board.

MEEM 1933 - Cyber Physical System

Cyber-physical systems (CPS) are engineered systems that are built from, and depend upon, the seamless integration of computational algorithms and physical components. Designing algorithms to control CPS is challenging due to their tight coupling with physical behavior. The future CPS workforce is likely to include CPS engineers, who focus on the knowledge and skills spanning cyber technology and physical systems that operate in the physical world. This course provides a foundation that highlights the interaction of cyber (computation and/or communication) and physical aspects (physical plants) of systems.

MEEM 1963 - Deep Learning

This course is a complete course to deep learning. It is intended to be an advanced course in graduate and postgraduate studies in the deep learning field. This course will focus on deep learning and provides a fundamental basis for MEEM 1973 Intelligent Vision System, which focuses on the application of deep learning in computer vision. By adapting this knowledge, students will be able to (1) relate machine learning with deep learning, (2) have end-to-end understanding of neural networks, (3) train and troubleshoot neural networks, and (4) implement simple deep learning applications using the Deeplearning4java (DL4J) framework.

MEEM 1973 - Intelligent Vision System

This course is a complete course to advanced computer vision. It is intended to be an advanced course in graduate and postgraduate studies in the deep learning in computer vision field. As most of the deep learning part has been covered by the MEEM1963 Deep Learning course, this course will focus on the application of deep learning in computer vision. By completing the course, students will be able to 1) relate deep learning with computer vision, 2) identify computer vision problems, 3) propose end-to-end deep learning solutions to computer vision problems, and, 4) implement proposed deep learning solutions into real-life solutions using the Deeplearning4java (DL4J) framework.

MASTER OF ENGINEERING (ELECTRICAL POWER)

PROGRAMME SPECIFICATIONS

The program is an advanced degree program to cater for graduates and professionals who are seeking and updating greater knowledge of current technology and techniques in electrical power, energy conversion, and high voltage engineering. The Master of Engineering (Electrical Power) offers high-level graduate program with strong foundations in theory, to equip student with the skills necessary to grasp and develop new technologies and trends in the electrical engineering field. It is designed to develop competent electrical power system professionals and the potentials of tomorrow's leaders in the power industry. The program prepares students to make an immediate contribution to the workplace and become leaders in the industry. Outstanding students can have the opportunities to further their studies leading to a Ph.D. degree.

Opportunity for BEM Electrical Engineering conversion

This program also provides opportunity for prospective students who currently registered as graduate engineers with BEM under the electronics category to convert to electrical category (terms and conditions apply, subject to approval from BEM).

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of Electrical Power Engineering field.
PEO2	Practice professionalism and high standards of ethical conducts within organization and society.
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Attain advanced knowledge on theories, methods and applications related to Electrical Power Engineering field.
PLO2	Demonstrate mastery in conducting research independently in solving problems related to Electrical Power Engineering field through relevant analytical methods, simulations and/or experiments.
PLO3	Synthesize engineering knowledge through design and development.
PLO4	Plan and perform research undertakings responsibly, professionally and ethically.
PLO5	Communicate and express knowledge and ideas effectively.
PLO6	Continue life-long learning and apply technology for the betterment of humanity.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
MASTER OF ENGINEERING (ELECTRICAL POWER)					
SCHOOL COMPULSORY-12 CREDITS (4 COURSES)					
1	MKEP 1533	Power Electronics System	3	3	
2	MKEP 1553	High Voltage Insulation & Coordination	3	3	
3	MKEP 1603	Power System Analysis & Computational Method	3	3	
4	MKEP 1633	Power System Devices & Apparatus	3	3	
SCHOOL ELECTIVES-12 CREDITS (4 COURSES)					
5	MKEP 1513	Electronic Power Conversion	3	3	
6	MKEP 1523	Electrical Drives	3	3	
7	MKEP 1543	Advanced High Voltage Technology	3	3	
8	MKEP 1563	Power Quality	3	3	
9	MKEP 1613	Power System Control	3	3	
10	MKEP 1623	Power Transmission & Security	3	3	
11	MKEP 1643	Lightning Protection & Grounding System	3	3	
12	MKEP 1653	Integrated Resource Planning in Energy Sector	3	3	
13	MKEP 1663	Special Topic in Power Engineering	3	3	
14	MKEP 1673	Power System Protection	3	3	
15	MKEP 1683	Alternative Energy Technology System	3	3	
FREE ELECTIVES FROM MKEL/MKEM/MKEP/MKET-3 CREDITS (1 COURSE)					
16	MKEx 1xxx		3	3	
MASTER'S PROJECT-10 CREDITS (2 COURSES)					
17	MKEP 1814	Research Project Proposal	4	4	
18	MKEP 1826	Research Project Report	6	6	
TOTAL CREDIT OF ELECTRICAL ENGINEERING COURSES (a)			37	37	
SCHOOL/UNIVERSITY COMPULSORY- 6 CREDITS (2 COURSES)					
19	MKEU 0013	Introduction to Research Methodology in Electrical Engineering	3	3	
20	Uxxx xxx3	Non-technical subject	3	3	
TOTAL CREDIT OF SCHOOL/UNIVERSITY COMPULSORY COURSES (b)			6	6	
TOTAL CREDIT TO GRADUATE (a + b)			43	43	

COURSE SYNOPSIS

CORE COURSES

MKEP 1533 - Power Electronics System

This course provides an understanding of the principles of power electronic conversion systems and the ability to design power converters for certain applications. The topics covered are: 1. Concepts and prospects of power electronic systems: power switches, switching methods, drivers and losses in power electronics system. 2. ac-to dc conversion: rectifier with different loads, performance criteria, line distortion, effects of line inductance/overlap. 3. dc to dc conversion: non-isolated topologies-Buck, Boost, Buck-boost, CCM, DCM operation, non-idealities, isolated topologies-Flyback, Full-Bridge, switched-mode power supply, converter control. 4. dc to ac conversion: single-phase, three-phase, harmonics, square wave, PWM inverters, harmonics elimination PWM and multilevel inverter topologies. The focus is the design of power converters for specific applications such as utility, domestic appliance, electric vehicle and industrial applications.

MKEP 1553 - High Voltage Insulation & Coordination

This course provides an understanding of high voltage phenomena, and to present the concepts of high voltage insulation in power systems networks. The first part of the course stresses on the phenomena of conduction and breakdown in insulation materials in order to provide the students with a firm knowledge on high voltage phenomena and insulation technology. The second part of the course covers the introduction to dielectric properties of materials, diagnostic testing of insulation and insulation coordination. By adapting this knowledge, students will be able to develop essential technical skills in solving real-world problems involving insulation characteristics with some degree of acceptable conditions. The student will use software to solve engineering problems related to high voltage engineering applications.

MKEP 1603 - Power System Analysis & Computational Methods

This reviews basic Power Network Concepts, Power Transmission Lines Transformer and generator and their respective parameters and equivalent circuit models. Students will be taught how to formulate rigorously power system network model and Bus admittance matrix and to appreciate all assumptions made. The application of Bus admittance matrix to Fault Analysis and the application of symmetrical sequence components to unbalanced fault analysis is will be covered. Further application of the power system network model and numerical techniques will be used to solve Power Flow analysis using Newton-Raphson Method and the Decoupled Load Flow. The student is expected to write and develop basic fault analysis and load flow analysis program. The programs will be tested with IEEE test systems with the aim to achieve results comparable with commercial software. Commercial grade professional software will be used to design simple and practical reactive power and voltage control. The concept of Multi-machine transient stability analysis will be covered in the course, in order to understand large scale power system response to any power disturbance.

MKEP 1633 - Power System Devices & Apparatus

This course introduces students to relevant apparatuses and devices in the operation of power system engineering. It will initially involve discussions on features and characteristics of power system devices such as synchronous machines, transmission lines, and transformers. Then, the dynamic aspects of the devices will be discussed. With the knowledge gathered, students are expected to be able to propose a design and perform relevant analysis on power system configurations consisting of the devices and apparatuses discussed in the course. Available computer packages such as MATLAB or PowerWorld can be used for better understanding of the relevant concepts related to the course. By integrating the knowledge, the students will be able to develop essential technical skills related to design and operation of power system.

ELECTIVE COURSES

MKEP 1513 - Electronic Power Conversion

This course basically relates to static power converters applications. It begins with the introduction of basic control concepts in the context of power electronic systems. Key definitions and concepts from feedback system theory are revisited for discussion related to regulation problem and feedback requirement of power converters. Models for control design are briefly introduced at the end of this topic. The next topic covered by the course is UPS system, which include UPS classification, applications, converter topologies and control methods. Active power filtering is also highlighted in this course. Some background on harmonics sources and effects are discussed followed by the mitigation methods. Active power filter classifications, concepts and control methods are covered quite extensively in this course. Finally, some industrial and residential applications of power converters are dealt with for a complete picture on static applications of power converters.

MKEP 1523 - Electrical Drives

The course introduces students to the fundamentals of electrical drives. The basics of electrical drives, such as the fundamental torque equations, main components of electrical drives, various \square characteristics of load and motors as well as multi-quadrant operations of electrical drives are covered in the introduction section of the course. The analysis and controller design of typical power electronic converters used in the electrical drives are studied with the help of MATLAB/SIMULINK simulation package. Specific examples of controller design for DC drives are presented. The scalar control using the constant V/Hz for induction motor drives based on steady-state per-phase equivalent circuit is discussed. These include the slip-compensation, current controlled, open loop and closed loop structures of constant V/Hz scheme. Finally, the dynamic modelling of induction machine is introduced. Using the dynamic model, the high-performance induction motor control schemes such as the field-oriented control and the direct torque control are presented and analyse using MATLAB/SIMULINK

MKEP 1543 - Advanced High Voltage Technology

There have been a number of key advances in the area of high voltage technology. This course reviews basic as well as recent reconsideration related to partial discharges and their measurement, overvoltages and insulation coordination on transmission networks, zinc oxide surge arresters, and SF6 insulation systems and their monitoring. The course also reviews various numerical analyses of electrical fields in high voltage equipment, optical

measurements and monitoring in high voltage environments, and pulsed power principles and applications. The student is expected to be able to critically apply key advances in high voltage technology to solve problems in power engineering and to design the insulation coordination for a given transmission network.

MKEP 1563 - Power Quality

The power quality course deals with the understanding of electrical power quality and its effect on power system performance. The course begins with the fundamental concepts on power quality. Next, the different power quality issues, their sources and effects and different related standards are presented. For each type of disturbances, case-study examples and concepts are provided. Following that, the solution of the problem is discussed in order to understand and maximize the available benefits. At the end of the course, the measurement technique is introduced to expose an idea commonly present in the actual system. By combining the knowledge obtained, students will be able to conduct power quality measurement, analysis the data and suggest suitable mitigation for different types of the power quality problem.

MKEP 1613 - Power System Control

The main goal of this course is to provide students with an overview of the engineering matter involved in designing, operating and controlling the power generation and transmission of a large-scale, interconnected power system. The objective is to provide knowledge on the importance of the different systems, the functionality they provide, the data used and exchanged as well as the development of these systems. At the conclusion of the course, students should be able to design and simulate a typical power system and analyze with the help of MATLAB/SIMULINK or Power World simulation packages. By adapting this knowledge, students will be able to develop essential technical skills in solving real problems in power system control by following the IEC standard or at least Malaysian Standard.

MKEP 1623 - Power System Transmission and Security

This course is divided into 2 parts: The first part introduces students to power systems transmission system while the second part introduces students to power systems security. In the first part, it will cover the power transmission in details ranging from transmission line modelling to transmission line design. Key issues such as transmission losses in determining the economic dispatch of power system will be covered. In the second part, it will cover the issue of power system security in which the concentration will be given involving transmission system security. The concept of contingency analysis, N-1 security will be discussed. Then the issue of congestion management and allocation in deregulated electricity market will be covered in this course.

MKEP 1643 - Lightning Protection and Grounding System

This course will cover the following areas: lightning phenomena; earth performance under lightning current as well as under short-circuit condition; lightning related damages, lightning parameters, lightning surge propagation in transmission lines, lightning effects on human being and animals, principle of lightning protection based on IEC standard, lightning protection for building structures, lightning protection of transmission line and shielding failure, interaction of lightning with low voltage; and introduction to earthing systems: resistance value; measurement of soil resistivity and earth resistance value, step potential, touch potential and transfer potential, soil characteristics under impulse condition, transmission-line tower

earthing installation, computer network earthing, design of AC substation earthing system.

MKEP 1653 - Integrated Resource Planning in Energy Sector

This course is designed to give an overview understanding of energy supply, demand, energy balance and sustainability issues. It covers the assessment of past, current and future energy system and provides the analytical framework and assessment methodologies needed to promote Integrated Resource Planning (IRP) in electricity sector. IRP is the process of selecting an electric resources mix on the basis of comparing the benefits and costs of demand and supply resources. By adapting this knowledge, student will be able to develop essential technical skill in solving real-world problem of providing electricity at lowest possible economic, social and environmental cost.

MKEP 1663 - Special Topic in Power Engineering

The aim of the Special Topic course is to provide a mechanism for one-off topic to be offered by any graduate faculty or visiting professor. The topic of any Special Topic course has to be vetted and endorsed by the Faculty's Academic Committee.

MKEP 1673 - Power System Protection

This course introduces students to some major views, theories and applications in the area of power system protection. It will examine some key issues in overcurrent protection with special focus in IDMT relay application in power system network. The course will also discuss on distance, differential and load shedding protection. The students will also be taught with the topic related to power system fault diagnostic. The students are expected able to evaluate the performance of power system protection. By mastering this knowledge, students will be able to interpret various causes of fault in power system.

MKEP 1683 - Alternative Energy Technology Systems

This course provides in depth coverage of alternative energy technology (AET) systems that includes solar/photovoltaics (PV) energy, wind energy, fuel cells, microturbines etc. Emphasis will be placed on the energy flow, power management, hybridization, energy conversion and control, storage element, testing and integration with the utility grid. In addition, various storage devices for the incorporation of AET system and the associated power electronic converters will be discussed and analyzed. This course also covers the design, simulation and analysis of several AET system applications. With these fundamental exposures, students should be able to design simple AET systems for the application of distributed generation, grid connected systems, rural electrification and electric/hybrid vehicles.

MASTER OF ENGINEERING (WIRELESS COMMUNICATION AND NETWORK)

PROGRAMME SPECIFICATIONS

This programme aims to produce professionals with advanced knowledge and skills in the field of Wireless Communication and Network in line with the development of today's communications technology. The program will also provide exposure in entrepreneurship and sustainability in technology and engineering to further contribute to the generation of talent and transformation leaders according to the current needs of the country. In addition, there are opportunities for students to pursue studies leading to a Ph.D. degree in the field relevant to this programme.

