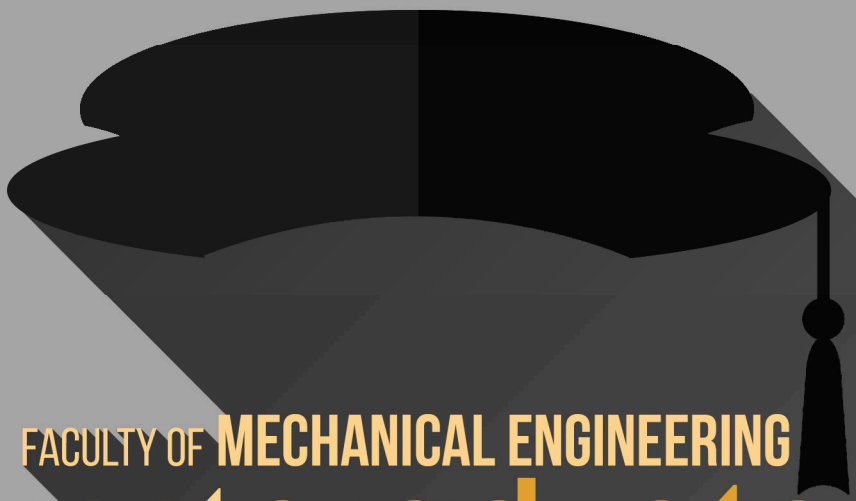
UTM
UNIVERSITI TEKNOLOGI MALAYSIA

Faculty of
Mechanical Engineering



FACULTY OF MECHANICAL ENGINEERING

postgraduate handbook

24/25 session

The content of this book is true and accurate at the time of publication. The Faculty of Mechanical Engineering UTM reserves the right to change any information contained herewith.

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Foreword by The Dean

I am grateful to the Almighty Allah S.W.T for enabling me to compose a few words in this Undergraduate Handbook. 2024/2025. Welcome to the Faculty of Mechanical Engineering, Universiti Teknologi Malaysia (UTM).I would like to congratulate all new students on being admitted to the various degree programs offered by the faculty. I hope that the opportunity given will be taken up to strive to your utmost performance in acquiring the knowledge, necessary skills and transformative life experiences to be a holistic talent and successful engineer.

The Undergraduate Handbook contains brief information on the curriculum structures and syllabuses of the programmes offered by the faculty which is applicable to the students of the 2024/2025 session intake. It also serves as your main source of reference related to your academic affairs and provides the required information for students, particularly on the implementation of programs and detailed courses offered. This handbook can be used by the students throughout their studies for the graduation plan. In addition, a special topic on Academic Advising is also included so that both students and academic advisors can play their roles effectively.

We hope that all new students will use the information in this handbook for your benefit in enhancing your educational experience toward a high-quality graduate.

On behalf of the faculty, I would like to extend my utmost appreciation and sincere gratitude to all parties involved in the publication of this Undergraduate Handbook. I wish all the new students to perform at your very best in the studies and we hope that this handbook will be useful to all. I really hope that the students could give your full effort and commitment with great perseverance during your study period toward a successful journey with knowledgeable, skilful, holistic and balanced attributes.

Associate Professor
Ir. Ts. Dr. Zaini Ahmad
Dean
Faculty of Mechanical Engineering

Thank You

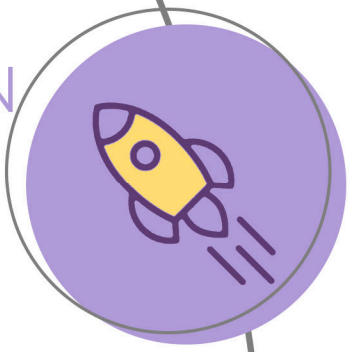
VISION, MISSION, MOTTO, AND CORE VALUES

VISION

"A leading mechanical faculty with future oriented talents for providing unique engineering solutions."

MISSION

"To provide innovative education and solutions for industry and society through dynamic and sustainable mechanical engineering practices."

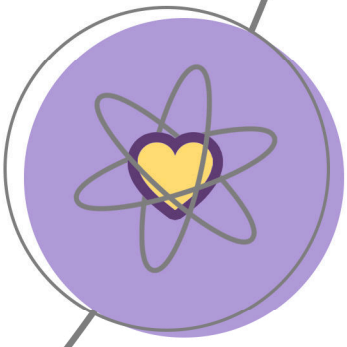


MOTTO

"Gearing Up the Future with ME"

CORE VALUES

"Bold • Prompt • Persistent"



FACULTY OF
MECHANICAL ENGINEERING

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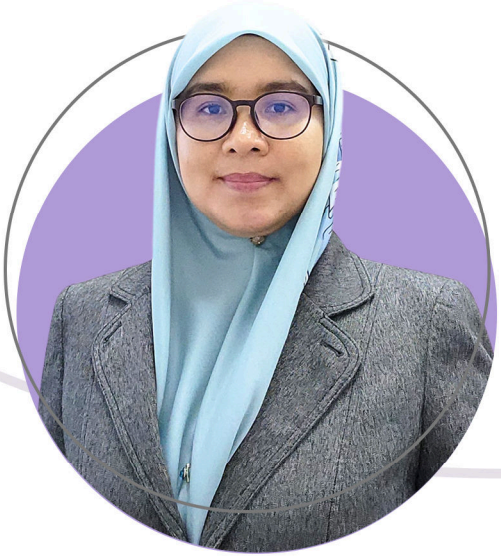

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ABOUT THE FACULTY OF MECHANICAL ENGINEERING

Faculty Background

Faculty of Mechanical Engineering (FME) formerly known as *Fakulti Kejuruteraan Jentera* (FKJ), was set up in 1975 at UTM Kuala Lumpur campus. FKJ initially had two departments, namely, the Department of Mechanical Engineering and Department of Petroleum Engineering. The faculty was managed by a Dean with the assistance of a Deputy Dean and two Heads of Department.

The faculty initially offered degree and diploma programmes in Mechanical Engineering and Petroleum Engineering. The student population during the 1976/1977 session was 544 with the number of students undergoing the Diploma in Mechanical Engineering (DKJ) programme and Diploma in Petroleum Engineering (DKP) programme totalling of 312 and 66, respectively, while for the Degree in Mechanical Engineering (SKJ) programme and Degree in Petroleum Engineering (SKP) programme, it was 126 and 40, respectively. As a result of the UTM-TUDM initiative, a new programme, Diploma in Aeronautical Engineering was offered during the 1980/1981 session. A total of 30 students enrolled in the programme. During the 1981/1982 session, another new programme was offered by the Faculty, namely, Diploma and Bachelor Degree in Ocean Engineering. A total of 29 students enrolled the diploma programme and 25 students for the degree programme.

