MASTER OF SCIENCE (ENERGY MANAGEMENT)

PROGRAMME SPECIFICATIONS

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

General Information

<table>
<tr><td colspan="3">1. Awarding Institution</td><td colspan="2">Universiti Teknologi Malaysia</td></tr>
<tr><td colspan="3">2. Teaching Institution</td><td colspan="2">Universiti Teknologi Malaysia</td></tr>
<tr><td colspan="3">3. Programme Name</td><td colspan="2">Master of Science (Energy Management)</td></tr>
<tr><td colspan="3">4. Final Award</td><td colspan="2">Master of Science (Energy Management)</td></tr>
<tr><td colspan="3">5. Programme Code</td><td colspan="2">MKKE</td></tr>
<tr><td colspan="3">6. Professional or Statutory Body of Accreditation</td><td colspan="2">MQA</td></tr>
<tr><td colspan="3">7. Language(s) of Instruction</td><td colspan="2">English and Bahasa Melayu</td></tr>
<tr><td colspan="3">8. Mode of Study (Conventional, distance learning, etc.)</td><td colspan="2">Conventional, Active and Cooperative Learning (Taught Course)</td></tr>
<tr><td colspan="3">9. Mode of operation (Franchise, self-govern, etc.)</td><td colspan="2">Self-governing</td></tr>
<tr><td colspan="3">10. Study Scheme (Full Time/Part Time)</td><td colspan="2">Full-Time and Part-Time</td></tr>
<tr><td colspan="3">11. Study Duration</td><td colspan="2">Full-Time
Minimum: 1 year
Maximum: 3 years

Part-Time
Minimum: 2 years
Maximum: 4 years</td></tr>
<tr><td rowspan="2">Type of Semester</td><td colspan="2">No. of Semesters</td><td colspan="2">No. of Weeks</td></tr>
<tr><td>Full Time</td><td>Part Time</td><td>Full Time</td><td>Part Time</td></tr>
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Normal	2	4	14	14
Short	1	1	8	8

Course Classification

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

Programme Educational Objectives (PEO)

PEO1 - Have in-depth knowledge and skills in Energy Management
PEO2 - Successfully integrate sustainable energy management system into its working environment.
PEO3 - Embrace professional, ethical, environmental and societal responsibilities.

Programme Learning Outcomes (PLO)

PLO1 - Ability to develop in depth knowledge on the planning and management of energy supply and demand for energy sustainability
PLO2 - Ability to perform research using computational tools and techniques
PLO3 - Ability to solve problems related to energy technology, planning and management
PLO4 - Ability to demonstrate professional ethics, in developing sustainable operation and facilities.
PLO5 - Ability to demonstrate ideas and findings through oral presentation and scientific writing effectively.
PLO6 - Ability to independently engage in lifelong learning and acquire contemporary knowledge on energy technology, planning and management effectively.
PLO7 - Ability to work in groups effectively in energy technology, planning and management-related areas.
PLO8 - Ability to show entrepreneurial skills effectively.

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist with minimum B grade. Students must achieve a total of 45 credit hours with a minimum

of cumulative B grade or CGPA of 3.0 and passed master research project and has submitted the approved dissertation to UTM. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
PROGRAMME CORE COURSES (Compulsory)					
1	MKKE 1113	Mechanical and Electrical Energy Management	3	3	
2	MKKE 1123	Energy Life Cycle Cost and Emission Analysis	3	3	
3	MKKE 1213	Sustainable Energy Management	3	3	
4	MKKE 1223	Project Management and Ethics	3	3	
5	MKKE 1233	Research Methodology and Design of Experiments	3	3	
6	MKKE 1243	Computer Aided Tools for Energy-Efficient Industry	3	3	
TOTAL CREDIT OF CORE COURSES (a)			**12**	**12**	
PROGRAMME ELECTIVE COURSE (Choose only 4 Courses)					
7	MKKE 2133	Renewable Energy	12	12	
8	MKKE 2143	Energy Integration and Resource Conservation			
9	MKKE 2153	Thermal Energy Management			
10	MKKE 2163	Biomass for Renewable Energy, Fuels and Chemicals			
11	MKKE 2173	Inherent Occupational Health Assessment in Chemical Process			
12	MKKE 2253	Solid and Hazardous Waste Management			
TOTAL CREDIT OF ELECTIVE COURSE (b)			**12**	**12**	
UNIVERSITY GENERAL COURSE					
13	U*** ***3	University General Course	3	3	
TOTAL CREDIT OF UNIVERSITY GENERAL COURSE (c)			**3**	**3**	
RESEARCH SKILLS					
14	MKKE 1315	Master Project 1	5	5	
15	MKKE 2327	Master Project 2	7	7	

TOTAL CREDIT OF RESEARCH SKILLS (d)	**12**	**12**	
TOTAL CREDIT TO GRADUATE [(a)+(b)+(c)+(d)]	**45**	**45**	

COURSE SYNOPSIS

CORE COURSES

MKKE 1113 - Mechanical and Electrical Energy Management
This course presents 4 parts of lecture, Part A is the introduction to general energy audit. Part B will cover energy audit on mechanical equipment such as electric motor, chiller, cooling tower, fans & blower, pumps, air compressor energy audit and Part C is the electrical systems energy audit that covers electrical systems and Part D is on the Integrated Resource Planning.

MKKE 1123 - Energy Life Cycle Cost and Emission Analysis
This course discusses life cycle cost analysis for energy conservation projects and emission analysis thorough the life cycle of a product. It presents the principles, methodology and case studies to develop an understanding of life cycle cost and emission analysis that can reduce environmental impact and promote sustainable practice.