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of Wireless Communication and Network engineering field.
PEO2	Practice professionalism and high standards of ethical conducts within organization and society.
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Attain advanced knowledge on theories, methods and applications related to Wireless Communication and Network engineering field.
PLO2	Demonstrate mastery in conducting research independently in solving problems related to Wireless Communication and Network Engineering through relevant analytical methods, simulations and/or experiments.
PLO3	Synthesize engineering knowledge through design and development.
PLO4	Plan and perform research undertakings responsibly, professionally and ethically.
PLO5	Communicate and express knowledge and ideas effectively.
PLO6	Continue life-long learning and apply technology for the betterment of humanity.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
MASTER OF ENGINEERING (WIRELESS COMMUNICATION AND NETWORK)					
SCHOOL COMPULSORY-15 CREDITS (5 COURSES)					
1	MKET 1513	Sustainable Design, Engineering & Management	3	3	
2	MKET 1523	Internet of Things Technologies	3	3	
3	MKET 1423	Wireless Communication Systems	3	3	
4	MKET 1313	Communication and Computer Networks	3	3	
5	MKET 1433	RF/Microwave and Antenna Design	3	3	
SCHOOL ELECTIVES-9 CREDITS (3 COURSES)					
6	MKET 1323	Broadband Multimedia Networks	3	3	
7	MKET 1383	Satellite Communication	3	3	
8	MKET 1393	Network Modeling & Performance	3	3	
9	MKET 1413	Advanced Digital Communications	3	3	
10	MKET 1533	Computer and Network Forensics	3	3	
11	MKET 1543	Advanced Antenna Design	3	3	
12	MKET 1553	Microwave and Millimeter Wave System Design	3	3	
13	MKET 1563	Advanced Optical Fiber Communication	3	3	
14	MKET 1573	Optical Communication Networks	3	3	
15	MKET 1583	Entrepreneurship for Telecommunication Industry	3	3	
FREE ELECTIVES FROM MKEL/MKEM/MKEP/MKET-3 CREDITS (1 COURSE)					
16	MKEx 1xxx		3	3	
MASTER'S PROJECT-10 CREDITS (2 COURSES)					
17	MKET 1814	Research Project Proposal	4	4	
18	MKET 1826	Research Project Report	6	6	
TOTAL CREDIT OF ELECTRICAL ENGINEERING COURSES (a)			37	37	
SCHOOL/UNIVERSITY COMPULSORY- 6 CREDITS (2 COURSES)					
19	MKEU 0013	Introduction to Research Methodology in Electrical	3	3	

		Engineering			
20	Uxxx xxx3	Non-technical subject	3	3	
TOTAL CREDIT OF SCHOOL/UNIVERSITY COMPULSORY COURSES (b)			6	6	
TOTAL CREDIT TO GRADUATE (a + b)			43	43	

COURSE SYNOPSIS

CORE COURSES

MKET 1313 - Communication and Computer Networks

This course will enhance the students' knowledge on communication and computer network. It explains the advance concept of network layers, protocols, interfacing and inter-working between computer networks and network devices in telecommunication systems. The students will be taught with the various possible techniques to understand the modern networks for wired and wireless services.

MKET 1423 - Wireless Communication Systems

This course introduces students to introductory and advanced level of wireless communication technologies. In the beginning students will be presented with the concept of wireless communication systems and mobile radio propagation. Students will then be illuminated on MIMO technology in mobile communication. Next, the course will describe on cellular concepts that will include small cell networks. This is followed by details on the overall evolution of mobile communication system. Finally, this course will cover on different multiple access techniques used in wireless communication systems.

MKET 1433 - RF/Microwave and Antenna Design

This course introduces students to the concept and advanced level of RF/Microwave passive and antenna circuit designs. In the beginning students will be introduced to the concept of transmission line and S Parameter in RF/Microwave Engineering. The analysis of the circuit design is based on the S parameter concept. The matching technique of the RF/Microwave design is based on the Smith Chart. Then, the design of each passive components such as matching network, coupler, divider and filter will be introduced and the analysis of this design will be using the RF simulation tools. The properties of the antenna will be introduced in the next section. The design of microstrip and microwave antenna will be discussed and analyzed through RF simulation tools.

MKET 1513 - Sustainable Design, Engineering & Management

The aim is to give students an insight and understanding of the environmental and sustainability challenges that are facing by Communication Engineers and how these have given rise to the practice of Sustainable Design, Engineering and Management. The objective of this course is to provide a comprehensive overview of the nature and causes of the major environmental problems facing our planet, with a particular focus on energy, Life Cycle Assessment (LCA) and green technology. Students will also experience conducting case studies and project-based learning encompassing four themes in sustainability which are connecting, conceptualizing, valuing and implementing.

MKET 1523 - Internet of Things Technologies

The course provides students with a technical background to the Internet of Things (IoT) which includes its concept, architecture and applications. It also gives the underlying communication protocols and technologies. The course has a significant practical element that will be delivered during lab sessions in which students are expected to complete exercises involving system design, device programming and cloud development.

ELECTIVE COURSES

MKET 1323 - Broadband Multimedia Networks

This course introduces the basics of multimedia communication systems and services. Students will be familiarized with the underlying theory, concepts and principles of multimedia communication system and the practicality in the current and future IP based network. The topics include the introduction to the concept of multimedia communication model and elements of multimedia communication systems. An overview of the recent trend in multimedia communication system development will be given. The students will be given a comprehensive understanding on multimedia processing in communication, distributed multimedia systems, multimedia communication standards and multimedia communications across networks. The emphasis will be on multimedia communication on next generation IP based network. Finally, the students will be exposed with the various multimedia applications including VOIP, VOD, IPTV etc.

MKET 1383 - Satellite Communication

This course introduces students to introductory and advanced level of satellite communication. In the beginning students will be introduced to the concept of satellite communication systems. Then the orbit mechanic concepts which include look angle and orbit determination. This topic will be extended to the satellite subsystems, link design and propagation effects. The topic of satellite system will include VSATS, satellite broadcasting for TV and radio and Global Position System.

MKET 1393 - Network Modeling & Performance

Network performance and modeling is important in estimating the performance of a particular event in a network. This course introduces the students to the techniques in network modeling and discrete event simulation. Students will also learn queuing analysis and telecommunication system.

MKET 1413 - Advanced Digital Communications

This course provides fundamental concepts in the analysis and design of digital communication system. Main topics to be covered are introduction to information theory, signal space analysis, digital modulation/demodulation over AWGN channel, baseband transmission over bandlimited channel, channel coding, error control coding. Finally, the system trade-off in designing a digital communication system in AWGN channel is explored.

MKET 1533 - Computer and Network Forensics

The knowledge of computer and network forensics has become essential in securing today's network-centric computing environment. This course will give the students both the fundamental knowledge and hands-on practice on computer and network forensics. Upon completing this course, the students are expected to understand the basics of computer and network forensics, to be well-trained as next-generation cyber-crime investigators, and to be prepared for active research at the forefront of these areas.

MKET 1543 - Advanced Antenna Design

This course introduces students to the concept and advanced level of antenna design. In the beginning students will be introduced to the fundamental concept of antenna. The properties and the analysis of the antenna will be introduced. The design of filtering antenna, reconfigurable antenna, smart antenna and metamaterial antenna will be introduced and thoroughly discussed. Finally, the antenna measurement setup is explained.

MKET 1553 - Microwave and Millimeter Wave System Design

The aim of this course is to introduce the theories, concepts and design of microwave and millimeterwave system. The properties of the devices will be discussed including substrate materials, surface wave phenomena and analytical methods for discontinuity effect. Design of devices concerning front-end system such beam-forming network utilizing three different technologies, which are planar, waveguide and substrate integrated waveguide (SIW). In RF MEMS, switches for millimeterwave will be covered. Fabrication technique will be then introduced as well as analysis and measurement.

MKET 1563 - Advanced Optical Fiber Communication

The aim of this course is to equip students with knowledge on advanced optical fiber communications. It starts with an extensive introduction to the development history of optical communications. The main components and modules required for the implementation of optical communication network is then explored. The course then explores the theoretical and practical aspect of signal propagation through an optical fiber. Factors affecting the signal quality along the optical fiber are then covered which include studying the various noise sources and the way they affect the signal quality. Advanced modulation techniques and detection system employed for achieving high spectral efficiency will be covered next. The course will be concluded looking at the recent trends in advanced optical network.

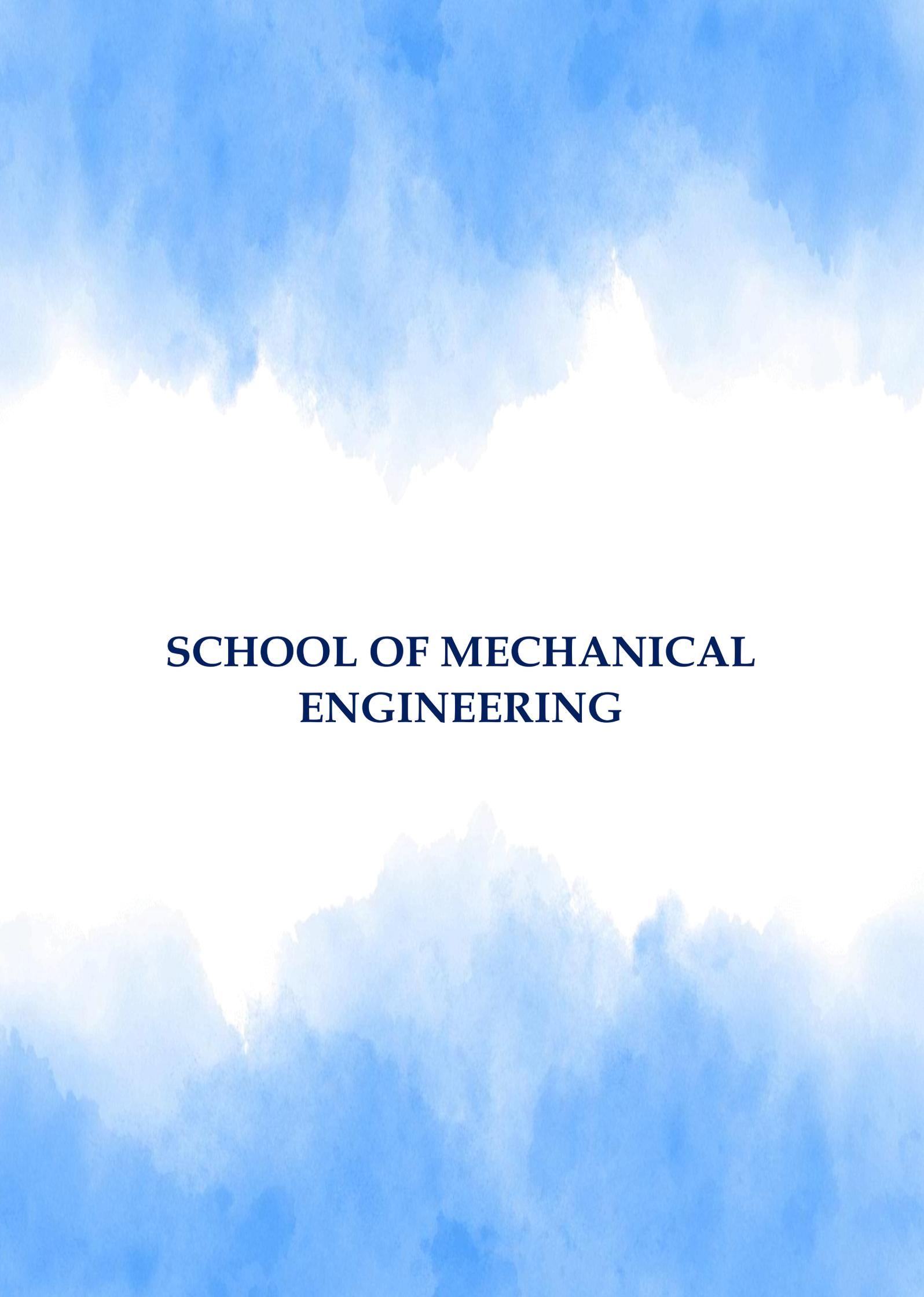
MKET 1573 - Optical Communication Networks

This course offers students the essential aspects of optical networking which is the key for today's high-speed data transportation technology. It commences with the underlying fiber optic link design and the basic optical components needed for point-to-point links and interchange nodes. The basic principles of operation of optical transmitters, detectors, amplifiers, multiplexers, filters, couplers, isolators, wavelength converters and optical cross connects will be described. The remainder of this course will emphasis on the transport/networking protocols that are run on optical layer such as SONET/SDH, IP, ATM, Storage Area Networks and Gigabit Ethernet. Other topics that will be covered include network design, control and management, and network deployment in various network domains from access to metro and core networks. At the end of the course, students should be able to critically design an optical network at given specification using suitable programming software.

MKET 1583 - Entrepreneurship for Telecommunication Industry

The course entrepreneurship for telecommunication engineers is an integrative course on the basics of entrepreneurship in the telecommunication engineering industry. The importance of the telecommunications sector in the domestic and global economy has dramatically increased in recent years and is expected to grow further. This unique course offers students the opportunity to bring telecommunication engineering knowledge and idea into the business setting. It commences with the concepts and practices of entrepreneurial thinking and

entrepreneurship. It also focuses on the in-depth understanding of aspects as idea generation, forming start-up, business plan, marketing and markets, and entrepreneurial finance. Using lectures, guest lecturers, case studies, business plans and presentations, the course teaches the skills in entrepreneurial that can be used in starting telecommunication companies or executing R&D projects in companies. Topics include on national and international communication networks, policies and regulations, and global trends in technology and market reforms of telecommunication industry.

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**SCHOOL OF MECHANICAL
ENGINEERING**

School of Mechanical Engineering (SME) is offering postgraduate programmes in all major fields of mechanical engineering including applied mechanics, robotics, engineering design, thermodynamics, fluid mechanics, materials engineering, advanced manufacturing, aeronautical engineering, automotive engineering, industrial engineering, and marine technology. Currently, SME offers the following postgraduate programmes:

1. **Doctor of Philosophy, PhD (Research)**
2. **Master of Philosophy, MPhil (Research)**
3. **Master of Science, MSc (Coursework)**

School of Mechanical Engineering	
Research	Coursework
<ul style="list-style-type: none"> ▪ PhD (Mechanical Engineering) ▪ MPhil (Mechanical Engineering) ▪ MPhil (Marine Technology) 	<ul style="list-style-type: none"> ▪ MSc (Mechanical Engineering) ▪ MSc (Industrial Engineering)

DOCTOR OF PHILOSOPHY

FIELD OF RESEARCH: MECHANICAL ENGINEERING

PROGRAMME SPECIFICATION

The Doctor of Philosophy Field of Research: Mechanical Engineering (PKMM) is offered on a full-time basis. The duration of study is in between a minimum of three (3) years to a maximum of eight (8) years. The PhD candidate must be supervised by a Graduate Faculty. In terms of supervision panel, co-supervisor(s) may come from other higher learning institutions or the industry. The academic progress of a candidate is assessed through a research progress report submitted at the end of each semester as well as on the research proposal presented during proposal defence (mini viva). The degree is awarded based on an examination of the thesis (including viva- voce) submitted by the candidate upon completion of the study.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia		
2. Teaching Institution	Universiti Teknologi Malaysia		
3. Programme Name	Doctor of Philosophy		
4. Final Award	Doctor of Philosophy Field of research: Mechanical Engineering		
5. Programme Code	PKMM3		
6. Professional or Statutory Body of Accreditation	MQA		
7. Language(s) of Instruction	English		
8. Mode of Study	Research		
9. Mode of operation (Franchise, self-governs, etc.)	Self-governing		
10. Study Scheme	Full Time		
11. Study Duration	Minimum : 3 years Maximum : 8 years		
Type of Semester	No. of Semesters		No of Weeks per Semester
	Min	Max	
Normal	6	16	14
Short	-		-

Course Classification

No.	Classification	Credit Hours
i.	University Elective (1 course)	3
ii.	Research Methodology	HW
iii.	Research (Minimum 6 semesters)	0
iv	Thesis	0
	Total	3

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to incorporate in-depth relevant knowledge in engineering practices with capabilities to research, develop and integrate.
PEO2	Graduates are able to apply a wide range of relevant knowledge to critically analyze and solve problems related to engineering in various situations and contexts effectively and innovatively.
PEO3	Graduates are able to advocate and communicate ideas and/or solutions to mechanical engineering problems intellectually, ethically and professionally
PEO4	Graduates able to adopt the latest relevant niche knowledge and technologies through life-long learning process

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Demonstrate advanced knowledge and capabilities to further develop or use these for new situations in mechanical engineering.
PLO2	Demonstrate research skills in appraising available information and research evidence, and applying them in mechanical engineering contexts
PLO3	Apply critical thinking and problem-solving skills in addressing mechanical engineering problems utilizing relevant tools and techniques.
PLO4	Perform research on mechanical engineering problems professionally, ethically and responsibly.
PLO5	Communicate technical knowledge and ideas effectively in written and oral forms.
PLO6	Adopt the latest relevant knowledge and technologies through life-long learning.