In 1981, the faculty introduced a new position, the Deputy Dean II and set up a new department known as the Department of Production and Industrial Engineering. 15th of March 1983 marked a significant occasion in the history of FKJ when the Department of Petroleum Engineering was officially separated from FKJ to form a new faculty known as the Faculty of Chemical and Natural Resources Engineering. FKJ moved to a new main campus in Skudai, Johor in June 1989. As an effort to make the faculty more internationally marketable, the University has agreed to rename the *Fakulti Kejuruteraan Jentera* (FKJ) to the *Fakulti Kejuruteraan Mekanikal* (FKM) or Faculty of Mechanical Engineering (FME) on the 20th of December 1995. Since then, the faculty has considerably thrived and grown into a reputable and healthy organisation through a number of changes and transformation related to the expansion of academic programmes, new departments, improved facilities and infrastructures, and increased in number of staff and students.

Faculty Structure and Departments

Faculty of Mechanical Engineering is currently led by a Dean and assisted by two Deputy Deans; the Deputy Dean (Academic and Student Affairs) and Deputy Dean (Research, Innovation, and Development). A Deputy Registrar with the assistance of a Senior Assistant Registrar handles the administrative matters of the faculty. The administration of the Information Technology (IT) unit is headed by an IT Manager and the Teaching Laboratories are headed by a Research Manager. Currently, the Faculty has four (4) academic departments, each headed by a Director of Department. They are as follows:

- Department of Applied Mechanics & Design
- Department of Thermofluids
- Department of Materials, Manufacturing & Industrial Engineering
- Department of Aeronautics, Automotive & Ocean Engineering

Academic Programmes

The faculty currently offers the following programmes:

Postgraduate Programmes:

Master programmes taught by course:

1. Master of Science (Mechanical Engineering)
2. Master of Science (Industrial Engineering)

Master of Philosophy (Field of Research):

Mechanical Engineering

Doctor of Philosophy:

Mechanical Engineering

Facilities

The faculty is well-equipped with lecture halls, smart classrooms, lecture and tutorial rooms, seminar halls and resource centre (mini library). To support teaching and research activities, laboratories and workshops are available and headed by a Research Manager, who supervises the following Teaching Laboratories:

- Industrial and Systems Engineering Laboratory
- Metrology Laboratory
- Metal Forming Laboratory
- Fabrication Laboratory

- Mechanics of Materials & Structures Laboratory
- Control & Instrumentation Laboratory
- Mechanics of Machines Laboratory
- Noise & Vibration Laboratory
- Thermodynamics Laboratory
- Fluid Mechanics Laboratory
- Foundry Laboratory
- Combustion Laboratory

Workshop facilities are available as follows:

- Machine Shop

The faculty is also equipped with the following Laboratories of Excellence:

- Marine Technology Laboratory
- Aeronautical Laboratory
- Automotive Laboratory
- Materials Science Laboratory
- Production Laboratory

Apart from the above the faculty also has a number of Higher Education Centre of Excellence (HICoE), Centre of Excellence (CoE), Research Centres (RC), Research Institutes (RI):

- Institute of Noise and Vibration (IKG) - HICoE
- Centre for Advanced Composite Materials (CACM) - CoE
- Institute for Vehicle System and Engineering (IVeSE) - RI
- Low Carbon Transport in corporation with Imperial College London (LoCARtic) - RC
- Marine Technology Centre (MTC) - RC
- Automotive Development Centre (ADC) - RC
- Aeronautics Research Centre (AeroLab) - RC

Computing and IT Facilities

Five computer laboratories with more than 250 computers are available for students use. To facilitate computer aided teaching and learning, fully licensed software packages such as Solidworks, MATLAB/Simulink, Witness 14, as well as Open-Source software are readily available to use. Students are also able to access e-mail and e-learning facilities provided by the faculty and university. Internet facilities are widely available through both cabled and wireless configurations installed across the faculty. Additional computing facilities are also available in the UTM Department of Digital Services (UTMDigital), main library and student hostels.

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.

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					
Degree Class	CPA Scale of 4	CPA Scale of 5	CPA Scale of 20	Percentage	1000 Marks	Working Experience
First Class Second Class Upper Excellent Pass	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 Lower Very Good Pass	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
Third Class Good Pass	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

UTM Entry Requirement to Master by Coursework Programme						
	Obtained Bachelor degree with the following grade					
Degree Class	CPA Scale of 4	CPA Scale of 5	CPA Scale of 20	Percentage	1000 Marks	Working Experience
First Class Second Class Upper Excellent Pass	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 Lower Very Good Pass	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

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 (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 Centres 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 enrol 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.

Students 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 a 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 are released in English for students who were enrolled from 2000 onwards.

Award Requirements

Doctor of Philosophy

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 certificates and academic transcript WILL NOT be considered.
5. Duration of study:

- Full time students MUST have completed their study within 30 months until 48 Months.

6. Students MUST obtain a 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

- Students 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.
- Proof of evidence for indexed publication MUST be attached and fulfil 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

- Students MUST have participated in international or national conferences during their study as the presenter.
- Students who have received the best paper or oral presenter during the conference.
- Students MUST upload the certificate of attendance for the conference as the presenter.

9. Recognition

- Students MUST have received an award at an International, National or University level.

10. Intellectual Property / Commercialization

- Students 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 applications which are recommended by the supervisor and endorsed by faculty 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 the 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 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 certificates and academic transcript WILL NOT be considered.
5. Duration of study:
   - Full time students MUST complete study within 15 months until 27 months.
6. Students MUST obtain a 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
   - Students MUST be the first student author for all publications. Otherwise, the publication will not be counted.
   - 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.
   - Proof of evidence for indexed publication MUST be attached and fulfil 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 conferences during their study as the presenter.
   - Students who have received the best paper or oral presenter during the conference.
   - Students MUST upload the certificate of attendance for the conference as the presenter.
9. Recognition
   - Students MUST have received an award at an International, National or University level.
10. Intellectual Property / 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 to academic matters.
12. All information for the application is based on the current programme of studies only.

13. Only applications which are recommended by the supervisor and endorsed by faculty 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 the 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 certificates and academic transcript WILL NOT be considered.
5. Duration of study:
    - Full time students MUST complete study within 4 semesters or below.
6. Students MUST obtained A+, A or A- grade for master dissertation / master project and CPA 3.70 or above.
7. Publication / Book Chapter
    - Students 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
    - Proof of evidence for indexed publication MUST be attached and fulfil 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 conferences during their study as the presenter.
    - Students who have received the best paper or oral presenter during the conference.
    - Students MUST upload the certificate of attendance for the conference as the presenter.
9. Recognition
    - Students MUST have received an award at an International, National or University level.
10. Intellectual Property / 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 applications which are recommended by the supervisor and endorsed by faculty will be considered.
14. After online submission, the applicant is required to follow up with the supervisor to verify his/her application.
15. All results of application are strictly final and no appeal will be entertained.