MKKE 1213 - Sustainable Energy Management
This course presents the principles for a holistic approach for energy management in a company setting. It provides strategies and methodologies for setting up a sustainable energy management system in a company and for implementing state-of-the-art energy conservation measures using various analysis tools, involving various process equipment, for thermal as well as electrical energy systems.

MKKE 1223 - Project Management and Ethics
The course intends to develop comprehensive understanding on various aspects of project management which relevant to energy project, including the planning, programming, budgeting and acquisition of capital assets. The principal focus is to ensure energy management projects are delivery on schedule, within budget, with the required performance capability, and compliant with quality, environmental, safety and health standards. Ethics moral are integrated with respective Project Management topics.

MKKE 1233 - **Research Methodology and Design Of Experiment**
This course provides guidelines for preparing a research proposal and defends it. It provides the rationale for the research, the research objectives, the proposed methods for data collection, design of experiment, and data analysis. The proposal is based on the individual interest on sustainable energy management topics. In the proposal you will present the research and statistical methodology and with expected result and discussion.

MKKE 1243 - **Computer-Aided Tools for Energy Efficient Industry**
This course provides students with the ability to use energy related software for efficient energy utilization in industry. Students are expected to simulate the case study using state of the art energy software MER, EFFECT, MARKAL, Leap as well as new developed software i.e. Optimal Heat, Optimal Audit, IDEAS and INCAM. Emphasis will be placed on the simulation, interpret meaningful results and reporting the energy savings and environmental benefits.

MKKE 1315 - Master Project 1
The course aims to develop skills in scientific research. This is the first part of the Master's Project. Students will be assigned with, or give a freedom to choose, any research topics related to Energy Technology and Management. Students will conduct the research under a supervisor since the beginning of the first part until the second part of the Master's Project. Prior to the research work, each student is required to come up with written research proposals, and present them in a seminar. The proposal should include the background of study, problem statement, and objectives of study, scope of study and significance of study. Also required are literature review, overall research methodology, research planning, and expected/preliminary results. The proposal must be submitted at the end of the semester to be evaluated. If pass, only then, student can proceed to the second part of the Master's Project.

MKKE 2327 - Master Project 2
The course aims to develop skills in scientific research and solve problems or improve systems related to Energy Management, Technology and Planning. Student will be assigned with a related topic under a supervisor since the beginning of the first semester of their Master's Project 1 course. Prior to this second part of the project, each student is required to come up with written research proposals, and present them in a seminar. The proposal should include the literature survey, scopes and objectives methodology, preliminary outcomes (if any), theories, and planning schedule. A full Master's Project report is to be submitted at the end of the project.

ELECTIVE COURSES

MKKE 2133 - Renewable Energy
The course provides an understanding of the management diversity of the renewables/sustainable low-carbon energies portfolio for sustainable energy future. The module includes the assessment of economic and environmental benefits of renewable energy (RE) from various sources such as biomass, biogas, solar, water, geothermal and wind. The emphasis will be given for the conversion of the renewable sources into fuels, energy, chemicals and bio-products. This module also will examine the business opportunities of RE including the industry structure, RE related policies, financing, risk

management, regulatory mechanisms and technologies.

MKKE 2143 - **Energy Integration and Resource Conservation**
This course presents the principles and methodology to develop an understanding of Pinch Analysis technique and acquire the skills to apply the technique for optimal resource conservation for the ultimate aim of producing cost effective, clean and resource efficient designs of new and existing chemical process systems. The course will cover the resource integration for heat, power, water and carbon emissions.

MKKE 2153 - Thermal Energy Management
This course presents the principles and methodology to analyze thermal energy equipment in the industries. The course will cover the fundamentals of fuels and combustion, boiler, steam system, furnace, cogeneration, heat integration and waste heat boilers.

MKKE 2163 - Biomass for Renewable Energy, Fuels and Chemicals
The subject examines biomass resources and technologies available for conversion to energy, fuels and chemicals. The module looks at technologies for the production of heat, electricity, transport fuel and chemicals, the economics of production and the potential for reducing carbon dioxide emissions.

MKKE 2173 - Inherent Occupational Health Assessment In Chemical Process Design
This course covers the fundamentals of inherent occupational health (IOH), which is a new concept introduced for sustainable process development. The course is started by enlightening the students on the idea of inherent safety, which is the origin of the IOH. The importance of adopting the IOH features during process development and design phase is discussed. Also included are the process lifecycle stages, with special attention on those related to development and design. Existing methods for health hazards assessment in chemical process industries are presented.

The next part of the course is to teach the students on the practical application of the IOH assessment during chemical process development and design. Three earlier lifecycle stages of research and development, preliminary process design, and basic engineering are covered. This is the main essence of the course. Throughout the assessment, the students are taught on many other related elements which include the estimation of: fugitive emissions, periodic emissions, workers' exposure to chemicals, as well as long-term and short-term health risks. Finally, the students are exposed to the strategies for reducing, if not eliminating, the hazards through inherent safety principles. This course employs Cooperative and Problem-Based Learning.

MKKE 2253 - **Solid and Hazardous Waste Management**
The course aims to provide an overview of solid and hazardous waste

management. Upon completion, the course enables the student to have the basic understanding of waste management and awareness of the importance of solid and hazardous waste management and the associated environmental problems that arise with poor management and disposal of such waste. The course includes sources, generation and characteristics of industrial and municipal wastes, analysis of collection systems, and handling and disposal practices of municipal wastes, significance of industrial wastes as environmental pollutants, pollution prevention and techniques for processing, treatment and disposal of industrial wastes.