GRADUATION CHECKLIST

Students must pass all the stated courses and assessment in this checklist to graduate. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessments are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
SCHOOL OF MECHANICAL ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKMP 0010	Research Methodology			
3	PKMM XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication minimum one (1) refereed article or two (2) indexed conference proceedings accepted as published in SCOPUS/ ERA/ WOS)			

MASTER OF PHILOSOPHY

FIELD OF RESEARCH: MECHANICAL ENGINEERING

PROGRAMME SPECIFICATION

The Master of Philosophy Field of Research: Mechanical Engineering (MKMM) is offered on a full-time basis. The duration of study is in between a minimum of one (1) year to a maximum of four (4) years. This master programme must be supervised by an academic staff (main supervisor) from the Graduate Faculty. The academic progress of a candidate is assessed through a research progress report submitted at the end of each semester as well as on the research proposal presented during proposal defence (mini-viva). The degree is awarded based on an examination of the thesis (including viva-voce) submitted by the candidate upon completion of the study

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Master of Philosophy	
4. Final Award		Master of Philosophy Field of Research: Mechanical Engineering	
5. Programme Code		MKMM3	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme		Full Time	
11. Study Duration		Minimum : 1 year Maximum : 4 years	
Type of Semester	No. of Semesters		No of Weeks per Semester
	Min	Max	
Normal	2	8	14
Short	-	-	-

Course Classification

No.	Classification	Credit Hours
i.	University Elective (1 course)	3
ii.	Research Methodology	HW
iii.	Research (Minimum 2 semesters)	0
iv	Thesis	0
	Total	3

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to incorporate in-depth relevant knowledge in engineering practices with capabilities to research, develop and integrate.
PEO2	Graduates are able to apply a wide range of relevant knowledge to critically analyze and solve problems related to engineering in various situations and contexts effectively and innovatively.
PEO3	Graduates are able to advocate and communicate ideas and/or solutions to mechanical engineering problems intellectually, ethically and professionally.
PEO4	Graduates able to adopt the latest relevant niche knowledge and technologies through life-long learning process.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Demonstrate advanced knowledge and capabilities to further develop or use these for new situations in mechanical engineering.
PLO2	Demonstrate research skills in appraising available information and research evidence, and applying them in mechanical engineering contexts.
PLO3	Apply critical thinking and problem-solving skills in addressing mechanical engineering problems utilizing relevant tools and techniques.
PLO4	Perform research on mechanical engineering problems professionally, ethically and responsibly.
PLO5	Communicate technical knowledge and ideas effectively in written and oral forms.
PLO6	Adopt the latest relevant knowledge and technologies through life-long learning

GRADUATION CHECKLIST

Students must pass all the stated courses and assessment in this checklist to graduate. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessments are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
SCHOOL OF MECHANICAL ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKMP 0010	Research Methodology			
3	MKMR XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) publication from journal article or conference proceeding or book chapter)			

MASTER OF PHILOSOPHY

FIELD OF RESEARCH: MARINE TECHNOLOGY

PROGRAMME SPECIFICATION

The Master of Philosophy Field of Research: Marine Technology (MKMB) is offered on a full-time basis. The duration of study is in between minimum of one (1) year to a maximum of four (4) years. This master programme must be supervised by an academic staff (main supervisor) from the Graduate Faculty. The academic progress of a candidate is assessed through a research progress report submitted at the end of each semester as well as on the research proposal presented during mini viva. The degree is awarded based on an examination of the thesis (including viva-voce) submitted by the candidate upon completion of the study

General Information

1. Awarding Institution		Universiti Teknologi Malaysia	
2. Teaching Institution		Universiti Teknologi Malaysia	
3. Programme Name		Master of Philosophy	
4. Final Award		Master of Philosophy Field of Research: Marine Technology	
5. Programme Code		MKMB3	
6. Professional or Statutory Body of Accreditation		MQA	
7. Language(s) of Instruction		English	
8. Mode of Study		Research	
9. Mode of operation (Franchise, self-govern, etc)		Self-governing	
10. Study Scheme		Full Time	
11. Study Duration		Minimum : 1 year Maximum : 4 years	
Type of Semester	No. of Semesters		No of weeks per semester
	Min	Max	
Normal	2	8	14
Short	-		-

Course Classification

No.	Classification	Credit Hours
i.	University Elective (1 course)	3
ii.	Research Methodology	HW
iii.	Research (Minimum 2 semesters)	0
iv	Thesis	0
Total		3

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Graduates are able to incorporate in-depth relevant knowledge in engineering practices with capabilities to research, develop and integrate.
PEO2	Graduates are able to apply a wide range of relevant knowledge to critically analyse and solve problems related to engineering in various situations and contexts effectively and innovatively.
PEO3	Graduates are able to advocate and communicate ideas and/or solutions to mechanical engineering problems intellectually, ethically and professionally.
PEO4	Graduates able to adopt the latest relevant niche knowledge and technologies through life-long learning process.

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Demonstrate advanced knowledge and capabilities to further develop or use these for new situations in mechanical engineering.
PLO2	Demonstrate research skills in appraising available information and research evidence and applying them in mechanical engineering contexts.
PLO3	Apply critical thinking and problem-solving skills in addressing mechanical engineering problems utilizing relevant tools and techniques.
PLO4	Perform research on mechanical engineering problems professionally, ethically, and responsibly.
PLO5	Communicate technical knowledge and ideas effectively in written and oral forms
PLO6	Adopt the latest relevant knowledge and technologies through life-long learning.

GRADUATION CHECKLIST

Students must pass all the stated courses and assessment in this checklist to graduate. It is the responsibility of the students to ensure that all courses and assessment are taken and passed. Students who do not complete any of the assessments are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
SCHOOL OF MECHANICAL ENGINEERING COURSES					
1	UXXX XXX3	University Elective (1 course)			
2	UKMP 0010	Research Methodology			
3	MKMS XX00	Research (Minimum 2 semesters)			
4		Thesis			
5		Publication (minimum one (1) publication from journal article or conference proceeding or book chapter)			

MASTER OF SCIENCE (MECHANICAL ENGINEERING)

PROGRAMME SPECIFICATIONS

The Master of Science by Taught Course extends the knowledge gained from undergraduate and develops new professional skills in a particular area of mechanical engineering discipline. The programme comprises a combination of compulsory courses, electives, and a master's project. This programme offers twelve (12) tracks which give more options to the students to choose specific area or specialization in the mechanical engineering field. The aim of this program is to provide an opportunity to pursue an in-depth study in the broadly based mechanical engineering disciplines, thus enhancing the technological developments.

This programme is offered either on a full-time or part-time basis. The full-time programme is offered only at the UTM Main Campus in Johor Bahru while the part-time programme is offered at various learning centres throughout Malaysia. The normal full-time program can be completed in a minimum of one year, i.e., two long semesters and one short semester. The full-time student is allowed to take a maximum of 20 credits in a normal semester and 10 credits in a short semester. The part time student is allowed to take a maximum of 12 credits in a normal semester and 6 credits in a short semester. Assessment is based on coursework and final examinations given throughout the semester.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Programme Name	Master of Science (Mechanical Engineering)			
4. Final Award	Master of Science (Mechanical Engineering)			
5. Programme Code	MEMM			
6. Professional or Statutory Body of Accreditation	Malaysian Qualification Agency, MQA			
7. Language(s) of Instruction	English			
8. Mode of Study	Conventional			
9. Mode of operation	Self-governing			
10. Study Scheme (Full Time/Part Time)	Full Time / Part Time			
11. Study Duration	Minimum : 1 year Maximum : 4 years			
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	8	8	14	14
Short	4	4	8	8

Course Classification

Course Category	Code	Course	Credit	Percentage
University General Courses	U### ###3	University Elective	3	7.5%
Programme Core	MEMM1013	Emerging Technologies and Management	3	22.5%
	MEMM1023	Product Innovation and Development	3	
	MEMM1903	Research Methodology	3	
Project	MEMM1914	Master Project I	4	25%
	MEMM2926	Master Project II	6	
Programme Track Electives				
General Mechanical	<i>Choose 5 courses from any tracks (1 to 12)</i>			37.5%
	MEMM1133	Elasticity and Plasticity	3	
	MEMM1143	Plates, Shell, and Pressure Vessels	3	
	MEMM1223	Adaptive control and Intelligent System	3	
	MEMM1233	Robotic System and Control	3	
	MEMM2213	Advanced Control System	3	
	MEMM1253	Acoustics	3	
	MEMM1273	Vibration Measurement and Control	3	
	MEMM1283	Structural Dynamics	3	
	MEMM1313	Viscous Fluid Flow	3	
	MEMM1323	Compressible Flows	3	
	MEMM1423	Thermo Fluid Measurement and Diagnostic	3	
	MEMM1453	Indoor Environmental Quality	3	
	MEMM2413	Advanced Engineering Thermodynamics	3	
	MEMM2423	Advanced Combustion	3	
MEMM1533	Virtual Reality for Engineers	3		
MEMM1553	Creative Design Engineering	3		
Structural Health and monitoring	<i>Choose 5 courses from this track</i>			
	MEMM1213	Automatic Control & Instrumentation	3	
	MEMM1263	Condition Monitoring	3	
	MEMM1463	Conduction And Convection Heat Transfer	3	
	MEMM1123	Computational Method in Solid Mechanics	3	
	MEMM1343	Friction, Wear & Lubrication	3	
	MEMB1633	Assets Integrity & Management	3	
MEMM1113	Fatigue & Fracture Mechanics	3		

Sustainable Engineering	<i>Choose 5 courses from this track</i>		
	MEMM1213	Automatic Control & Instrumentation	3
	MEMM1413	Energy Management	3
	MEMM1433	Sustainable Energy System and Technology	3
	MEMM2113	Advanced Mechanics of Composite Structure	3
	MEMM1543	Engineering Design and Reliability	3
	MEMP1723	Green Manufacturing Technology	3
Computational Mechanics	<i>Choose 5 courses from this track</i>		
	MEMM1913	Advance Engineering Mathematics	3
	MEMM1123	Computational Method in Solid Mechanics	3
	MEMM1333	Computational Fluid Dynamics	3
	MEMM1513	CAD and It's Applications	3
	MEMM2223	Advanced Industrial Automation	3
	MEMM1523	Optimization in Engineering Design	3
Manufacturing Engineering	<i>Choose 5 courses from this track</i>		
	MEMP1733	Digital Manufacturing	3
	MEMP2733	IT for Manufacturing	3
	MEMP1713	Statistical Quality Engineering	3
	MEMP2703	Automation Systems and Robotics	3
	MEMP1723	Green Manufacturing Technology	3
	MEMP2763	Advanced Manufacturing Processes	3
	MEMP2773	Machining and Machine Tools Technology	3
	MEMP2713	Welding technologies and Applications	3
	MEMP2723	Smart Manufacturing	3
	MEMP1753	Manufacturing Science	3
Materials Engineering	<i>Choose 5 courses from this track</i>		
	MEMB1613	Advanced Materials Processing	3
	MEMB1623	Smart Materials	3
	MEMB1633	Assets Integrity and Management	3
	MEMB1643	Structural composites	3
	MEMB2613	Advanced Materials Characterization	3
	MEMB2623	Advanced Surface Modification for Metallic Materials	3
	MEMB2633	Electron Microscopy for Nanomaterials	3
	MEMB2643	Mechanical Behavior of Materials	3
	MEMB2653	Corrosion and Materials Degradation	3

	MEMB2663	Advanced Ceramic Processing	3
Future generation vehicle	<i>Choose 5 courses from this track</i>		
	MEMV2213	Automotive Noise, Vibration and Harshness	3
	MEMV1313	Advanced Vehicle Dynamics	3
	MEMV1613	Future Mobility Solution	3
	MEMV1203	Automotive Electronics & Control	3
	MEMV1623	Vehicle Connectivity	3
	MEMV1013	Advanced Automotive Technology	3
Energy efficient vehicle	<i>Choose 5 courses from this track</i>		
	MEMV2213	Automotive Noise, Vibration and Harshness	3
	MEMV1403	Internal Combustion Engine & Boosting System	3
	MEMV1503	Advanced Vehicle Powertrain	3
	MEMV2413	Low Carbon Fuel	3
	MEMV2513	Automotive Tribology	3
	MEMV1013	Advanced Automotive Technology	3
Industrial Aerodynamics	<i>Choose 5 courses from this track</i>		
	MEMF1313	Advanced Aerodynamics	3
	MEMF2323	Computational Aerodynamics	3
	MEMF2343	Industrial Aerodynamic and Wind Engineering	3
	MEMF2353	Experimental Aerodynamics	3
	MEMF2213	Advanced Aircraft Dynamics and Control	3
Advanced Aerospace Engineering	<i>Choose 5 courses from this track</i>		
	MEMF1313	Advanced Aerodynamics	3
	MEMF2213	Advanced Aircraft Dynamics and Control	3
	MEMF2013	Computational Method for Aerostructures	3
	MEMF2113	Advanced Aircraft Structures and Materials	3
	MEMF2423	Jet Propulsion	3
	MEMF2433	Rocket Technology	3
	MEMF2443	Gas Turbine Technology	3
	MEMF2513	Helicopter System and Performance	3
	MEMF2613	Aviation Management and Airworthiness	3
MEMF2223	Aircraft Instrumentation and Avionics	3	
<i>Choose 5 courses from this track</i>			

Ship technology	MEMO1213	Dynamic of Marine Structures (compulsory)	3	
	MEMO2813	Safety, Risk and Reliability in Marine Operation (compulsory)	3	
	MEMO2113	Strength and Vibration of Marine Structures (compulsory)	3	
	MEMO2003	Marine Environment and Renewable Energy	3	
	MEMO1713	Ship Repair, Survey, and Inspection	3	
	MEMO2313	Ship Powering and Propulsion	3	
	MEMO1413	Dynamic of Marine Power Plant	3	
	MEMO2833	Marine Transport System	3	
	MEMO3843	Maritime Management and Law	3	
	MEMO2513	Design for Advance Marine Vehicles	3	
	<i>Choose 5 courses from this track</i>			
Offshore technology	MEMO1213	Dynamic of Marine Structures (compulsory)	3	
	MEMO2813	Safety, Risk and Reliability in Marine Operation (compulsory)	3	
	MEMO2113	Strength and Vibration of Marine Structures (compulsory)	3	
	MEMO2003	Marine Environment and Renewable Energy	3	
	MEMO2123	Decommissioning and Recycling of Marine Structures	3	
	MEMO2223	Mooring and Riser Analysis	3	
	MEMO2723	Unmanned Underwater Vehicles for Offshore Operations	3	
Free Elective	M### ###3	<i>Choose any 1 course cross discipline / area / track / school</i>	3	7.5%
Total Credit Value			40	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of mechanical engineering field
PEO2	Practice professionalism and high standards of ethical conducts within organization and society
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Attain new frontiers of knowledge in the field of Mechanical Engineering (Knowledge and understanding).
PLO2	Solve complex problems critically and integratively using systematic approaches (Cognitive skills).
PLO3	Apply practical skills to solve problems in the field of Mechanical Engineering (Practical skills).
PLO4	Demonstrate effective collaboration with stakeholders professionally (Interpersonal skills).
PLO5	Communicate effectively the knowledge, skills and ideas using appropriate method to peers, experts and communities (Communication skills).
PLO6	Use digital technologies and appropriate software competently to enhance study and practice (Digital skills).
PLO7	Evaluate numerical and graphical data critically using quantitative or qualitative tools in solving problems (Numeracy skills).
PLO8	Demonstrate leadership, autonomy and responsibility in managing resources (Leadership, autonomy and responsibility).
PLO9	Engage self-advancement through continuous learning or professional development (Personal skills).
PLO10	Demonstrate entrepreneurial skills with relevant knowledge and expertise (Entrepreneurial skills).
PLO11	Demonstrate respectable ethical conducts and professionalism skills in an organization and society (Ethics and professionalism skills).