Pre-Master at Faculty Mechanical 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

Pre-Master Course (Undergraduate Core Course)	Master by Taught Course
SEMM 1113 - Mechanics of Solids I SEMM 2313 - Mechanics of Fluids I SSCE 1793 - Differential Equations	Master of Science (Mechanical Engineering)
SEMM 3813 - Industrial Engineering SSCE 2193 - Engineering Statistics SEMI 4823 - Operations Research	Master of Science (Industrial Engineering)

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UTM
UNIVERSITI TEKNOLOGI MALAYSIA

Faculty of
Mechanical Engineering

Doctor of Philosophy

Field of Research: Mechanical Engineering

Ph.D.

DOCTOR OF PHILOSOPHY
FIELD OF RESEARCH: MECHANICAL ENGINEERING

Programme Specification

The Doctor of Philosophy Field of Research: Mechanical Engineering (PEMM) 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**	PEMM3
6.	**Professional or Statutory Body of Accreditation**	Malaysian Qualifications Agency (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/Part Time)**	Full Time
11.	**Study Duration**	Minimum : 3 years Maximum : 8 years

Type of Semester	No. of Semesters		No of Weeks/Semester
	Minimum	Maximum	
Normal	6	16	14
Short	-		-

Course Classification

No.	Classification	Credit Hours
1.	University Elective (1 course)	3
2.	Research Methodology	HW
3.	Research (Minimum 6 semesters)	0
4.	Thesis	0
	Total	**3**

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Mastery of knowledge and competency in advanced areas of Mechanical Engineering.
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 (PO)

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

Code	Intended Learning Outcomes
PO1	Synthesize, critique, apply, and extend in-depth relevant knowledge independently using innovative techniques, tools, and skills in the field of Mechanical Engineering as a basis for research to produce new ideas and solution.
PO2	Demonstrate research skills in appraising available information and research evidence, and applying them in mechanical engineering contexts
PO3	Integrate highly advanced and specialized research methodologies and tools based on the forefront knowledge and latest development in the field of Mechanical Engineering to solve complex research problems with reasonable degree of originality.
PO4	Demonstrate decent collaboration with peers, scholarly communities and society at large in the relevant field of expertise and research.
PO5	Communicate effectively the knowledge, skills, ideas and research findings using appropriate methods to peers, scholarly communities, and societies through various medium.
PO6	Use, improve existing or develop new appropriate tools or methodologies using a broad range of digital technology, media and software to support and enhance research activities.
PO7	Demonstrate skills in designing, critical evaluation, and analysing numerical and graphical data using quantitative or qualitative tools to support and enhance research activities.
PO8	Demonstrate leadership, professionalism and management skills, and take full responsibility for own work, and significantly for others in the research organization.
PO9	Demonstrate the ability to manage and enhance own self- and if necessary, can be accountable for overall management of one's research organization and professional development.
PO10	Develop potential commercialisation research output.
PO11	Demonstrate adherence to legal, professional and contribute to the development of ethical sound codes of practice.

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	Course Code	Course Name	Credit Earned	Credit Counted	Tick (/) If Passed
Faculty of Mechanical Engineering Courses					
1	UXXX xxx3	University Elective (1 course)			
2	UEMP 0010	Research Methodology			
3	PEMM xx00	Research (Minimum 2 semesters)			
4		Thesis			
5	Requirement	ONE (1) article (accepted or published) in a journal indexed on the WOS or, TWO (2) articles (accepted or published) in journal indexed in SCOPUS/ERA/Journals listed in myJurnal (Malaysian Journal Management System) from MyCite (Malaysian Citation Center).			

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

Faculty of
Mechanical Engineering

Master of Philosophy

Field of Research: Mechanical Engineering

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**	MEMM3
6.	**Professional or Statutory Body of Accreditation**	Malaysian Qualifications Agency (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/Part Time)**	Full Time
11.	**Study Duration**	Minimum : 1 years Maximum : 4 years

Type of Semester	No. of Semesters		No of Weeks/Semester
	Minimum	Maximum	
Normal	2	8	14
Short	-		-

Course Classification

No.	Classification	Credit Hours
1.	University Elective (1 course)	3
2.	Research Methodology	HW
3.	Research (Minimum 2 semesters)	0
4.	Thesis	0
	Total	**3**

Programme Educational Objectives (PEO)

Code	Intended Educational Objectives
PEO1	Knowledgeable and competent in research on advanced areas of Mechanical Engineering.
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 (PO)

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

Code	Intended Learning Outcomes
PO1	Integrate and generate in-depth relevant knowledge independently using innovative techniques, tools and skills for decision-making to manage and resolve a complex problem in the field of Mechanical Engineering as a basis for research.
PO2	Construct a critical and innovative solution for complex problems or issues in the field of Mechanical Engineering through research using the latest techniques and skills.
PO3	Devise standard research methodology that are based on the forefront knowledge and latest development in the field of Mechanical Engineering to solve research problems with reasonable degree of originality.
PO4	Demonstrate effective collaboration with peers, scholarly communities and society at large in the relevant field of expertise and research.
PO5	Communicate the knowledge, skills, ideas clearly using appropriate methods to peers, experts, and non-experts through various medium.
PO6	Use a broad range of suitable digital technologies, media, and software to design, manage, analyse and report research studies.
PO7	Demonstrate skills in designing, planning evaluation activities, and analysing numerical and graphical data using quantitative or qualitative tools in solving problems.
PO8	Demonstrate leadership, autonomy and responsibility in conducting and managing own research and resources.
PO9	Demonstrate the ability to manage and enhance own self-advancement for academic development, professional development and research skills using lifelong learning strategies.
PO10	Develop potential commercialisation research output.
PO11	Demonstrate adherence to legal, ethical and professional codes of practice in the field of Mechanical Engineering and research activities.

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	Course Code	Course Name	Credit Earned	Credit Counted	Tick (/) If Passed
Faculty of Mechanical Engineering Courses					
1	UXXX xxx3	University Elective (1 course)			
2	UEMP 0010	Research Methodology			
3	MEMM xx00	Research (Minimum 2 semesters)			
4		Thesis			
5	Requirement	ONE (1) publication in the form of a journal article OR conference paper OR book chapter that has been accepted for publication OR has been published.			