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
UNIVERSITY GENERAL COURSES					
1	U### ###3	University Course Electives	3	3	
TOTAL CREDIT OF UNI. GENERAL COURSES (a)			3	3	
PROGRAMME CORE COURSES					
1	MEMM1013	Emerging Technologies and Management	3	3	
2	MEMM1023	Product Innovation and Development	3	3	
3	MEMM1903	Research Methodology	3	3	
TOTAL CREDIT OF PROG. CORE COURSES (b)			9	9	
MASTER PROJECT COURSES					
1	MEMM 1914	Master Project I	4	4	
2	MEMM 2926	Master Project II	6	6	
TOTAL CREDIT OF MASTER PROJECT COURSES (c)			10	10	
PROGRAMME TRACK ELECTIVES COURSES (5 COURSES)					
1	MEM# ###3	Elective 1	3	3	
2	MEM# ###3	Elective 2	3	3	
3	MEM# ###3	Elective 3	3	3	
4	MEM# ###3	Elective 4	3	3	
5	MEM# ###3	Elective 5	3	3	
TOTAL CREDIT OF TRACK ELECTIVES COURSES (d)			15	15	
FREE ELECTIVE COURSE					
1	M### ###3	Any 1 course cross discipline / Area / Track / School	3	3	
TOTAL CREDIT OF FREE ELECTIVE COURSE (e)			3	3	
TOTAL CREDIT TO GRADUATE (a + b + c + d + e)			40	40	

COURSE SYNOPSIS

PROGRAMME CORE COURSES

MEMM1903 - Research Methodology

This course aims to provide students with fundamental knowledge of research and the methodologies commonly used in engineering. It encompasses literature review, problem formulation, designing research methods, analysis methods and report writing

MEMM1013 - Emerging Technologies and Management

This course covers description of current trends and recent technology in mechanical engineering as well as basic description on financial and management. A wide range of topics are discussed which may include design and applied mechanics, thermofluid engineering, renewable energy, materials, and composite, industrial and manufacturing, vehicle and marine engineering as well as management and maintenance relevant to the mechanical engineering. Emerging technologies derived from major mechanical fields are disseminated to students through four (4) different modules plus 1 module on financial and management. It is expected that the contents provide an overview of the state-of-the-art in recent mechanical engineering research. Given to the topics covered, the course will be of interest for students, researchers and professionals working in mechanical engineering.

MEMM1023 - Product Innovation and Development

This course introduces the students to the various stages of product design and development methods that can be put into immediate practice in developing products or projects. The development procedures blend the various perspectives of marketing, design, and manufacturing into a single approach to product development. Aspects of sustainable design and manufacturing will also be covered. The course also provides practice in carrying out small projects to expose the various stages of product development. It also includes the various prototyping and manufacturing systems strategies in developing product prototypes.

MASTER PROJECT COURSES

MEMM 1914 - Master Project I

The Master project is an essential course of the master programme where substantial piece of independent work is required. Master Project I requires a student to prepare a research proposal which will be conducted over two semesters (Projects I and II). Master Project I covers project introduction (problem statement, objective and scope), literature review, methodology, proposed method of solution, provide preliminary data and research model and planning for Projects I and II. The student is required to write a draft report and to present and defend his/her research proposal.

MEMM 2926 - Master Project II

Master Project II is a continuation of Master Project I. The student conducts the research work either in a laboratory, workshop, computer laboratory, or industry. The student then required to do data collection, analyses data and interpret the results to solve the research problem that has been identified in Master Project I. The student is required to write a complete report and

defend the findings. On top of the report writing, student also requires producing a technical article based on the project findings.

PROGRAMME TRACK ELECTIVES

TRACK 1 – GENERAL MECHANICAL

This track provides an opportunity to pursue an in-depth study beyond the undergraduate level in the broadly based mechanical engineering disciplines, thus enhancing the technological developments. This track offers general electives in the Mechanical engineering discipline. Students are required to choose five elective courses provided under this track. Additionally, students can also register any courses that are offered within the 12 tracks listed.

MEMM 1133 - Elasticity and Plasticity

This course introduces students to general in-depth theories in the area of elasticity and plasticity. Stress analysis is extended to 3D stress transformation using the stress transformation equation and 3D Mohr's circle in conjunction with typical failure criteria. The stress states of plane stress and plain strain problems are theoretically evaluated in rectangular coordinate systems and by using the stress function concept. For the plasticity concept, fundamental theory of plasticity is introduced for practical applications. Furthermore, the elastoplastic in bending and torsion with strain hardening effect in beams including residual stress is also included in the plasticity analysis. Plasticity analysis on beams and frames is taught to be applied for more complicated structures. Commercial finite element code LS-DYNA is employed as the simulation tools for plasticity application. Upon mastering the software, a case study is given as a group project for evaluating energy absorption capacity of thin-walled structure under large deformation.

MEMM 1143 - Plates, Shells and Pressure Vessels

In this course students are provided with the definitive concepts and principles of pressure vessel design. Students are introduced to the basic theories of elasticity, bending of rectangular and circular flat plates and shell theory. Concepts of plasticity, limit analysis, shakedown, design-by-rule and design-by-analysis are covered. In the former the course covers topics built around the relevant Standards, principally the BS and ASME. Examples are used to illustrate the various topics required to design the majority of 'basic' pressure vessels. In the latter, students are provided with an introduction to the stress analysis of pressure vessels: shell analysis, finite element analysis and the basic concepts of DBA. Pressure vessel components are encompassed within topics including design of dished ends, including buckling aspects, design for external pressure, local loading, supports and mountings, nozzle design and branch connections. At the end of the course, students will be able to consider how the shape and configuration of the vessel will perform under service loading and design them so that they are fit for service.

MEMM 1223 - Adaptive Control and Intelligent System

The course shall cover the essential and basic theory of adaptive control engineering and intelligent systems. It shall cover the followings: System identification using least squares, generalised least squares, recursive least squares, adaptation concepts, theory of adaptive algorithms, and their use in control and estimation, servo follower and regulator, self-tuning

and adaptive model reference controllers. The intelligent system part shall cover the history, basic theory and architecture of Neural Network (MLP), Adaptive Neural Networks (Elman Networks), Deep Learning and Meta-heuristic Algorithms such as Genetic Algorithm, Particle Swarm Algorithm and Firefly Algorithm. MATLAB and Simulink software package shall be demonstrated and used as a tool in solving system identification, adaptive control and artificial intelligent problems throughout the course.

MEMM 1233 - Robot Systems and Control

This course is designed to enable the students at graduate level to develop the necessary insight into the areas of robotic and control. It will examine the fundamental elements of robot system related to anatomy and configuration, robot main components, programming feature and methods and robot's performance specifications. The students are expected to acquire analytical skills through the analyses of robot manipulators related to their kinematics, statics and dynamics which typically constitute the important prerequisites to designing the mechanical structure, planned trajectory path and control aspects. The robot control topic that is included in the later section provides a platform for the students to explore the various control algorithms that address the stability, accuracy, and robustness of the systems. Particular emphasis is laid on the mathematical modelling and simulation of the control schemes. A number of case studies pertaining to selected robotic systems are expected to further strengthen the students understanding and insight into the actual systems.

MEMM 2213 - Advanced Control System

This course prepares the students to grasp the concept, theory, and application of topics of advanced control system theory for postgraduate students with adequate preparation in linear discrete and continuous system control theory. Students will have hands-on experience on the use of Hardware-In-the-Loop (HIL) technology in the design and development of an automated discrete control systems.

MEMM 1253 - Acoustics

This course prepares the future engineers with the physical principles of acoustics together with the tools and analysis techniques for sound measurements. Students will be taught on the physics of sound, measurement instrumentations, analysis techniques, sound inside room & enclosure, transmission of sound through structure and outdoor sound. Students will also be introduced and exposed to the typical acoustic and sound measurement instrumentations available in the acoustics laboratory. The project/s assigned to students during this course requires understanding on the basic principles of sound along with the use of sound measurement instrumentations and data analysis. At the end of this course, students should understand thoroughly all the underlying physical principles of acoustics and should be able to measure and analyse sound levels whenever required.

MEMM 1273 - Vibration, Measurement and Control

The course relates to practical aspects of vibration measurements and the control of vibration in mechanical and engineering systems. Cause and effects of vibration related failures are presented that highlight the importance of measurements, diagnosis, assessment, and control of vibration in the industry. A review of vibration basics from a measurement perspective is presented. Important aspects of vibration data acquisition, signal processing and data

interpretation are covered. Topics in vibration fault analysis, avoidance of vibration induced failures, and reduction of vibration and design of control solutions are covered. The course involves measurements and design exercises to demonstrate and to apply knowledge in vibration instrumentation and control.

MEMM 1283 - Structural Dynamics

Structural dynamics investigate the vibrating or oscillating of mechanical structure subjected to dynamic loads. These structures are continuous system thus requiring wave propagation methods in determining the dynamic response of various beams, rods, shafts, and plates. Mobility technique in determining and measuring the response of structures are introduced. Topics also cover on modal analysis which analytically and experimentally determine the natural frequencies, damping and the corresponding mode shapes of structure in motion. Vibration measurement instrumentations are introduced, and laboratory works are offered related to the mobility of structures and modal testing and analysis.

MEMM 1313 – Viscous Fluid Flow

This course is intended for graduate students wishing to have deep understanding in viscous flow and boundary layer. In this course, it starts with basic properties of fluid and derivation of basic equations for viscous flow problems. Student also will be introduced the boundary condition for viscous flow problems. Then, the derivation of equation of viscous flow regarded to conservation of mass, conservation of momentum and energy equation will be introduced. After that, a set of equations based on the conservation of momentum were used to solve Couette flow and Poiseuille flow. Finally, applying the momentum equation to solve boundary layer related engineering problems and incompressible turbulent mean flow problems.

MEMM 1323 - Compressible Flow

This course is designed to provide students with a clear explanation of the physical phenomena encountered in compressible flow, to develop in them an awareness of practical situations in which compressibility effects are likely to be important, to provide a thorough explanation of the assumptions conventionally used in the analysis of compressible flows, to provide a broad coverage of the subject, and to provide a firm foundation for the study of more advanced and specialized aspects of the subject. The course starts with the basic principles and thermodynamics concepts, then expose the students with the analysis of one-dimensional isentropic flow together with area-Mach number relationships, of normal and oblique shock waves, and of expansion waves. The course also covers the analysis of nozzle characteristics, of friction effects, of heat exchange effects and of steady two-dimensional which includes small perturbation theory

MEMM 1423 - Thermo Fluid Measurement and Diagnostic

The course will explore the thermal and fluid measurement parameters such as pressure, flow, temperature, heat flux, combustion pollutant, sprays, and tools to measure them by either intrusive or nonintrusive methods. The classical, standard, and advanced thermal fluid measuring tools will be discussed. This course also introduces students to the basics of advanced optical of fluids and combustion flow diagnostics concepts, principles, and techniques. Quantitative and qualitative measurement techniques for reacting and

nonreacting flows will also be emphasized in this course. The course will be conducted through lectures, laboratory works and projects-based methods.

MEMM1453 - Indoor environmental quality

The course describes factors that affect Indoor Environmental Quality (IEQ) in buildings. The course covers materials related to Thermal Comfort, Indoor Environmental Health, Air Contaminants, and Odors. In this course, to increase students' knowledge of digital technology, they will also be given a project related to environmental modelling using a numerical technique, such as computational fluid dynamics (CFD) analysis. The modelling project will provide added value to students related to information on contaminant characteristics and how numerical analysis could quickly examine the IEQ parameters. Understanding the IEQ factors inside buildings is a first step in identifying the actions necessary to avoid and reduce these aspects' adverse impacts on health.

MEMM 2413 - Advanced Engineering Thermodynamics

This course in advanced engineering thermodynamics provides a strong foundation in the fundamentals of thermal sciences for further advanced research. The students shall be exposed to the restrictions on possible properties and systems. An advanced treatment of the First and Second law of Thermodynamics will be given. Exergy analysis will be given in depth regarding fundamental concepts, techniques, and application in various systems.

MEMM 2423 - Advanced Combustion

This course explores deeper into the fundamentals of combustion. Multi-component conservation equations are explored taking into account chemical reactions. Combustion process is also analysed from the point of view of chemical kinetics to gain better understanding of species production especially pollutant formation. Numerical approach to solving combustion problems is introduced via equilibrium and kinetics packages. Detonation is given special treatment due to its increasing importance and potential for propulsion. At the end of the course, students are expected to be familiar with the thermodynamics and chemical kinetics concept related to the combustion process. The students will be able to analyse deflagration-type combustion like diffusion and premixed flame along with the detonation-type combustion by implementing the fundamental analysis method that are presented in this course.

MEMM 1553 - Virtual Reality for Engineers

The course will introduce techniques used to synthesize and recreate the real world by imitating its physical, visual, and audio stimuli and “immersing” a person in one such artificially created environment especially for engineers. To achieve this, OpenGL programming will be used, and its applications will focus on kinematics such as robot arm and slider crank. This course will expose students to current research on VR and look at future scopes of the same area.

MEMM1553 - Creative Design Engineering

This course introduces the new approach in the field of engineering design that has traditionally been primarily concerned with ‘how to make things’ – but as technology has advanced – the challenge has changed to ‘what to make’. Topics highlighted are basic

concerns associated with innovation. First, design is considered a kind of universal human act. Second, it is an interdisciplinary approach that brings together perspectives from fields such as cognitive science, cognitive psychology, and science of knowledge. Third, the scope of the discussion includes the process of creating an initial idea for a new product (pre-design phase) as well as the use of the product in society (the post-design phase).

TRACK 2 – STRUCTURAL HEALTH MONITORING

This track is focus on advanced mechanical knowledge related to the theoretical and technological aspects of structural control and health monitoring for materials and engineering infrastructure. The courses offered in this track include condition monitoring, advanced heat transfer, control and instrumentation, asset integrity and management, fatigue fracture mechanics and friction wear lubrication.

MEMM 1223 – Automatic, Control & Measurement

The course shall cover the essentials of both instrumentation and control aspects for graduate students. It will emphasize on the concepts and characteristics of instrumentation system, signal conditioning, transducers and continuing system. Students should be able to relate and describe the operating principle of various transducers and design instrumentation system for measuring load, displacement, temperature, and other physical quantities, select suitable instrumentation components and tools for intended application and solve problems related to basic instrumentation system. Special emphasis is given on the microcomputer-based application and data acquisition technique. The control section shall encompass the essence of control theory, mathematical modelling of dynamical system, time response, control action, stability analysis, frequency response and design of control system. A number of practical case studies shall be presented to include modelling and simulation of systems using MATLAB and Simulink.

MEMM 1263 - Conditional Monitoring

The course relates to practical aspects of maintenance and assets management practices in industry. The course focus on the condition base maintenance strategy where condition monitoring is the key aspects of this success. Several condition monitoring techniques such as vibration, ultrasonic, thermography, oil analysis/tribology-based analysis, acoustic emission, temperature monitoring and performance monitoring are discussed in detail. Important aspects of data acquisition, signal processing and data interpretation are covered in detail. The course involves practical exercises to demonstrate and to apply knowledge in condition monitoring.

MEMM 1463 - Conduction and Convection Heat Transfer

This course aims to increase the student's understanding of the fundamentals of conduction heat transfer and to demonstrate the variety of analytical techniques used in the formulation and solution of classical and applications-oriented conduction problems. Learn about the mathematical methods to solve one- and two-dimensional heat conduction problems. Get an overview of some specialized topics in heat conduction, such as the inverse heat conduction problem and experiments for heat conduction problems. This course also introduces the students to convective heat transfer mechanisms; derivation of general conservation equations; dimensional analysis; boundary layer approximation for laminar flow; similarity

solution; integral method; laminar forced convection in pipes and ducts, integral solution; convection in turbulent flow; forced heat convection around the bodies immersed in a fluid; natural convection and enhanced convective heat transfer.

MEMM 1123 - Computational Method in Solid Mechanics

This course extends the undergraduate-level introduction to the Finite Element Method for obtaining approximate solution to a wide variety of engineering problems in mechanics of materials and structures. The scope of analysis covers elastic-plastic range of continuous materials behaviour, including low-cycle fatigue. Emphasis is placed on the mathematical derivation of the constitutive equations for numerical implementation. Process and procedures in finite element modelling and simulation of realistic engineering problems are described and rigorously discussed using examples in plane, axis-symmetric and 3-D analyses in solid mechanics. Physical interpretation of the 3-D finite element simulation results is also discussed.

MEMM 1343 – Friction, Wear, and Lubrication

This course covers basic knowledge on tribological contact in mechanical systems in relative motion. The course presents the importance, role and properties of contact surfaces, materials and surroundings. Furthermore, the influence of the components of a tribological system and contact conditions on the properties of friction and tear is explained. The course covers the types and the role of lubricants, as well as their influence on the quality of lubrication, friction, and on various friction and wear mechanics. In relation to these topics, the analytical techniques available for the analysis of surface properties, lubricants, tribological behaviour and wider systems are presented.