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

Faculty of
Mechanical Engineering

Master of Science
Mechanical Engineering

MASTER OF SCIENCE (MECHANICAL ENGINEERING)

Programme Specification

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 a 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 Qualifications Agency (MQA)
7.	**Language(s) of Instruction**	English
8.	**Mode of Study**	Conventional
9.	**Mode of Operation (Franchise, Self-govern, etc.)**	Self-governing
10.	**Study Scheme (Full Time/Part Time)**	Full Time / Part Time
11.	**Study Duration**	Minimum : 1 years 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

No.	Classification	Credit Hours	Percentage
i.	University General Courses		
	(a) University Elective	3	15 %
	(b) Free Elective	3	
ii.	Programme Core (Including Master Project I and Master Project II)	19	47.5%
iii.	Programme Track Electives	15	37.5%
	Total	**40**	**100%**
	Classification of courses for engineering programme		
	Engineering Courses		
	(a) Lecture/Project/Laboratory	30	
	(b) Workshop/Field/Design Studio	0	100%
	(c) Final Year Project	10	
	Total Credit Hours	**40**	**100%**
	Total Credit Hours to Graduate	**40 credit hours**	

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 (PO)

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

Code	Intended Learning Outcomes
PO1	Attain new frontiers of knowledge in the field of Mechanical Engineering (Knowledge and understanding)
PO2	Solve complex problems critically and integratively using systematic approaches (Cognitive skills).
PO3	Apply practical skills to solve problems in the field of Mechanical Engineering (Practical skills).
PO4	Demonstrate effective collaboration with stakeholders professionally (Interpersonal skills).
PO5	Communicate effectively the knowledge, skills and ideas using appropriate method to peers, experts and communities (Communication skills).

PO6	Use digital technologies and appropriate software competently to enhance study and practice (Digital skills).
PO7	Evaluate numerical and graphical data critically using quantitative or qualitative tools in solving problems (Numeracy skills).
PO8	Demonstrate leadership, autonomy and responsibility in managing resources (Leadership, autonomy and responsibility).
PO9	Engage self-advancement through continuous learning or professional development (Personal skills).
PO10	Demonstrate entrepreneurial skills with relevant knowledge and expertise (Entrepreneurial skills).
PO11	Demonstrate respectable ethical conducts and professionalism skills in an organization and society (Ethics and professionalism skills).

Elective Courses

Apart from the core course, students must also take 15 credits of elective course. Student can pick FIVE (5) elective courses from ONE (1) programme track.

Programme Track	Code	Elective Courses
General Mechanical	MEMM 1133	Elasticity and Plasticity
	MEMM 1143	Plates, Shell, and Pressure Vessels
	MEMM 1223	Adaptive control and Intelligent System
	MEMM 1233	Robotic System and Control
	MEMM 1253	Acoustics
	MEMM 1273	Vibration Measurement and Control
	MEMM 1283	Structural Dynamics
	MEMM 1313	Viscous Fluid Flow
	MEMM 1323	Compressible Flows
	MEMM 1423	Thermo Fluid Measurement and Diagnostic
	MEMM 1453	Indoor Environmental Quality
	MEMM 1533	Virtual Reality for Engineers
	MEMM 1553	Creative Design Engineering
	MEMM 2213	Advanced Control System
	MEMM 2413	Advanced Engineering Thermodynamics
	MEMM 2423	Advanced Combustion
Structural Health and Monitoring	MEMB 1633	Assets Integrity & Management
	MEMM 1113	Fatigue & Fracture Mechanics
	MEMM 1123	Computational Method in Solid Mechanics
	MEMM 1213	Automatic Control & Instrumentation
	MEMM 1263	Condition Monitoring
	MEMM 1343	Friction, Wear & Lubrication
	MEMM 1463	Conduction And Convection Heat Transfer
Sustainable Engineering	MEMM 1213	Automatic Control & Instrumentation
	MEMM 1413	Energy Management
	MEMM 1433	Sustainable Energy System and Technology
	MEMM 1543	Engineering Design and Reliability
	MEMM 2113	Advanced Mechanics of Composite Structure
	MEMP 1723	Green Manufacturing Technology

Computational Mechanics	MEMM 1123	Computational Method in Solid Mechanics
	MEMM 1333	Computational Fluid Dynamics
	MEMM 1513	CAD and It's Applications
	MEMM 1523	Optimization in Engineering Design
	MEMM 1913	Advance Engineering Mathematics
	MEMM 2223	Advanced Industrial Automation
Manufacturing Engineering	MEMP 1713	Statistical Quality Engineering
	MEMP 1723	Green Manufacturing Technology
	MEMP 1733	Digital Manufacturing
	MEMP 1753	Manufacturing Science
	MEMP 2703	Automation Systems and Robotics
	MEMP 2713	Welding technologies and Applications
	MEMP 2723	Smart Manufacturing
	MEMP 2733	IT for Manufacturing
	MEMP 2763	Advanced Manufacturing Processes
	MEMP 2773	Machining and Machine Tools Technology
Materials Engineering	MEMB 1613	Advanced Materials Processing
	MEMB 1623	Smart Materials
	MEMB 1633	Assets Integrity and Management
	MEMB 1643	Structural composites
	MEMB 2613	Advanced Materials Characterization
	MEMB 2623	Advanced Surface Modification for Metallic Materials
	MEMB 2633	Electron Microscopy for Nanomaterials
	MEMB 2643	Mechanical Behaviour of Materials
	MEMB 2653	Corrosion and Materials Degradation
	MEMB 2663	Advanced Ceramic Processing
Future Generation Vehicle	MEMV 1013	Advanced Automotive Technology
	MEMV 1203	Automotive Electronics & Control
	MEMV 1313	Advanced Vehicle Dynamics
	MEMV 1613	Future Mobility Solution
	MEMV 1623	Vehicle Connectivity
	MEMV 2213	Automotive Noise, Vibration and Harshness
Energy Efficient Vehicle	MEMV 1013	Advanced Automotive Technology
	MEMV 1403	Internal Combustion Engine & Boosting System
	MEMV 1503	Advanced Vehicle Powertrain
	MEMV 2213	Automotive Noise, Vibration and Harshness
	MEMV 2413	Low Carbon Fuel
	MEMV 2513	Automotive Tribology
Industrial Aerodynamics	MEMF 1313	Advanced Aerodynamics
	MEMF 2213	Advanced Aircraft Dynamics and Control
	MEMF 2323	Computational Aerodynamics
	MEMF 2343	Industrial Aerodynamic and Wind Engineering
	MEMF 2353	Experimental Aerodynamics
Advanced Aerospace Engineering	MEMF 1313	Advanced Aerodynamics
	MEMF 2013	Computational Method for Aerostructures
	MEMF 2113	Advanced Aircraft Structures and Materials
	MEMF 2213	Advanced Aircraft Dynamics and Control
	MEMF 2223	Aircraft Instrumentation and Avionics