MEMB1633 - Assets Integrity & Management

This course is introducing the students to the Asset Integrity Management (AIM) system especially for an aging offshore oil field infrastructure. The platforms, pipelines and onshore facilities were aged and needed some extensive refurbishment and a new inspection and integrity regime put in place. The course also provides a comprehensive coverage of the various non-destructive techniques (NDT) used to assess the integrity of engineering components. The concepts and techniques used in assessing assets through risk based assessment (RBI) be covered.

MEMM 1113 - Fatigue & Fracture Mechanics

This course describes the theories of metal fatigue and fracture mechanics, and their applications to engineering structures. Both aspects of materials (metallurgical) and mechanics of the failure processes are discussed. Stress-life and strain-life approaches to fatigue analyses are described. Linear elastic fracture mechanics (LEFM) are elaborated. Fatigue crack propagation behaviour in pre-cracked solids is appropriately discussed. Relevant applications of fatigue, LEFM and fatigue crack growth analyses in design and life assessment of engineering structures are also demonstrated.

TRACK 3 – SUSTAINABLE ENGINEERING

This track is focused to provide students with advanced mechanical knowledge and applications of sustainable systems and approach. It is built upon several engineering courses focused on various sustainable methods such as engineering design and reliability, sustainable energy system and technology, advanced mechanics of composite structure and green manufacturing technology.

MEMM1213 - Automatic control & instrumentation

The course shall cover the essentials of both instrumentation and control aspects for graduate students. It will emphasize on the concepts and characteristics of instrumentation system; signal conditioning, transducers and continuing system. Students should be able to relate and describe the operating principle of various transducers and design instrumentation system for measuring load, displacement, temperature and other physical quantities, select suitable instrumentation components and tools for intended application and solve problems related to basic instrumentation system. Special emphasis is given on the microcomputer-based application and data acquisition technique. The control section shall encompass the essence of control theory, mathematical modelling of dynamical system, time response, control action, stability analysis, frequency response and design of control system. A number of practical case studies shall be presented to include modelling and simulation of systems using MATLAB and Simulink

MEMM1413 - Energy management

Energy management is meant for guiding energy-sector activities to conserve energy and enhance energy supply and security. Energy management includes four main functions: analysis of historical data, energy audit and accounting, engineering analysis of systems, and energy economics. This course covers contemporary energy management topics such as energy sector challenges, energy system thinking, energy management control systems, energy economics, and emerging energy technologies. This course also provides training in gathering updated energy related information to apply in real-life applications. The course is multidisciplinary in nature and students will be required to look at the energy sector problems from different points of views. Thus, the course is well suited to students from any of the mechanical, electrical, chemical, and environmental engineering major. After successful completion of this course, the students would comprehend the energy management knowledge to play their role in conserving and efficient use of energy in buildings and industry.

MEMM1433 - Sustainable Energy System and Technology

In the context of depleting fossil fuel reserves and environmental consequences, the concept sustainable energy has drawn a central focus among energy stakeholders. This course embraces both sustainable energy system and technology. The energy system is an entity that includes all components and technology related to energy exploration, production, conversion, delivery and end uses. This course explains the concepts of sustainable energy system and technology based on ethics, environments and economy (E3) and their role on sustainability in practical system applications. The course first recognizes the effects from the fossil dominated energy system and technology and then provides the latest review of the most important renewable energy resources and advanced technologies. The course also demonstrates evaluating the fossil and alternative energy systems and technologies in terms

of the sustainability criteria. Comprehension of the issues associated with sustainable energy system and technology are achieved through lectures, discussions, combined with reports and student presentations on the literature reviewed.

MEMM2113 - Advanced Mechanics of Composite Structure

This course introduces students to some major views and theories in the area of composite materials especially in the polymer based composite learning with emphasis on the types of materials, production methods, failure analysis and the mechanics of laminated composites. It will examine some key issues in the mechanics of laminated composites with special focus on the stress-strain relationship and interaction to the extensional, coupling and bending stiffness matrices in promoting learning. Sandwich structures and interlaminar fracture toughness will also be included in this syllabus. The course will also provide a visit to industries dealing with polymer based composite materials in order the students to understand more regarding the practical sides of the subject.

MEMM1543 - Engineering Design and Reliability

The course provides understanding of the statistical nature of design parameters (i.e.: stress and strength) as well as material properties and design performance. These understandings are used to develop design for reliability concepts. The basic concepts are extended to 'real world' problems, such as fatigue analysis, through class examples and case studies. Emphasis is placed on application to the optimization and reliability simulation of engineering designs. Some special topics on real life application are discussed. Although emphasis is on mechanical designs and structures, the concepts can be extended to other specialties in mechanical engineering (energy and fluids, and systems and dynamics).

MEMM1723 - Green Manufacturing Technology

This course introduces students to green manufacturing technology and sustainability considerations in product design and manufacture. It presents the principles, methodology and case studies to develop an understanding of sustainable development that can reduce environmental impact and promote green technology for sustainable practice. Besides that, it is also introducing the Life Cycle Assessment consists of four main phases, goal and scope definition, inventory, impact assessment, and interpretation. Analysis of use valid life cycle assessment method to collect and process data of the product's life cycle or the manufacturing processes consumption or declaring the total emissions from the manufacturing.

TRACK 4 – COMPUTATIONAL MECHANICS

This track aim is to extend the knowledge in mechanical engineering by exploring the problem-solving approach using computational techniques, mathematical algorithms, and computer-aided engineering tools. The courses offered in this track include advanced engineering mathematics, computational method in fluid dynamics and solid mechanics, computer aided design, advanced industrial automation and optimization in engineering design.

MEMM1913 - Advance Engineering Mathematics

The course provides engineers and scientists with the basis of intelligent working knowledge with the capacity to handle complex problems, equipped with the basic principles and methods, facts and techniques in applied mathematics and post-calculus relevant to engineering applications. This course prepares the mechanical engineering students to be proficient in solving engineering problems through suitable mathematical methods and interpreting the mathematical results meaningfully. The first part of the course deals with the ordinary and partial differential equations (ODE, PDE) that has significant importance in mechanical engineering field. The second part of the course consists of the vector calculus that includes vector differential and vector integral with and extension to the tensors. An emphasis to the mathematical modelling is placed throughout the course to allow the engineers to describe a system using mathematical tools, which constitutes an important task for accurate analysis and rapid optimization of real engineering applications. Therefore, understanding of the physical meaning of mathematical terms are placed at high priority in this course to serve as a continuation of the pure mathematical understanding that has been acquired in the related undergraduate courses.

MEMM1123 - Computational method in solid mechanics

This course extends the undergraduate-level introduction to the Finite Element Method for obtaining approximate solution to a wide variety of engineering problems in mechanics of materials and structures. The scope of analysis covers elastic-plastic range of continuous materials behaviour, including low-cycle fatigue. Emphasis is placed on the mathematical derivation of the constitutive equations for numerical implementation. Process and procedures in finite element modelling and simulation of realistic engineering problems are described and rigorously discussed using examples in plane, axis-symmetric and 3-D analyses in solid mechanics. Physical interpretation of the 3-D finite element simulation results is also discussed.

MEMM1333 - Computational Fluid Dynamics

This course connects the gap between the introductory level and the applied in engineering practice as well as in research and development of using computational fluid dynamics (CFD) for solving fluid flow problems. In the first part, the spatial and time discretization methods for solving fluid mechanics problems governed by the incompressible Navier-Stokes equations are introduced. This course also provides hands on experience using both commercial and community developed CFD software. This is followed by introducing advanced numerical schemes in CFD and various Multiphysics methods for modelling complex fluid flow.

MEMM1513 - CAD and It's Applications

This course is divided into two parts. The first part covers the foundation theories in CAD. Then, the second part discusses the applications the foundation theories. These applications include from the applications in the engineering design and extends to the framework in the creation an intelligent system. The course also exposes the possible research and emerging technologies related to CAD.

MEMM2223 - Advanced Industrial Automation

The course is an elective for students seeking a specialty in mechanical engineering. It shall introduce students to the methods, tools, and technologies used to automate a product or a plant. Primary automation technologies include sensors, actuators, signal conditioners, microprocessor/microcontroller, programmable logic controllers (PLCs), ON/OFF and automatic control, and PC-based control are covered within this course. Students will also experience development of automated product/plant through hardware programming and interfacing implementation.

MEMM1523 - Optimization in Engineering design

This course introduces the traditional non-linear optimisation methods that can be used to solve a wide range of problems across all engineering disciplines, mainly for engineering design. Optimisation involves finding the 'best' solution according to specified criteria. In Engineering Design, this might typically be minimum cost or weight, maximum quality or efficiency, or some of the performance index pertaining to a disciplinary objective. Realistic optimal design involves not only an objective function to be minimized or maximized, but also constraints that represent limitations on the design space. Numerical programming requires the mathematical representation of the design space (objective function and constraints) in terms of design variables- (parameters that signify some potential for change). Generally, the problems of interest in engineering are of a non-linear nature, in that the dependence of the objective function and constraints on the design variables is non-linear.

TRACK 5 – MANUFACTURING ENGINEERING

This track aims to provide students with a broad and diverse advanced manufacturing knowledge that derives its breadth from various manufacturing tools and technologies. Throughout the period of study, students may learn about smart manufacturing, machining and machine tools technology, welding technologies and applications, automation systems and robotics, etc. The breadth of the advanced manufacturing discipline allows students a variety of career options.

MEMM1733 - Digital Manufacturing

This course aims to prepare students with fundamental of knowledges under industrial 4.0 industrial revolutions. Digital Manufacturing (DM), comprising Subtractive, Additive and Laser technology as key technologies for supporting manufacturing techniques that involves part creation by joining material together without part-specific tooling, driven by a computer. The technologies focus on prototypes and low/high-technology applications, DM service parts are being used in safety-critical fields including aerospace, automotive, biomedical, and services industries. The purpose of this course is to provide participants with knowledge and tools for informed decision making relative to integration of DM processes and parts into the industrial application. The coverage includes current DM practice for metals, polymers and ceramics; mechanical properties; DM processing for production; and application related to industrial applications. At the end of the course, students should be able to describe fundamental aspects of the Subtractive processes, Additive Manufacturing/3D Printing Technology techniques, laser technology and their applications. Finally, this subject also performs engineering analysis to solve product manufacture problems and evaluate engineering investment/projects by utilised these technologies.

MEMP2733 - IT for Manufacturing

Knowledge Management and Knowledge Management Infrastructure are the main contents. The lecture is supplemented with the real data mapping and development of information systems. This course is an Instructional lecture and Cooperative learning (CL) enriched with student assignments and group projects. Students are required to perform problem solving using real case study and projects in their individual assignments/projects to measure their skill in communication and analysis of data. Students are guided through the real-life case study that requires them to construct into real data for database design. They are also to prove their ability by constructing a database information system using selected tools. The contents include Business System of project and Product Based, Information Security, Cyber physical system, networking, vertical & horizontal integration, Data exchange, Cloud manufacturing and computer integrated manufacturing (CIM).

MEMP1713 - Statistical Quality Engineering

This course is designed to provide the students with sound understanding to statistical methods in quality improvement. It encompasses various statistical process control problem-solving tools. For control charts, emphasis was given on additional control charts not covered previously at the undergraduate level. Advanced tools and techniques such as Gauge Repeatability and Reproducibility (GR & R), Quality Function Deployment (QFD), Failure Mode Effect Analysis (FMEA) and experimental design methodology were also covered.

MEMP2703 - Automation systems and robotics

This course is designed to enable the students at graduate level to develop the necessary insight into the areas of automation, robotic and control. It will examine the fundamental elements of automation and robot systems related to anatomy and configuration, robot main components, programming features and methods and robot's performance specifications with their integration. The student will study automation and control both on a theoretical level and on a practical level – learning to design, test and implement the automation systems function. The students are expected to acquire digital skills on simulation study of several robotic control systems. This provides a platform for the students to explore the performance of different control algorithms that address the stability, accuracy and robustness of the systems. A number of case studies pertaining to selected robotic automated systems are expected to further strengthen the students' understanding and insight into the actual systems which meet the 4th Industrial revolution system requirements.

MEMP1723 - Green Manufacturing Technology

This course introduces students to green manufacturing technology and sustainability considerations in product design and manufacture. It presents the principles, methodology and case studies to develop an understanding of sustainable development that can reduce environmental impact and promote green technology for sustainable practice. Besides that, it is also introducing the Life Cycle Assessment consists of four main phases, goal and scope definition, inventory, impact assessment, and interpretation. Analysis of use valid life cycle assessment method to collect and process data of the product's life cycle or the manufacturing processes consumption or declaring the total emissions from the manufacturing.

MEMP2763 - Advanced Manufacturing Processes

This course introduces automation and advanced techniques used in the modern manufacturing. Types of automation systems, applications, advantages and disadvantages are discussed. It also includes discussion on the principle of CAD/CAM/CNC and other applications in various manufacturing automation systems such as GT, FMS and CIM. This course will also allow student to carry out small case studies in the real environments for exposing them on certain issues related to manufacturing automation.

MEMP2773 - Machining and Machine Tools Technology

This course introduces the students to the fundamental knowledge in metal cutting theory and principle. Some of the essential topics that will be covered include machinability, cutting forces, cutting tool, tool wear mechanism and tool life. The basic metal cutting concept and operations for product manufacture such as turning, milling and grinding processes will be taught. The students are also exposed to the various aspects of machine tools technology and its elements such as the constructional and design features, guideways and slideways, drives, vibration and chatter, machine tool metrology. Individual assignments and exercise are given to the students to enhance their knowledge in machining theory and machine tool technology.

MEMP2713 - Welding technologies and Applications

This course discusses the physical principles, operating characteristics and practical applications of a variety of welding processes to enable selection of a suitable process for a particular application. The importance to understand the principles behind the most recent developments in welding processes. There is a strong emphasis on laser welding, as well as recent developments in arc, friction and resistance welding. The module will cover the operating principles, characteristics and practical applications of each process.

MEMP2723 - Smart Manufacturing

This course introduces the overview of Smart Manufacturing architectural framework, its application, related technologies and its future directions related to various case studies around the globe. The aim is to introduce students to the new era of Industrial Revolution (IR4.0) related to the power of digital manufacturing and product model data for manufacturing integration. Students will also gain deep insights into how various support systems are used in harnessing from product design, knowledge management, data analysis and other technologies being seamlessly transfer through the entire lifecycle of a manufactured product.

MEMP1753 - Manufacturing Science

This course is designed to expose the students on various principles and theories related to Precision Engineering fields. It involves derivation of fundamental tolerance from basic principle, application of tolerance on system design, interpreting machining and inspection symbols, fundamental of precision machining, principles of precision measurement and recent development in Precision Engineering fields will also be discussed.

TRACK 6 – MATERIALS ENGINEERING

This track aims to provide graduates with the advanced knowledge and capabilities to carry out research and solve complex material engineering problems effectively. Upon graduation, graduates may improve the knowledge related to smart material, advanced material

processing, asset integrity and management and corrosion and materials degradation, etc. The versatility of this program allows graduates a variety of career options.

MEMB1613 - Advanced Materials Processing

This course introduces students to the manufacturing methods of materials engineering into the desired shapes. It starts with the basic concepts of manufacturing and processing and their applications to materials engineering as it introduces students to solidification in casting, powder metallurgy, deformation processes. The course will examine the various processing methods for metals, ceramics, polymers and composite materials, including joining and recycling processes for metals, polymer and ceramics. The course emphasis on the role played by materials and their properties in selecting the optimum manufacturing method. In addition to the advanced processes of traditional materials, the course also covers the advanced process for semiconductor materials and optical fibre, the thin film deposition process on nanoscale application, and Layer-Based Additive Manufacturing Technologies.

MEMB1623 - Smart Materials

This course introduces students to the recent developments on the various classes of smart materials or functional materials used in applications such as aerospace, automotive, biomedical and electronic industries. It will emphasize on the important properties exhibited by smart materials that make them selected for high-end and advanced applications. The physical and mechanical properties of the various classes of smart materials will be detailed as well as the unique processing techniques associated with producing these materials. The course will also cover shape memory alloys, self-healing materials, materials for sensor and actuator, and sustainable materials. The students are enabled to describe structural setup and function of advanced and functional materials. They command modern synthesis techniques and are able to apply these techniques to the preparation of new compounds. The students can interpret and evaluate the results of various methods for structural analysis of functional materials and apply the knowledge to select suitable materials for a given engineering project.

MEMB1633 - Assets Integrity and Management

This course is introducing the students to the Asset Integrity Management (AIM) system especially for an aging offshore oil field infrastructure. The platforms, pipelines and onshore facilities were aged and needed some extensive refurbishment and a new inspection and integrity regime put in place. The course also provides a comprehensive coverage of the various non-destructive techniques (NDT) used to assess the integrity of engineering components. The concepts and techniques used in assessing assets through risk based assessment (RBI) be covered.

MEMB1643 - Structural composites

Advanced composite materials are used in many industries including aerospace, marine, automotive, medical, energy, and recreation. Striking examples of the expanding use of composites are the Boeing 787 and Airbus A350, as these materials improve performance and save weight. To better prepare engineers in applying these new material technologies to the design and manufacturing of composite structures. This subject provides an introduction to structural composites, starting with the "trinity" - the interaction between shape design, base material and manufacturing. The course covers the design principles of composites structure;

durability and fatigue; testing; manufacturing methods and mechanics. The main focus is on composites structures made with polymer matrices but use of metals and ceramics as matrices will be addressed as well. By the end of this course students will be able to know what design choices they have to make for different requirements. Also, the student will be able to identify the unique characteristics of composites and apply the fundamental and practical knowledge necessary to build and maintain composite structures.

MEMB2613 - Advanced Materials Characterization

This course provides the students with a deep and broad insight into the principles of advanced techniques used in characterizing and determining the structure and properties of materials. The technique includes x-ray analysis method such as XRD, XRF, Raman spectroscopy and fourier transform infrared (FTIR). The students will also be introduced microscopy techniques which covers from light to electron microscopy (SEM, TEM, HRTEM, STEM) and analytical techniques such as energy dispersive x-ray (EDX/WDX), electron energy loss spectroscopy (EELS). To learn the principles and application of advanced surface characterisation techniques including atomic force microscopy (AFM), X-ray photoelectron spectroscopy (XPS). The principles and interpretation of various thermal analysis techniques will also be covered in this course.

MEMB2623 - Advanced Surface Modification for Metallic Materials

Corrosion, wear, or the combined effects of these destructive failure modes cost industrial economic hundreds of billions of dollars each year. One of the most effective means of mitigating damage due to corrosion and wear is to treat or 'engineer' the surface so that it can perform functions that are distinct from those functions required from the bulk of the material. Understanding corrosion and wear problems and the factors involved must be considered before selecting the specific surface modification process. Different process demonstrates different thickness ranges, hardness, wear resistance, corrosion resistance, cost, processing time, operating temperature, surface finish/roughness and other surface characteristics. The course provides an overall view of the advanced surface modification processes with emphasis on the strengths and limitations of each method and practical design guidelines for surface modification. At the end of the course students should gain an understanding of how improvements in the surface properties are achieved through a range of processes and also be able to apply the knowledge to select an appropriate surface modification process for the specific application.

MEMB2633 - Electron Microscopy for Nanomaterials

This course introduces the fundamental aspects of nanomaterials and electron microscopy. The importance of nanomaterials and their improved properties compared to conventional materials. The principles and relative merits of a range of techniques for fabricating nanostructures in one-dimensional and two-dimensional materials, including a single atomic layer and multilayers, are discussed. The analytical and imaging characterization techniques of electron microscopy will be introduced in detail to students. Students will also learn how to analyze digital data using digital software and understand how to evaluate nanomaterials properties.

MEMB2643 - Mechanical Behavior of Materials

This course introduces students to the dislocation theory and the role of these dislocations on the metal's ability to deform plastically as well as strengthening mechanisms. It will focus on the mechanical behaviour of all classes of materials (metals, polymers, ceramics and composites) under different stressing conditions such as fatigue, creep, and fracture. The course will also provide students with the principles of fracture mechanics and its application. At the end of the course the student should be able to relate between the behaviour of materials and their structures and design procedures to control failure of materials.

MEMB2653 - Corrosion and Materials Degradation

This course will give an overview on the importance of corrosion, electrochemical reactions, thermodynamics and kinetics of electrochemical phenomena. Different forms of corrosion related to materials, environment and stresses will also be discussed followed by the five main corrosion control methods. Apart from aqueous corrosion, the high temperature oxidation will be addressed and discussed. Degradation of various materials classes such as polymers, composites and electronic materials will also be covered in the course. The course will also provide students to the various techniques of corrosion testing and monitoring

MEMB2663 - Advanced Ceramic Processing

This course covers on the concepts of processing of advanced ceramics materials, such as electroceramic, bioceramic, oxide ceramics, non-oxide ceramics and their characterizations. The aims are to broaden the knowledge on oxide ceramics towards that of the expanding family of carbides, nitrides and borides. Specific case studies will be discussed to illustrate the potential of multiple phase technical ceramics as well superconducting and ceramic sintering. Students will be involved in the case studies and will be exposed to new materials and processing techniques.

TRACK 7 – FUTURE GENERATION VEHICLE

This track aims to provide graduates with the advanced knowledge and capabilities to carry out research and solve complex future generation vehicle problems effectively. Upon graduation, graduates may improve the knowledge related to advanced automotive technology, vehicle connectivity, hybrid technology, and future mobility solutions. The versatility of this program allows graduates a variety of career options.

MEMV2213 - Automotive Noise, Vibration and Harshness

This course focuses on the principle of vehicle vibration and acoustics and its application in automotive. The course modules include understanding the effects of vibration and acoustic on vehicle systems and components. Students will learn the human perception of noise and vibration according to guidelines and assessment methods. Common methods using signal processing such as Fast Fourier transform (FFT) to reduce vehicle noise and vibration will be explored. Students may also engage with the industry such as visiting a local car/car parts manufacturer or conducting an industrial level of experimentation to boost their knowledge.

MEMV1313 - Advanced Vehicle Dynamics

This course discusses vehicle dynamics in general which covers the vehicle's ride and handling behaviours. The systems which contribute to a better vehicle dynamic performance in modern passenger vehicle will be covered in this course. This includes the semi-active and active suspension systems, roll control systems, electronic brake force distribution (EBD) system, antilock braking system (ABS) and active steering system. The importance of vehicle dynamics for automated vehicle will also be covered in this course. This includes handling modelling and control system of an automated vehicle which utilises sensors data to maneuver. All of the mentioned systems will be introduced theoretically followed by the development of the systems' simulation model using MATLAB/SIMULINK. At the end of the course, the students are able to develop modern vehicle dynamics-controlled systems which are typically used for an outstanding dynamics performance for a vehicle.

MEMV1613 - Future Mobility Solution

Urban transport is strategically important for economic competitiveness, social cohesion, and sustainable growth. This course focuses on innovative and sustainable urban mobility solutions implemented in different parts of the globe, to tackle urban congestion, greening the transport network and making it safer, more efficient, and accessible.

MEMV1203 - Automotive Electronics & Control

This course focuses on vehicle electronic, incorporating studies on the principles of sensors and actuators used in automotive control applications. The major topics cover the variety and role of electronic sensors and actuators, sensor's signal conditioning systems, actuator's drivers and control systems in automotive applications. At the end of this course, students are expected to be able to design and develop electronic and control system for vehicles.

MEMV1623 - Vehicle Connectivity

This course provides advancements in enabling connected cars are astonishing. Advances in connectivity are creating opportunities in the automotive industry. Dashboard navigation, infotainment systems, and Bluetooth-enabled dashboards are a glimmer of what is coming in the notso-distant future. It will explain connectivity is turning the car into smart devices with the potential to become crucial pieces in enabling the Internet of Things (IoT). Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) technology allow the cars to communicate with other cars and infrastructure like traffic light. This course focuses on innovative and technologies in vehicle connectivity in the cars that will transform driving experience and challenging issues in terms of traffic infrastructure and product affordability.

MEMV1013 - Advanced Automotive Technology

This course focuses on advanced technology in automotive development. The topics covered includes environmental policy and safety in automotive design standards, advanced materials, alternative fuels and alternative powertrain technology. Development and the future of autonomous technology will also be taught. At the end of this course, students are expected to be able to propose advanced automotive technology design in compliance with the current established standards.

TRACK 8 – ENERGY EFFICIENT VEHICLE

This track aims to provide graduates with the advanced knowledge and capabilities to carry out research and solve complex energy efficient vehicle problems effectively. Upon graduation, graduates may improve the knowledge related to advanced automotive technology, vehicle powertrain, electronic and control, internal combustion engine and boosting system, and vehicle dynamics. The versatility of this program allows graduates a variety of career options.

MEMV2213 - Automotive Noise, Vibration and Harshness

This course focuses on the principle of vehicle vibration and acoustics and its application in automotive. The course modules include understanding the effects of vibration and acoustic on vehicle systems and components. Students will learn the human perception of noise and vibration according to guidelines and assessment methods. Common methods using signal processing such as Fast Fourier transform (FFT) to reduce vehicle noise and vibration will be explored. Students may also engage with the industry such as visiting a local car/car parts manufacturer or conducting an industrial level of experimentation to boost their knowledge.

MEMV1403 - Internal Combustion Engine & Boosting System

This course is designed to deliver the principles of internal combustion engine and boosting systems. The subject covers the types of internal combustion engines and its operations. Furthermore, the latest technologies that make internal combustion engine to be more efficient and less polluting are also covered in this subject. Additionally, the course emphasizes on the engine air induction system, in particular the turbocharging and supercharging methods. It covers the science governing the operation of turbochargers and superchargers – which include aerodynamics, gas dynamics and thermodynamics. Upon completion of this course, students will have advanced understanding of how internal combustion engine with boosting system can meet the strict emission and energy efficiency targets.

MEMV1503 - Advanced Vehicle Powertrain

This course covers principle knowledge of conventional and alternative powertrain systems for automotive applications. It includes main components in the powertrain systems namely powerplant (internal combustion engine/electric motor), transmissions and power storage (battery). At the end of the course, students should be able to propose the powertrain system for a passenger vehicle.

MEMV2413 - Low Carbon Fuel

This course focuses on low-carbon transportation fuels, that are emerging options to displace petroleum-based fuels. The topics covered includes low carbon fuel standards, alternative fuels technology, economics, and transitional issues. Assessment of Life-cycle Analysis of the alternative fuels will also be taught. At the end of this course, students are expected to be able to analyse a range of policy tools and mechanisms that could be employed to deliver greenhouse gas emission reductions and decarbonisation of transport fuels for a sustainable transportation future.

MEMV2513 - Automotive Tribology

Tribology is focusing on the friction, wear and lubrication principle and application. The course is originated from the art of lubrication but has developed to many different types and range of applications. Among the topics discussed are principle of lubrication and surface topography characterization. In automotive application, almost half of the mechanical power generated by the engine is wasted in friction between pistons and cylinders and within the gearbox and transmission gears. At the end of this course, students are able to predict the most suitable tribological surfaces characteristic for best tribological performance. Advanced

MEMV1013 - Automotive Technology

This course focuses on advanced technology in automotive development. The topics covered includes environmental policy and safety in automotive design standards, advanced materials, alternative fuels and alternative powertrain technology. Development and the future of autonomous technology will also be taught. At the end of this course, students are expected to be able to propose advanced automotive technology design in compliance with the current established standards.

TRACK 9 – INDUSTRIAL AERODYNAMICS

The objective of this track is to enhance participants with further knowledge and skills in industrial aerodynamics. Students will be exposed to the experimental work by conducting wind tunnel testing on real industrial projects, coupled with the numerical work. The courses in this track include advanced aerodynamics, computational aerodynamics, industrial aerodynamic and wind engineering, experimental aerodynamics and advanced aircraft dynamics and control.

MEMF1313 - Advanced Aerodynamics

This course gives a foundation for advanced study in aerodynamics by focussing on the fundamentals as well as the distinctive characteristics of flow around solid boundary. Emphasis will be given to turbulence flow since this area of study is still a mystery. The course will continue to cover aircraft aerodynamics and high-speed aerodynamics.

MEMF2323 - Computational Aerodynamics

This course deals with the applications of computational methods to the solutions of aerodynamics problems. Emphasis on introductory concepts in finite difference and finite volume methods as applied to various ordinary and partial differential model equations in aerodynamics; fundamentals of spatial discretization and numerical integration; numerical linear algebra. Introduction to applied engineering and scientific computing environment. Advanced topics may include finite element methods, spectral methods, grid generation, turbulence modelling.

MEMF2343 - Industrial Aerodynamic and Wind Engineering

This course deals with industrial aerodynamics where contents of learning include the physics of the air, wind energy, vehicle and building aerodynamics and flow induced vibration. Students shall be given projects where they need to conduct the experimental work in wind tunnel and analyse the data accordingly.

MEMF2353 - Experimental Aerodynamics

This course is on aerodynamic experimental work covering topics on wind tunnel designs and classifications, instrumentation, flow qualities, aerodynamic load measurements, flow visualisations, blockage correction and moment transfers. Wind-tunnel testing is one of the fundamental tools to determine the flow characteristics and the aerodynamic forces and moments acting on the tested object. Students shall be given a mini project where they need to conduct the wind tunnel tests and analyse the data accordingly.

MEMF2213 - Advanced Aircraft Dynamics and Control

This course is about the dynamics behaviour of rigid body aircraft and the application of control system theory to design aircraft stability augmentation systems to more complex automatic flight control systems. This includes the application of modern multivariable control system design using classical and modern control techniques, the nonlinear aircraft model, transfer function models, numerical solution of the state equations, stability augmentation, control augmentation system, the handling-qualities requirements, and autopilots. Examples are demonstrated by using MATLAB and FLIGHTGEAR. At the end of the course, the aircraft behaviour can be demonstrated by using a flight simulator.

TRACK 10 – ADVANCED AEROSPACE ENGINEERING

This track aims to extend the knowledge and practical skills in aerospace engineering. It covers variety of aerospace disciplines such as advanced aerodynamics, computational method for aerostructures, advanced aircraft structures and materials, advanced aircraft dynamics and control, jet propulsion, rocket technology, gas turbine technology, helicopter system and performance, aviation management and airworthiness, and aircraft instrumentation and avionics.

MEMF1313 - Advanced Aerodynamics

This course gives a foundation for advanced study in aerodynamics by focussing on the fundamentals as well as the distinctive characteristics of flow around solid boundary. Emphasis will be given to turbulence flow since this area of study is still a mystery. The course will continue to cover aircraft aerodynamics and high-speed aerodynamics.

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This course is about the dynamics behaviour of rigid body aircraft and the application of control system theory to design aircraft stability augmentation systems to more complex automatic flight control systems. This includes the application of modern multivariable control system design using classical and modern control techniques, the nonlinear aircraft model, transfer function models, numerical solution of the state equations, stability augmentation, control augmentation system, the handling-qualities requirements, and autopilots. Examples are demonstrated by using MATLAB and FLIGHTGEAR. At the end of the course, the aircraft behaviour can be demonstrated by using a flight simulator.

MEMF2013 - Computational Method for Aerostructures

This course gives an understanding on the principles of the finite element method and its implementation in solving real-life structural problems

MEMF2113 - Advanced Aircraft Structures and Materials

This course focuses on the structural analysis of aircrafts and understanding the structural and material behaviour of airframes. The topics covered include plane stress field equations, plate bending and buckling, wing and fuselage analysis of light aircrafts, advanced alloys, advanced composites, and aircraft structural integrity. Jet Propulsion MEMF2423 Introduction to jet propulsion system including its historical background. Review of thermodynamics and fluid mechanics. Review of gas dynamics. Cycle analysis: air standard cycle and real cycle (with friction). Turbojet engine cycle. Gas turbine engine components and their functions. Turbine blades cooling techniques. Gas turbine emissions. Introduction to rocket engines. Types of rocket engines. Rocket basic principles. Chemical rocket engines: solid rocket, liquid rocket, hybrid rocket.

MEMF2433 - Rocket Technology

Classification of Rocket Propulsion Systems (chemical, electric and nuclear). Performance parameters (thrust equation, propulsive efficiency, characteristic velocity, thrust coefficient, specific impulse, nozzle flow). Theoretical rocket performance calculation. Solid propellants and combustion. Grain design. Liquid propellants and combustion. Injector and combustion chamber design. Hybrid rocket. Electric rockets. Nuclear rocket.