	MEMF 2423	Jet Propulsion
	MEMF 2433	Rocket Technology
	MEMF 2443	Gas Turbine Technology
	MEMF 2513	Helicopter System and Performance
	MEMF 2613	Aviation Management and Airworthiness
Ship Technology	MEMO 1213	Dynamic of Marine Structures (compulsory)
	MEMO 1413	Dynamic of Marine Power Plant
	MEMO 1713	Ship Repair, Survey, and Inspection
	MEMO 2003	Marine Environment and Renewable Energy
	MEMO 2113	Strength and Vibration of Marine Structures (compulsory)
	MEMO 2313	Ship Powering and Propulsion
	MEMO 2513	Design for Advance Marine Vehicles
	MEMO 2813	Safety, Risk and Reliability in Marine Operation (compulsory)
	MEMO 2833	Marine Transport System
	MEMO 3843	Maritime Management and Law
Offshore Technology	MEMO 1213	Dynamic of Marine Structures (compulsory)
	MEMO 2003	Marine Environment and Renewable Energy
	MEMO 2113	Strength and Vibration of Marine Structures (compulsory)
	MEMO 2123	Decommissioning and Recycling of Marine Structures
	MEMO 2223	Mooring and Riser Analysis
	MEMO 2723	Unmanned Underwater Vehicles for Offshore Operations
	MEMO2813	Safety, Risk and Reliability in Marine Operation (compulsory)

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	Course Code	Course Name	Credit Earned	Credit Counted	Tick (/) If Passed
		University General Course			
1	UXXX xxx3	University Course Electives	3	3	
TOTAL CREDIT FOR UNIVERSITY GENERAL COURSE (A)			**3**	**3**	
		Programme Core Courses			
1	MEMM 1013	Emerging Technologies and Management	3	3	
2	MEMM 1023	Product Innovation and Development	3	3	
3	MEMM 1903	Research Methodology	3	3	
TOTAL CREDIT FOR PROGRAMME 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 FOR MASTER PROJECT COURSES (C)			**10**	**10**
Programme Track Elective 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 FOR PROGRAMME TRACK ELECTIVE COURSES (D)			**15**	**15**
Free Elective Courses				
1	MXXX xxx3	Free Elective Course (cross-discipline / Area / Track / Faculty)	3	3
TOTAL CREDIT FOR FREE ELECTIVE COURSE (E)			**3**	**3**
TOTAL CREDIT TO GRADUATE (A + B + C + D + E)			**40**	**40**

Course Synopsis – Programme Core Courses

MEMM 1013 - 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 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 the topics covered, the course will be of interest for students, researchers and professionals working in mechanical engineering.

MEMM 1023 - 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.

MEMM 1903 - 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

Course Synopsis – 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 is then required to do data collection, analyse 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, students also require producing a technical article based on the project findings.

Course Synopsis – 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, 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 following: 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 packages 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 robotics and control. It will examine the fundamental elements of a robot system related to anatomy and configuration, robot main components, programming features 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 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 systems thus requiring wave propagation methods in determining the dynamic response of various beams, rods, shafts, and plates. Mobility techniques in determining and measuring the response of structures are introduced. Topics also cover 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. Students also will be introduced to the boundary condition for viscous flow problems. Then, the derivation of the equation of viscous flow regarding 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 exposes 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 non-intrusive methods. The classical, standard, and advanced thermal fluid measuring tools will be discussed. This course also introduces students to the basics of advanced optical fluids and combustion flow diagnostics concepts, principles, and techniques. Quantitative and qualitative measurement techniques for reacting and non-reacting flows will also be emphasized in this course. The course will be conducted through lectures, laboratory works and projects-based methods.

MEMM 1453 - 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 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.

MEMM 1553 - 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).

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 automated discrete control systems.

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.

TRACK 2:
Structural Health Monitoring

This track is focused 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 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.

MEMM 1123 - Computational Method in Solid Mechanics

This course extends the undergraduate-level introduction to the Finite Element Method for obtaining approximate solutions 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. Processes 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 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 systems 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 systems. 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 systems, 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 focuses on the condition-based maintenance strategy where condition monitoring is the key aspect 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 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.

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.

MEMB 1633 - 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.

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.

MEMM 1213 - 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 systems 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 systems. 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 systems, 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 1413 - 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 majors. 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.

MEMM 1433 - Sustainable Energy System and Technology

In the context of depleting fossil fuel reserves and environmental consequences, the concept of sustainable energy has drawn a central focus among energy stakeholders. This course embraces both sustainable energy systems 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 systems 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 systems and technology are achieved through lectures, discussions, combined with reports and student presentations on the literature reviewed.

MEMM 1543 - 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 applications 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).

MEMM 2113 - 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 for the students to understand more regarding the practical sides of the subject.

MEMP 1723 - 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, the Life Cycle Assessment consists of four main phases, goal and scope definition, inventory, impact assessment, and interpretation. Analysis uses a 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 methods in fluid dynamics and solid mechanics, computer aided design, advanced industrial automation and optimization in engineering design.

MEMM 1123 - Computational method in solid mechanics

This course extends the undergraduate-level introduction to the Finite Element Method for obtaining approximate solutions 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. Processes 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 1333 - 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.

MEMM 1513 - CAD and Its Applications

This course is divided into two parts. The first part covers the foundation theories in CAD. Then, the second part discusses the applications of the foundation theories. These applications include from the applications in the engineering design and extends to the framework in the creation of an intelligent system. The course also exposes the possible research and emerging technologies related to CAD.

MEMM 1523 - 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.

MEMM 1913 - Advanced 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 have significant importance in the mechanical engineering field. The second part of the course consists of the vector calculus that includes vector differential and vector integral with an extension to the tensors. An emphasis on 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 is 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.

MEMM 2223 - 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 products/plants through hardware programming and interfacing implementation.

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.

MEMP 1713 - Statistical Quality Engineering

This course is designed to provide the students with a sound understanding of 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.

MEMP 1723 - 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, the Life Cycle Assessment consists of four main phases, goal and scope definition, inventory, impact assessment, and interpretation. Analysis uses a 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.

MEMP 1733 - Digital Manufacturing

This course aims to prepare students with fundamentals of knowledge under industrial 4.0 industrial revolutions. Digital Manufacturing (DM), comprising Subtractive, Additive and Laser technology as key technologies for supporting manufacturing techniques that involve 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.

MEMP 1753 - Manufacturing Science

This course is designed to expose the students to 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, fundamentals of precision machining, principles of precision measurement and recent development in Precision Engineering fields will also be discussed.

MEMP 2703 - 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, robotics 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.

MEMP 2713 - 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 of understanding 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.

MEMP 2723 - 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 product design, knowledge management, data analysis and other technologies being seamlessly transferred through the entire lifecycle of a manufactured product.

MEMP 2733 - 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 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).

MEMP 2763 - Advanced Manufacturing Processes
This course introduces automation and advanced techniques used in 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 students to carry out small case studies in the real environments for exposing them to certain issues related to manufacturing automation.

MEMP 2773 - 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 exercises are given to the students to enhance their knowledge in machining theory and machine tool technology.