MEMF2443 - Gas Turbine Technology

An Overview of Gas Turbines. Theoretical and Actual Cycle Analysis. Compressor and Turbine Performance Characteristics. Performance and Mechanical Standards. Rotor Dynamics. Centrifugal and Axial-Flow Compressors. Radial-inflow and Axial flow turbines. Combustors. Gas turbine emissions, their sources, impact, and method of mitigation. Materials. Fuels.

MEMF2513 - Helicopter System and Performance

This course presents a comprehensive introduction to rotorcraft technology covering a wide range of disciplines. Student will be exposed to the theory of helicopter flight which is relevant to the helicopter system and performance. Each student will be given a mini project to enhance his/her understanding in the principle work of helicopter technology.

MEMF2613 - Aviation Management and Airworthiness

This course is about the management of the aviation industry. It covers the basic concepts of management, project management, human factors, airspaces, airport management, air traffic management and airworthiness. The course shall use documents from the International Civil Aviation Organisation (ICAO) and Civil Aviation Authority Malaysia (CAAM). Site visits to the established aviation organisations will be part of the course.

MEMF2223 - Aircraft Instrumentation and Avionics

This course delivers fundamental knowledge of aircraft instrumentation design, avionics system design, analysis and development. The course covers topics from sensor and transducers, signal conditional circuits, data transmission, data acquisition system, measurement errors, reliability study, failure analysis, fault tolerance and aircraft data bus.

TRACK 11 – SHIP TECHNOLOGY

The track allows students to develop technical and managerial knowledge essential to the global maritime sector. Students will study key topics such as advanced marine design, maritime management and law, marine transport system, marine safety and risk, ship repair survey and inspection, dynamics of marine structure, strength and vibration of marine structures, ship propulsion and performance, dynamics of marine power plant. The marine environment and renewable energy course is also introduced to enable graduates to respond to the needs, challenges and demands of the United Nation Sustainable Development Goals.

MEMO1213 - Dynamic of Marine Structures

This subject equips the students with knowledge of the environment and relating it with performance of the vessel in seakeeping and maneuvering. The first part of the subject introduces the ocean environment (Theory of regular/irregular waves and wave energy spectrum). The second part covers the seakeeping aspect – By applying the knowledge of dynamics, vessel's motions due to ocean waves can be predicted. The third part covers the aspect of vessel's maneuvering and directional stability. The final part discusses on the aspect of using devices such as bilge keels and rudders to control vessel's motions. Besides that, this subject also introduces to student the skill for computer modelling and simulation engineering (CMSE). The CMSE software such as Rand Model Designer and MATLAB Simulink will be used to solve the engineering problem and complete the given project/assignment.

MEMO2813 - Safety, Risk and Reliability in Marine Operation

The course equips the students with important concepts and theories on safety, risk and reliability in marine operations especially those that supports standards, rules and regulations imposed by maritime regulating bodies like IMO. The course content is divided into three parts related to marine system and operation, first being hazard and risk assessment, secondly reliability analysis and lastly the safety procedures based on the maritime regulating bodies. Risk evaluation tools will include formal safety assessment method such as failure mode and effect analysis and fault tree analysis, Monte Carlo simulation method, moment likelihood method, queuing theory, etc. The delivery of the course will be case study assisted

MEMO2113 - Strength and Vibration of Marine Structures

This course covers to the fundamentals and calculations of structural plastic analysis, strength design of column and beam-column, strength design of unstiffened and stiffened plate, and analysis of structural vibrations for ship and offshore platform. The course begins with the basics and marine structural safety concerns, and design process through all phases of calculations: loads, response, and limits state stress. The focus of this course in on the structural design synthesis including design philosophy and procedures, and the importance of vibration in ship and offshore structural design. The course is presented through classroom

lectures, student participation in practical exercises. The course addresses the universally accepted mathematical calculations of unstiffened and stiffened plate response, and analysis on vibrations model.

MEMO2003 - Marine Environment and Renewable Energy

This course is designed to give students an understanding of the science of marine environment particularly waves and tides, and how this affects efforts to exploit energy from these resources. Students will first be introduced to fundamentals of oceanography and marine meteorology. It explains the fluid physical characteristics and movement on the earth surface. As such, the student will have a clear understanding of the weather that results from the interaction between the atmosphere and the sea surface. Student will then learn on marine environmental issues related to ship and offshore structure. This course also introduces the main forms of marine renewable energy particularly wind, wave and tidal, focusing on the technology and resource assessment associated with each.

MEMO1713 - Ship Repair, Survey and Inspection

This course is offered with aim of preparing the students to be able to assume the middle management roles of identifying, planning, scheduling, monitoring the ship construction and ship repair project, managing the tasks, time, material, manpower and money of a given project effectively. The students can learn how to perform the duty of a ship surveyor effectively and identify the critical items to be considered during the inspection process. The course also covers the NDT works to be carried out during new construction, repair and maintenance, survey and inspection works. The course can be delivered in module-by-module base, 2 days x 7 hours per day per module.

MEMO2313 - Ship Powering and Propulsion

This course provides the knowledge on hydrodynamics theory and practices that enable the students to perform calculation, analysis, design and evaluation of ship's performance and behavior in seaway. The first part of the course provides students with knowledge on ship resistance and its component, prediction ship resistance according to the standard procedures and discuss the effect of weather condition on ship performance. The second part of the course touch the knowledge on ship propulsion system which covers the basic propeller action, propeller design parameters, and procedures of engine-propeller matching.

MEMO1413 - Dynamic of Marine Power Plant

The course is designed for introducing the students to the various aspects of marine power plant dynamic behaviours. This includes the different types of power plant characteristics, plant performance and selection procedures, machinery control systems, balancing and vibration characteristics of the power plant.

MEMO2833 - Marine Transport System

Generally, marine transport is one of the main activities for shipping. The requirement for marine transport system will naturally support direct and indirectly many other shipping or maritime based related activity such shipbuilding, oil and gas, port operation, logistic and supply chain, etc. In the process of executing these activities, several relevant policies, rules,

and regulation such as Flag of Convenient, Chartering, etc. to be considered and applied accordingly ensuring the optimum transport undertakings.

MEMO3843 - Maritime Management and Law

This course provides candidates with advanced knowledge on marine management and law. The objective is to expose candidates to advanced issues in the marine industry that currently challenge the traditional management principles. The syllabus has three main categories: firstly, management principle for organization and project. The second category is strategic project management. The third category is the theory and practice on maritime law. There will be sub modules for management planning, human resources, managerial skills, project management and maritime law. Each sub module starts with a preview of a one to two pages of case study material, short series of lectures on the underlying principles, detail synthesizing of the case study material, preparation of short report, presentation of report with questions and answer and finally feedback from the lecturer.

MEMO2513 - Design for Advance Marine Vehicles

This course equips the students with knowledge on the development of advance marine vehicles (AMV) and emphasizes the differences between conventional-ship design and AMV-design. The course starts with the philosophy of evolution of maritime transportation from the early days to the present state of the transportation system. Students are then provided with the definition and classification of AMV together with the method of quantifying the means of achieving high transport. The course also includes the discussions of each of the 'nodes' of the ship design spiral which students should enable to relate it with the AMV criteria. Students are provided with numerous examples of high transportation case studies that enhances the ability to critically decide the viability of the future transportation requirement. Students will be required to comprehend the future potential of AMV and the limitations that systems and technology limits.

TRACK 12 – OFFSHORE TECHNOLOGY

Offshore Technology is multi-disciplinary, and engineers with a versatile skill-set are in high demand. To meet these challenges, the track offers a wide range of up-to-date topics of significant relevance to the offshore industry including Decommissioning and Recycling of Marine Structures, Dynamics of Marine Structure, Strength and Vibration of Marine Structures, Safety Risk and Reliability of Marine Operation, Mooring and Riser Analysis and Unmanned Underwater Vehicles for Marine and Offshore Operations. The Marine Environment and Renewable Energy course is also introduced to enable graduates to respond to the needs, challenges and demands of the United Nation Sustainable Development Goals.

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MEMO2123 - Decommissioning and Recycling of Marine Structures

This course equips the students with knowledge on the development of decommissioning and recycling of offshore structures. The course starts with the introduction to national and international legislations regarding decommissioning of offshore structures. Students are then provided with the definition and classification of decommissioning and recycling methods. Health and safety issues in decommissioning and recycling will also be covered. The course will enable students to develop the best option for sustainable decommissioning and recycling of marine structures.

MEMO2223 - Mooring and Riser Analysis

This course provides the design and installation operations for riser and mooring systems. Emphasis is made on design of deep-water moorings and riser system by the accepted industry practices and design codes and criteria. It starts with the types and layout of risers, layout and geometry of mooring and line types. Then the riser and mooring line design cycle is introduced and in this section the students calculate the environmental loads, pretension and static equilibrium, and Vortex Induced Vibration (VIV), and analyse the static and dynamic performances including floaters. The students also solve the dynamic performances of riser/mooring lines using simulation software and analyse the fatigue of riser and mooring chains.

MEMO2723 - Unmanned Underwater Vehicles for Offshore Operations

Unmanned Underwater Vehicle (UUV) is essential in marine and offshore operations. Generally, there are two types of unmanned underwater vehicle namely the Remote Operated Vehicle (ROV) and Autonomous Underwater Vehicle (AUV). This course will develop the student's knowledge and understanding on the basic principles and operations required for both types of unmanned underwater vehicles. Essential topics which include the hull form and pressure hull design, hydrostatics and hydrodynamic requirements, onboard systems and power and propulsion specific to underwater vehicles will be introduced in this course. Students will apply the knowledge they have by designing, constructing and evaluating the performance of their model scale underwater vehicle which capable to execute predetermined tasks.

MASTER OF SCIENCE (INDUSTRIAL ENGINEERING)

PROGRAMME SPECIFICATION

Master of Science (Industrial Engineering) program makes up the core of the Industrial Engineering studies at the School of Mechanical Engineering, Faculty of Engineering, UTM. It is designed to provide the students with the knowledge and capabilities to use appropriate techniques, skills, and tools to identify, formulate, analyse, and solve complex problems in both engineering and management. This master programme is by taught course comprises a combination of compulsory courses, electives, and a Master's Project. This program offers four (4) tracks which give more options to the students to choose the most suitable track. The four (4) tracks offered are Engineering Management, System Engineering, Manufacturing Engineering and Quality Engineering. The aims of this program are to equip graduates with quantitative, analytical, and applications skills. This will prepare graduates as entrepreneurs, problem solvers, effective decision-makers, and change agents in a competitive business environment or as prospective scientists in academia.

This programme is offered either on a full-time or part-time basis. The full-time programme is offered only at the UTM Main Campus in Johor Bahru while the part-time programme is offered at various learning centres throughout Malaysia. The normal full-time program can be completed in a minimum of one year, i.e., two long semesters and one short semester. The full-time student is allowed to take a maximum of 20 credits in a normal semester and 10 credits in a short semester. The part time student is allowed to take a maximum of 12 credits in a normal semester and 6 credits in a short semester. Assessment is based on coursework and final examinations given throughout the semester.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia
2. Teaching Institution	Universiti Teknologi Malaysia
3. Programme Name	Master of Science (Industrial Engineering)
4. Final Award	Master of Science (Industrial Engineering)
5. Programme Code	MKMN
6. Professional or Statutory Body of Accreditation	Kementerian Pendidikan Malaysia
7. Language(s) of Instruction	English
8. Mode of Study	Conventional
9. Mode of operation	Self-governing
10. Study Scheme (Full Time/Part Time)	Full Time / Part Time
11. Study Duration	Minimum : 1 year Maximum : 4 years

Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	8	8	14	14
Short	4	4	8	8

Course Classification

Course Category	Code	Course	Credit	Percentage
University General Courses	U### ###3	University Elective	3	7.5%
Programme Core	MEMI1903	Research Methodology	3	30%
	MEMI1843	Operations Planning and Control	3	
	MEMI1853	Operations Research and Application	3	
	MEMI1863	Industrial Data Analytics	3	
Project	MEMI1914	Master Project I	4	25%
	MEMI2926	Master Project II	6	
Programme Track Electives (Choose 1 track only)				
Engineering Management	<i>Choose 4 courses from this track</i>			30%
	MEMI2813	Project Management	3	
	MEMI2823	Engineering Economy and Finance	3	
	MEMI2833	Safety Management	3	
	MEMI2843	Quality Management	3	
	MEMI2853	Engineering and Technology Management	3	
	MEMI2863	Lean Manufacturing	3	
System Engineering	<i>Choose 4 courses from this track</i>			30%
	MEMI1813	Statistical Quality Engineering	3	
	MEMI1823	Supply Chain and Logistics	3	
	MEMI1833	Work Systems and Ergonomics	3	
	MEMI2823	Engineering Economy and Finance	3	
	MEMI2873	Modelling and Simulation	3	
	MEMI2883	Facilities Planning and Design	3	
Manufacturing Engineering	<i>Choose 4 courses from this track</i>			30%
	MEMI1813	Statistical Quality Engineering	3	
	MEMP1723	Green Manufacturing Technology	3	
	MEMP1743	CAD/CAM/AM	3	
	MEMP2723	Smart Manufacturing	3	
	MEMP2733	IT for Manufacturing	3	
	MEMM1023	Product Innovation & Development	3	

Quality Engineering	<i>Choose 4 courses from this track</i>			
	MEMI1813	Statistical Quality Engineering	3	
	MEMI2803	Engineering and Environmental Safety	3	
	MEMI2843	Quality Management	3	
	MEMI2863	Lean Manufacturing	3	
	MEMI2893	Risk Management	3	
	MEMP2723	Smart Manufacturing	3	
Free Elective	M### ###3	<i>Choose any 1 course cross discipline / area / track / school</i>	3	7.5%
Total Credit Value			40	100%

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of Industrial Engineering field.
PEO2	Practice professionalism and high standards of ethical conducts within organization and society.
PEO3	Responsive to changing situations by continuously acquiring new knowledge and skills

Programme Learning Outcomes (PLO)

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

Code	Intended Learning Outcomes
PLO1	Attain new frontiers of knowledge in the field of Industrial Engineering (Knowledge and understanding).
PLO2	Solve complex problems critically and integratively using systematic approaches (Cognitive skills).
PLO3	Apply practical skills to solve problems in the field of Industrial Engineering (Practical skills).
PLO4	Demonstrate effective collaboration with stakeholders professionally (Interpersonal skills).
PLO5	Communicate effectively the knowledge, skills and ideas using appropriate method to peers, experts and communities (Communication skills).
PLO6	Use digital technologies and appropriate software competently to enhance study and practice (Digital skills).
PLO7	Evaluate numerical and graphical data critically using quantitative or qualitative tools in solving problems (Numeracy skills).
PLO8	Demonstrate leadership, autonomy, and responsibility in managing resources (Leadership, autonomy and responsibility).
PLO9	Engage self-advancement through continuous learning or professional development (Personal skills).

PLO10	Demonstrate entrepreneurial skills with relevant knowledge and expertise (Entrepreneurial skills).
PLO11	Demonstrate respectable ethical conducts and professionalism skills in an organization and society (Ethics and professionalism skills).

GRADUATION CHECKLIST

Students must pass all the stated courses in this checklist to graduate. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the courses are not allowed to graduate.