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.

MEMB 1613 - 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.

MEMB 1623 - 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.

MEMB 1633 - 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.

MEMB 1643 - 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.

MEMB 2613 - 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 methods 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.

MEMB 2623 - Advanced Surface Modification for Metallic Materials

Corrosion, wear, or the combined effects of these destructive failure modes cost the 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 processes demonstrate 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.

MEMB 2633 - 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 analyse digital data using digital software and understand how to evaluate nanomaterials properties.

MEMB 2643 - Mechanical Behaviour 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.

MEMB 2653 - 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

MEMB 2663 - Advanced Ceramic Processing
This course covers 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.

MEMV 1013 - 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.

MEMV 1203 - Automotive Electronics & Control
This course focuses on vehicle electronics, 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 systems for vehicles.

MEMV 1313 - 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 vehicles will be covered in this course. This includes the semi-active and active suspension systems, roll control systems, electronic brake force distribution (EBD) system, anti lock braking system (ABS) and active steering system. The importance of vehicle dynamics for automated vehicles will also be covered in this course. This includes handling modelling and control system of an automated vehicle which utilises sensor data to manoeuvre. 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 outstanding dynamics performance for a vehicle.

MEMV 1613 - 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.

MEMV 1623 - Vehicle Connectivity
This course provides advancements in enabling connected cars. 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 not so-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 lights. 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.

MEMV 2213 - 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.

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.

MEMV 1013 - 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.

MEMV 1403 - 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 engines 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 engines with boosting systems can meet the strict emission and energy efficiency targets.

MEMV 1503 - Advanced Vehicle Powertrain

This course covers principal 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.

MEMV 2213 - 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.

MEMV 2413 - Low Carbon Fuel

This course focuses on low-carbon transportation fuels, which are emerging options to displace petroleum-based fuels. The topics covered include 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.

MEMV 2513 - Automotive Tribology

Tribology is focusing on the friction, wear and lubrication principle and application. The course originated from the art of lubrication but has developed to many different types and range of applications. Among the topics discussed are the 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

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.

MEMF 1313 - 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.

MEMF 2213 - 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.

MEMF 2323 - 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.

MEMF 2343 - 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 the wind tunnel and analyse the data accordingly.

MEMF 2353 - 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.

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.

MEMF 1313 - 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.

MEMF 2013 - 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

MEMF 2113 - 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.

MEMF 2213 - 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.

MEMF 2223 - 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.

MEMF 2433 - 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.

MEMF 2443 - 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.

MEMF 2513 - Helicopter System and Performance
This course presents a comprehensive introduction to rotorcraft technology covering a wide range of disciplines. Students 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.

MEMF 2613 - 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.

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 are also introduced to enable graduates to respond to the needs, challenges and demands of the United Nation Sustainable Development Goals.

MEMO 1213 - Dynamic of Marine Structures

This subject equips the students with knowledge of the environment and relates it with performance of the vessel in seakeeping and manoeuvring. 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 manoeuvring and directional stability. The final part discusses the aspect of using devices such as bilge keels and rudders to control a vessel's motions. Besides that, this subject also introduces to students 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.

MEMO 1413 - 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.

MEMO 1713 - Ship Repair, Survey and Inspection

This course is offered with the 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 a module-by-module base, 2 days x 7 hours per day per module.

MEMO 2003 - 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. Students 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.

MEMO 2113 - Strength and Vibration of Marine Structures

This course covers 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 is 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.

MEMO 2313 - 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 behaviour in seaway. The first part of the course provides students with knowledge on ship resistance and its components, predicting ship resistance according to the standard procedures and discussing the effect of weather conditions on ship performance. The second part of the course touches on the knowledge on ship propulsion systems which covers the basic propeller action, propeller design parameters, and procedures of engine-propeller matching.

MEMO 2513 - Design for Advanced Marine Vehicles

This course equips the students with knowledge on the development of advanced 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 enhance 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.

MEMO 2813 - 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 support 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 methods 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

MEMO 2833 - Marine Transport System

Generally, marine transport is one of the main activities for shipping. The requirement for a marine transport system will naturally support directly and indirectly many other shipping or maritime based related activities such as shipbuilding, oil and gas, port operation, logistics and supply chain, etc. In the process of executing these activities, several relevant policies, rules, and regulations such as Flag of Convenient, Chartering, etc. to be considered and applied accordingly ensuring the optimum transport undertakings.

MEMO 3843 - 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, a short series of lectures on the underlying principles, detailed synthetizing of the case study material, preparation of a short report, presentation of report with questions and answers and finally feedback from the lecturer.

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 Marin Operations. The Marine Environment and Renewable Energy course are also introduced to enable graduates to respond to the needs, challenges and demands of the United Nation Sustainable Development Goals.

MEMO 1213 - Dynamic of Marine Structures

This subject equips the students with knowledge of the environment and relates it with performance of the vessel in seakeeping and manoeuvring. 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 manoeuvring and directional stability. The final part discusses the aspect of using devices such as bilge keels and rudders to control a vessel's motions. Besides that, this subject also introduces to students 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.

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. Students 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.

MEMO 2113 - Strength and Vibration of Marine Structures
This course covers 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 is 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.

MEMO 2123 - 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.

MEMO 2223 - 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 systems 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.

MEMO 2723 - 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 is capable of executing predetermined tasks.

MEMO 2813 - 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 support 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 methods 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.

UTM
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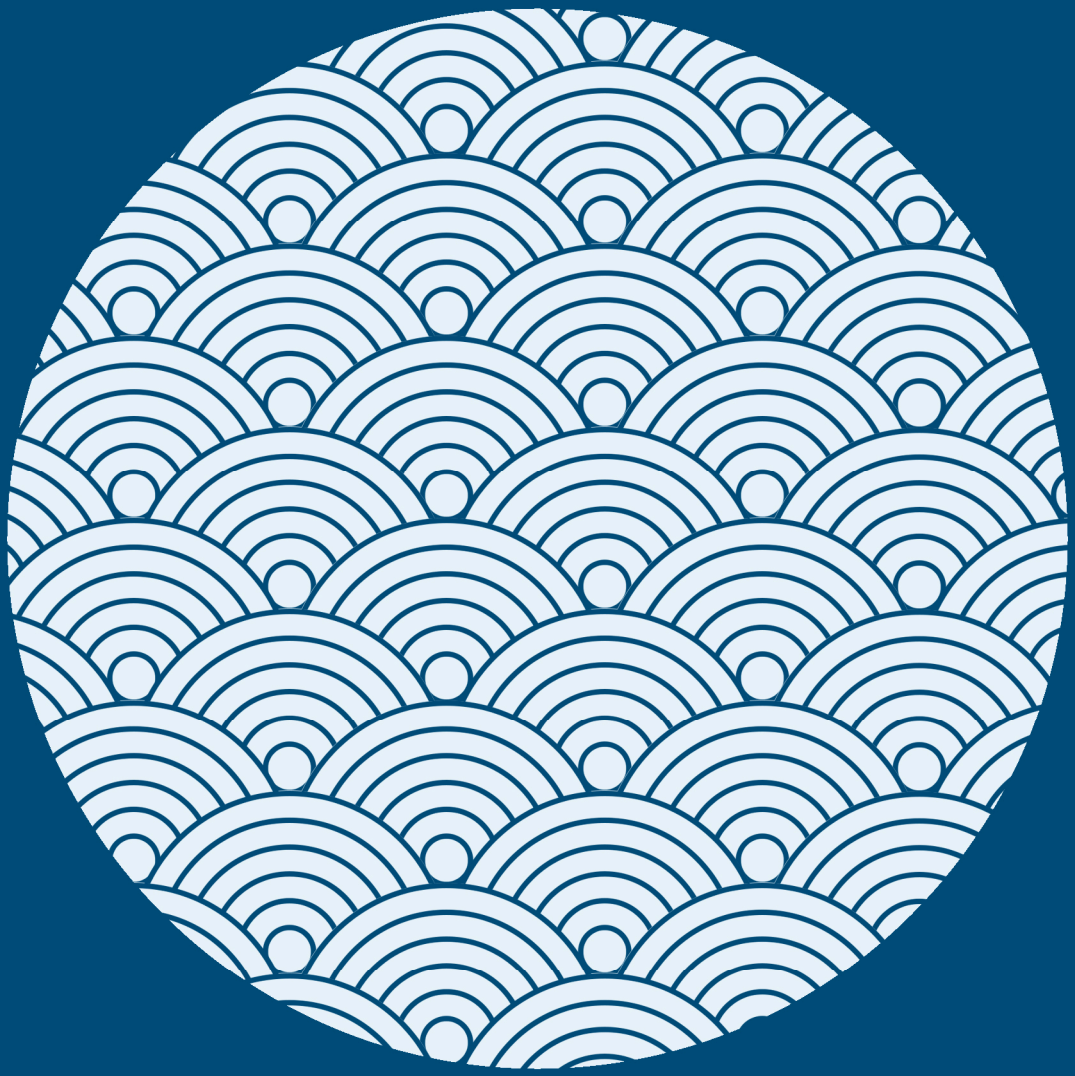
Mechanical Engineering



Master of Science
Industrial Engineering

MASTER OF SCIENCE (INDUSTRIAL ENGINEERING)

Programme Specification

Master of Science (Industrial Engineering) program makes up the core of the Industrial Engineering studies at the Faculty of Mechanical 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 (Franchise, Self-govern, etc.)**	Self-governing
10.	**Study Scheme (Full Time/Part Time)**	Full Time / Part Time
11.	**Study Duration**	Minimum : 1 years 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

No.	Classification	Credit Hours	Percentage
i.	University General Courses		
	(c) University Elective	3	15 %
	(d) Free Elective	3	
ii.	Programme Core (Including Master Project I and Master Project II)	22	55 %
iii.	Programme Track Electives	12	30 %
	Total	**40**	**100 %**
	Classification of courses for engineering programme		
	Engineering Courses		
	(d) Lecture/Project/Laboratory	30	
	(e) Workshop/Field/Design Studio	0	100%
	(f) Final Year Project	10	
	Total Credit Hours	**40**	**100%**
	Total Credit Hours to Graduate	**40 credit hours**	

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 (PO)

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

Code	Intended Learning Outcomes
PO1	Attain new frontiers of knowledge in the field of Mechanical Engineering (Knowledge and understanding)
PO2	Solve complex problems critically and integratively using systematic approaches (Cognitive skills).
PO3	Apply practical skills to solve problems in the field of Mechanical Engineering (Practical skills).
PO4	Demonstrate effective collaboration with stakeholders professionally (Interpersonal skills).
PO5	Communicate effectively the knowledge, skills and ideas using appropriate method to peers, experts and communities (Communication skills).

PO6	Use digital technologies and appropriate software competently to enhance study and practice (Digital skills).
PO7	Evaluate numerical and graphical data critically using quantitative or qualitative tools in solving problems (Numeracy skills).
PO8	Demonstrate leadership, autonomy and responsibility in managing resources (Leadership, autonomy and responsibility).
PO9	Engage self-advancement through continuous learning or professional development (Personal skills).
PO10	Demonstrate entrepreneurial skills with relevant knowledge and expertise (Entrepreneurial skills).
PO11	Demonstrate respectable ethical conducts and professionalism skills in an organization and society (Ethics and professionalism skills).

Elective Courses

Apart from the core course, students must also take 12 credits of elective course. Student can pick FOUR (4) elective courses from ONE (1) programme track.

Programme Track	Code	Elective Courses
Engineering Management	MEMI 2813	Project Management
	MEMI 2823	Engineering Economy and Finance
	MEMI 2833	Safety Management
	MEMI 2843	Quality Management
	MEMI 2853	Engineering and Technology Management
	MEMI 2863	Lean Manufacturing
System Engineering	MEMI 1813	Statistical Quality Engineering
	MEMI 1823	Supply Chain and Logistics
	MEMI1 833	Work Systems and Ergonomics
	MEMI 2823	Engineering Economy and Finance
	MEMI 2873	Modelling and Simulation
	MEMI 2883	Facilities Planning and Design
Manufacturing Engineering	MEMI 1813	Statistical Quality Engineering
	MEMM 1023	Product Innovation & Development
	MEMP 1723	Green Manufacturing Technology
	MEMP 1743	CAD/CAM/AM
	MEMP 2723	Smart Manufacturing
	MEMP 2733	IT for Manufacturing
Quality Engineering	MEMI 1813	Statistical Quality Engineering
	MEMI 2803	Engineering and Environmental Safety
	MEMI 2843	Quality Management
	MEMI 2863	Lean Manufacturing
	MEMI 2893	Risk Management
	MEMP 2723	Smart Manufacturing

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	Course Code	Course Name	Credit Earned	Credit Counted	Tick (/) If Passed
		University General Course			
1	UXXX xxx3	University Course Electives	3	3	
	TOTAL CREDIT FOR UNIVERSITY GENERAL COURSE (A)		**3**	**3**	
		Programme Core Courses			
1	MEMI 1903	Research Methodology	3	3	
2	MEMI 1843	Operations Planning and Control	3	3	
3	MEMI 1853	Operations Research and Application	3	3	
4	MEMI 1863	Industrial Data Analytics	3	3	
	TOTAL CREDIT FOR PROGRAMME 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 FOR MASTER PROJECT COURSES (C)		**10**	**10**	
		Programme Track Elective 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 FOR PROGRAMME TRACK ELECTIVE COURSES (D)		**12**	**12**	
		Free Elective Courses			
1	MXXX xxx3	Free Elective Course (cross-discipline / Area / Track / Faculty)	3	3	
	TOTAL CREDIT FOR FREE ELECTIVE COURSE (E)		**3**	**3**	
	TOTAL CREDIT TO GRADUATE (A + B + C + D + E)		**40**	**40**	

Course Synopsis – Programme Core Courses

MEMI 1903 – Research Methodology

This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting 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

MEMI 1843 - 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.