NO	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (✓) IF PASSED
UNIVERSITY GENERAL COURSES					
1	U### ##3	University Course Electives	3	3	
TOTAL CREDIT OF UNI. GENERAL COURSES (a)			3	3	
PROGRAMME CORE COURSES					
1	MEMI1903	Research Methodology	3	3	
2	MEMI1843	Operations Planning and Control	3	3	
3	MEMI1853	Operations Research and Application	3	3	
4	MEMI1863	Industrial Data Analytics	3	3	
TOTAL CREDIT OF PROG. CORE COURSES (b)			12	12	
MASTER PROJECT COURSES					
1	MEMI 1914	Master Project I	4	4	
2	MEMI 2926	Master Project II	6	6	
TOTAL CREDIT OF MASTER PROJECT COURSES (c)			10	10	
PROGRAMME TRACK ELECTIVES COURSES (4 COURSES)					
1	MEM# ##3	Elective 1	3	3	
2	MEM# ##3	Elective 2	3	3	
3	MEM# ##3	Elective 3	3	3	
4	MEM# ##3	Elective 4	3	3	
TOTAL CREDIT OF TRACK ELECTIVES COURSES (d)			12	12	
FREE ELECTIVE COURSE					
1	M### ##3	Any 1 course cross discipline / Area / Track / School	3	3	
TOTAL CREDIT OF FREE ELECTIVE COURSE (e)			3	3	
TOTAL CREDIT TO GRADUATE (a + b + c + d + e)			40	40	

COURSE SYNOPSIS

PROGRAMME CORE COURSES

MEMI1903 – Research Methodology

This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Amongst topics that will be covered are introduction to research and its philosophy, problem formulation and research objective, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management

MEMI1843 - Operations Planning and Control

This course gives advanced knowledge on production planning and control concepts, issues, and techniques. It covers topics such as demand forecasting, aggregate planning, master production schedule, job scheduling, line balancing, capacity planning, inventory management and material requirement planning (MRP) and Enterprises Resources Planning. The focus is on analysis and integration of various techniques for solving production planning problems.

MEMI1853 - Operations Research and Application

This course provides students with the concepts and tools to model manufacturing or service systems efficiently using mainly Operations Research techniques. It focuses on formulating models based on deterministic and stochastic Operations Research techniques, applying these techniques for decision making, developing solutions from the models, and conducting simulation studies. Topics covered include linear programming, integer programming, transportation models, network models, goal programming, decision analysis, queuing theory, Monte Carlo simulation, etc.

MEMI1863 - Industrial Data Analytics

This course provides students with the concepts and techniques of data analytics in industrial engineering. The topics covered are based on data science lifecycle, data acquisition, feature engineering, modelling and visualization. Data analytics types to be included are descriptive, diagnostics, predictive and prescriptive. Descriptive analytics reveals what has happened and predictive analytics is for understanding trends and predict the future. The course focuses on statistical and machine learning techniques for data modelling, and data visualization to gain insights for decision making.

MASTER PROJECT COURSES

MEMI1914 - Master Project I

Master Project 1 requires a student to prepare a research proposal which will be conducted over two semesters (Projects 1 and 2). Master Project 1 covers introduction (problem statement, objective and scope), literature review, methodology, proposed method of solution, provide preliminary data and research model and planning for Projects 1 and 2. The student is required to write a draft report and to present and defend his/her research proposal.

MEMI2926 - Master Project II

Master Project 2 is a continuation of Master Project 1. The student conducts the research work either in a laboratory, workshop, computer laboratory, or industry. The student then required to do data collection, analyses data and interpret the results to solve the research problem that has been identified in Master Project 1. The student is required to write a complete report and defend the findings. On top of the report writing, student also requires to produce a technical article based on the project findings.

PROGRAMME TRACK ELECTIVES

TRACK 1 – ENGINEERING MANAGEMENT

Engineering Management track offers a specific skills gap in the industry for engineers with project management competencies who can lead on engineering projects in any sector focusing on both technical excellence and management ability in equal measure. This track offers the insights and skills which needed to reach a managerial level within the engineering field and also how to successfully manage the day-to-day projects as well as long-term, complex initiatives such as ensuring quality management, sustainability, and supply chain and operations. From that student will develop industrial engineering skills, knowledge and expertise, alongside knowledge of business and management techniques, strategies and concerns. It is a dynamic and demanding programme, combining in-depth technical knowledge with a multitude of personal attributes and business expertise.

MEMI2813 - Project Management

This subject introduces students to the myriad and exacting skills and knowledge expected to manage high risk projects and produce high quality deliverables within the time and cost constraints of their organizations. The phases of the project lifecycle, management deliverables, project charters, scope, work breakdown structures, activity lists, duration estimates, CPM/PERT network diagrams and risk analysis. This subject also covers scheduling resources and costs, reducing project duration as well progress performance measurement and evaluation. This section employs Cooperative Learning (CL).

MEMI2823 - Engineering Economy and Finance

This course prepares students to appreciate the financial impact of their decisions. The course takes a broad managerial perspective emphasizing the strategic impact of financial and accounting activities in relation to other activities of the firm. Evaluation of company's performance from financial statements, designing cost structures and determine costs of products or services for managerial use, Activity-based costing and Target costing, time value of money, inflation, taxes, measures of worth of individual projects and alternatives, and methods for capital budgeting methods for long term projects.

MEMI2833 - Safety Management

This course provides students with the knowledge on safety management and its implementation in industrial sector, act and regulations and familiar with the standards related to safety management, the principles in hazard identification, risk assessment & control, planning & implementing an effective safety program, behaviour-based safety and safety culture

MEMI2843 - Quality Management

This course covers the principles, philosophy and concepts of quality management and related issues. Application of the principles and concepts of Total Quality Management in their organization, developing a strategy for the development of TQM in an organization, applying the problem-solving process and relevant tools for organizational improvement, and using the continuous improvement process for establishing a quality organization. Others quality management initiatives such as Six Sigma, Lean and Lean Six Sigma, and current issues are also discussed.

MEMI2853 - Engineering and Technology Management

This course introduces students to the basic functions of engineering management which include planning, organizing, motivating, leading and controlling. Topics on strategic management, organizational structure, motivation, leadership, R&D management, technology management, innovation management, intellectual property management, and professional ethics are covered.

MEMI 2863 - Lean Manufacturing

This course provides concepts relating to lean manufacturing including kaizen system, value stream mapping, just in time (JIT), Kanban, single minute exchange of die (SMED) technique and line balancing. Selection of lean techniques for problem solving and waste minimization program.

TRACK 2 – SYSTEM ENGINEERING

System Engineering track is a multidisciplinary track that includes a combination of engineering, systems thinking and management courses. Focused on the design, improvement, and installation of integrated systems of people, materials, information, equipment, and energy, this track provides variety of skills in the areas of contemporary manufacturing processes/systems, product development, ergonomic analysis, logistics and supply chain management, and sustainable design and development, systems engineering/product development, and systems simulation. The track is the right blend of engineering, technology, and management training which prepares graduates to become technical leaders who apply a systems approach to successfully navigate and manage complex systems. Graduates from this track will be able to address systems integration, life cycle issues and systems thinking at the system and enterprise levels, in a market where globalization, quality, complexity, and productivity are the business drivers.

MEMI1813 - Statistical Quality Engineering

This course is designed to provide the students with sound understanding to statistical methods in quality improvement. It encompasses various statistical process control problem-solving tools. For control charts, emphasis was given on additional control charts not covered previously at the undergraduate level. Advanced tools and techniques such as Gauge Repeatability and Reproducibility (GR & R), Quality Function Deployment (QFD), Failure Mode Effect Analysis (FMEA) and experimental design methodology were also covered,

MEMI1823 - Supply Chain and Logistics

This course is identifying strategic importance of good supply chain and logistics design and management on the competitive position for each supply chain members. The main goal of this course is to understand the fundamental of supply chain and logistics including logistics vs supply chain, supply chain drivers, metrics and performance, distribution and network designs, 3PL, 4PL, transportation, procurement and sourcing and the logistics and supply chain in the future in order to satisfy end customers. This course also concerns about techniques for designing transportation networks, distribution issues, logistics management, integration issues and performance measurement.

MEMI1833 - Work Systems and Ergonomics

This course aims to provide students with fundamental knowledge of ergonomics (also known as human factors engineering) relevant for industry. This includes fundamental concepts and analysis of industrial problems in ergonomics such as practice of ergonomics principles and methodology, solving industrial problems related to ergonomics, information input and design, human physical work capacity, job design and task analysis including Ergonomics Risk Assessment (ERA).

MEMI2823 - Engineering Economy and Finance

This course prepares students to appreciate the financial impact of their decisions. The course takes a broad managerial perspective emphasizing the strategic impact of financial and accounting activities in relation to other activities of the firm. Evaluation of company's performance from financial statements, designing cost structures and determine costs of products or services for managerial use, Activity-based costing and Target costing, time value of money, inflation, taxes, measures of worth of individual projects and alternatives, and methods for capital budgeting methods for long term projects.

MEMI2873 - Modelling and Simulation

This course provides students with the concepts and tools to model manufacturing or service systems efficiently using a practical Simulation software. Topics under Discrete-Event Simulation that span from basic modelling concepts, types of discrete-event approaches, analysis of input data, goodness-of-fit tests, model verification and validation, to full model experimentation and analysis of outputs are covered.

MEMI2883 - Facilities Planning and Design

This subject provides students with the concepts and issues related to selection of facilities locations, facilities layout planning and design at the macro and micro levels. It also introduces students to the planning and design of warehousing, material handling systems and it related equipment. It uses both, quantitative and qualitative approaches in the analyses, together with the application of several layout procedures, algorithms, and computerized layout planning concepts within a typical manufacturing plant.

TRACK 3 – MANUFACTURING ENGINEERING

Manufacturing Engineering track deals with integrated science and technologies to develop and improve innovative products and manufacturing processes. This interdisciplinary program integrates fundamental science and knowledge from mechanical, industrial, production, and

materials engineering to research, design, and develop manufacturing systems, processes, machines, tools, and equipment. This track offers a deep knowledge in current and new manufacturing technologies, such as continuous manufacturing processes, regulatory issues affecting manufacturing, quality risk management, Lean Six Sigma, decision making tools, as well as a thorough knowledge in key aspects regarding the operation and management of a high-tech industry. This track aims to embrace the requirement of manufacturing industry areas such as production planning, design, materials handling, processes, and quality control.

MEMI1813 - Statistical Quality Engineering

This course is designed to provide the students with sound understanding to statistical methods in quality improvement. It encompasses various statistical process control problem-solving tools. For control charts, emphasis was given on additional control charts not covered previously at the undergraduate level. Advanced tools and techniques such as Gauge Repeatability and Reproducibility (GR & R), Quality Function Deployment (QFD), Failure Mode Effect Analysis (FMEA) and experimental design methodology were also covered.

MEMP1743 - Green Manufacturing Technology

This course introduces students to green manufacturing technology and sustainability considerations in product design and manufacture. It presents the principles, methodology and case studies to develop an understanding of sustainable development that can reduce environmental impact and promote green technology for sustainable practice. Besides that, it is also introducing the Life Cycle Assessment consists of four main phases, goal and scope definition, inventory, impact assessment, and interpretation. Analysis of use valid life cycle assessment method to collect and process data of the product's life cycle or the manufacturing processes consumption or declaring the total emissions from the manufacturing.

MEMP1743 - CAD/CAM/AM

This course discusses: the role of CAD in the design process, the Design/Manufacturing interface CAD/CAM, the basic techniques involved in CAD/CAM, its importance in the selection, implementation and management of CAD/CAM system, the link to machine control, fundamentals of Numerical Control (NC) and Additive Manufacturing (AM). The course also involves hands-on experience in CAD/CAM/AM

MEMP2723 - Smart Manufacturing

This course introduces the overview of Smart Manufacturing architectural framework, its application, related technologies and its future directions related to various case studies around the globe. The aim is to introduce students to the new era of Industrial Revolution (IR4.0) related to the power of digital manufacturing and product model data for manufacturing integration. Students will also gain deep insights into how various support systems are used in harnessing from product design, knowledge management, data analysis and other technologies being seamlessly transfer through the entire lifecycle of a manufactured product.

MEMP2733 - IT for Manufacturing

Knowledge Management and Knowledge Management Infrastructure are the main contents. The lecture is supplemented with the real data mapping and development of information systems. This course is an Instructional lecture and Cooperative learning (CL) enriched with

student assignments and group projects. Students are required to perform problem solving using real case study and projects in their individual assignments/projects to measure their skill in communication and analysis of data. Students are guided through the real-life case study that requires them to construct into real data for database design. They are also to prove their ability by constructing a database information system using selected tools. The contents include Business System of project and Product Based, Information Security, Cyber physical system, networking, vertical & horizontal integration, Data exchange, Cloud manufacturing and computer integrated manufacturing (CIM).

MEMM1023 - Product Innovation & Development

This course introduces the students to the various stages of product design and development methods that can be put into immediate practice in developing products or projects. The development procedures blend the various perspectives of marketing, design, and manufacturing into a single approach to product development. Aspects of sustainable design and manufacturing will also be covered. The course also provides practice in carrying out small projects to expose the various stages of product development. It also includes the various prototyping and manufacturing systems strategies in developing product prototypes.

TRACK 4 – QUALITY ENGINEERING

Quality Engineering track offer concepts and tools in quality improvement. It encloses all tasks from ideation to execution. These would include the analysis of a product's design, its development, and finally the manufacturing processes. The focus is on improving the quality of the final product and an efficient production process. Quality Engineering has a broad range of tools and methodologies. It encompasses various statistical process control problem-solving tools such as quality systems, product and process control and design, quality methods and tools, applied statistics, statistical process control (SPC), and design of experiments (DOE). This track aims to produce graduates which are able to ensure services or products are designed, developed, and manufactured to meet customer's expectations and also produces professionals with leadership skills.

MEMI1813 - Statistical Quality Engineering

This course is designed to provide the students with sound understanding to statistical methods in quality improvement. It encompasses various statistical process control problem-solving tools. For control charts, emphasis was given on additional control charts not covered previously at the undergraduate level. Advanced tools and techniques such as Gauge Repeatability and Reproducibility (GR & R), Quality Function Deployment (QFD), Failure Mode Effect Analysis (FMEA) and experimental design methodology were also covered.

MEMI2803 - Engineering and Environmental Safety

This course provides the fundamental concepts of engineering and environmental safety that covers both management and technical aspects. In engineering safety, the focus is on the safety of equipment commonly used in engineering installation and maintenance, safety of chemicals used in engineering processes, and implementation of safety engineering programs in engineering installations and plants. The environmental safety provides the principles and concepts of environmental safety elements, hazardous waste control, environmental assessment under OSHA 1994, impact and cause of global warning, green design and

manufacturing, sustainable energy and design for environment. The management element provides the elements of safety (engineering and environmental) management and relevant issues in industry. Certification to ISO 14000, ISO 14001 EMS and compliance to local regulations (EQA 1974) as well as environmental audit are included. The principles in hazard identification, risk assessment & control, planning & implementing an effective safety program and assessment of the effectiveness of safety program.

MEMI2843 - Quality Management

This course covers the principles, philosophy and concepts of quality management and related issues. Application of the principles and concepts of Total Quality Management in their organization, developing a strategy for the development of TQM in an organization, applying the problem-solving process and relevant tools for organizational improvement, and using the continuous improvement process for establishing a quality organization. Others quality management initiatives such as Six Sigma, Lean and Lean Six Sigma, and current issues are also discussed.

MEMI2863 - Lean Manufacturing

This course provides concepts relating to lean manufacturing including kaizen system, value stream mapping, just in time (JIT), Kanban, single minute exchange of die (SMED) technique and line balancing. Selection of lean techniques for problem solving and waste minimization program.

MEMI2893 - Risk Management

Enterprise risk management enables management to effectively deal with uncertainty and associated risk and opportunity, enhancing the capacity to build value. Value is maximized when management sets strategy and objectives to strike an optimal balance between growth, return goals and related risks, as well as efficiently and effectively deploys resources in pursuit of the entity's objectives. This course aims to prepare students with Enterprise risk management knowledge which encompasses i) aligning risk appetite and strategy, ii) enhancing risk response decisions, iii) reducing operational surprises and losses, iv) identifying and managing multiple and cross enterprise risks, v) seizing opportunities and vi) improving deployment of capital. Enterprise risk management helps ensure effective reporting and compliance with laws and regulations and helps avoid damage to the entity's reputation and associated consequences. In sum, enterprise risk management helps an entity get to where it wants to go and avoid pitfalls and surprises along the way.

MEMP2723 - Smart Manufacturing

This course introduces the overview of Smart Manufacturing architectural framework, its application, related technologies, and its future directions related to various case studies around the globe. The aim is to introduce students to the new era of Industrial Revolution (IR4.0) related to the power of digital manufacturing and product model data for manufacturing integration. Students will also gain deep insights into how various support systems are used in harnessing from product design, knowledge management, data analysis and other technologies being seamlessly transfer through the entire lifecycle of a manufactured product.