MEMI 1853 - 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.

MEMI 1863 - 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 predicting the future. The course focuses on statistical and machine learning techniques for data modelling, and data visualization to gain insights for decision making.

Course Synopsis – Master Project Courses

MEMI 1914 - 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.

MEMI 2926 - 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 is 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, students are also required to produce a technical article based on the project findings.

Course Synopsis – 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 are 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.

MEMI 2813 - 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).

MEMI 2823 - 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 determining 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.

MEMI 2833 - 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

MEMI 2843 - 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. Other quality management initiatives such as Six Sigma, Lean and Lean Six Sigma, and current issues are also discussed.

MEMI 2853 - 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.

MEMI 1813 - Statistical Quality Engineering
This course is designed to provide the students with sound understanding of 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.

MEMI 1823 - Supply Chain and Logistics
This course is identifying the strategic importance of good supply chain and logistics design and management on the competitive position for each supply chain member. 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 techniques for designing transportation networks, distribution issues, logistics management, integration issues and performance measurement.

MEMI 1833 - 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).

MEMI 2823 - 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 determining 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.

MEMI 2873 - Modelling and Simulation
This course provides students with the concepts and tools to model manufacturing or service systems efficiently using 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.

MEMI 2883 - 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 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 requirements of manufacturing industry areas such as production planning, design, materials handling, processes, and quality control.

MEMI 1813 - Statistical Quality Engineering

This course is designed to provide the students with a sound understanding of 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.

MEMM 1023 - 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.

MEMP 1723 - 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, the Life Cycle Assessment consists of four main phases, goal and scope definition, inventory, impact assessment, and interpretation. Analysis uses a 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.

MEMP 1743 - 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

MEMP 2723 - 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 product design, knowledge management, data analysis and other technologies being seamlessly transferred through the entire lifecycle of a manufactured product.

MEMP 2733 - 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 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).

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.

MEMI 1813 - 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.

MEMI 2803 - 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. Environmental safety provides the principles and concepts of environmental safety elements, hazardous waste control, environmental assessment under OSHA 1994, impact and cause of global warming, 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 programs.

MEMI 2843 - 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. Other quality management initiatives such as Six Sigma, Lean and Lean Six Sigma, and current issues are also discussed.

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.

MEMI 2893 - 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.

MEMP 2723 - 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 product design, knowledge management, data analysis and other technologies being seamlessly transfer through the entire lifecycle of a manufactured product.

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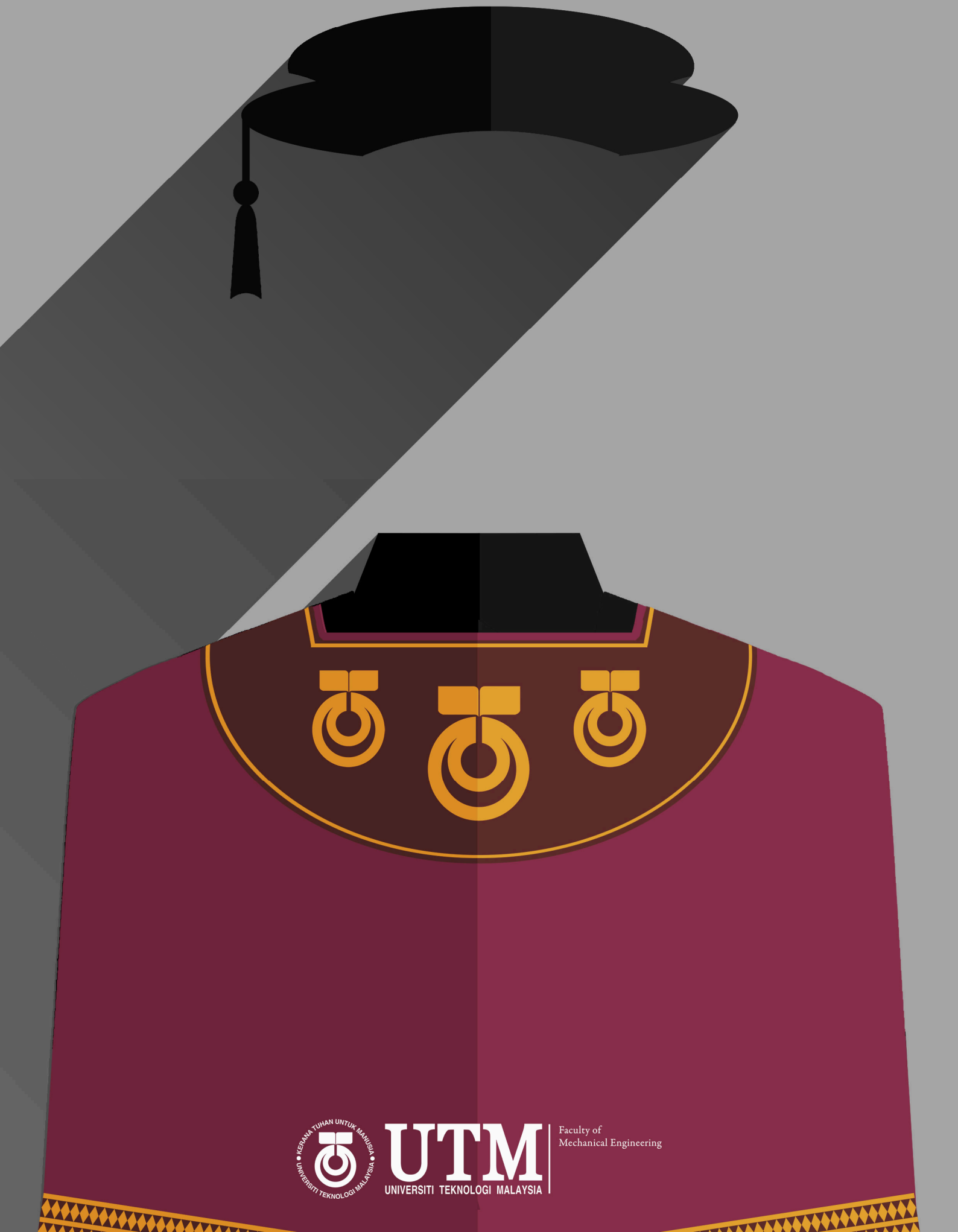

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