MASTER OF SCIENCE (AERONAUTICAL ENGINEERING)

PROGRAMME SPECIFICATION

Master of Science (Aeronautical Engineering) programme offers a broad and diverse subject that derives its breadth from the need to enhance knowledge and skills relevant to aeronautical engineering applications. Throughout the period of study, students may improve the knowledge related to aircraft aerodynamics, structures, avionics, dynamics & control and jet propulsion. Students may also expose to helicopter aerodynamics, system & performance, gas turbine, rocket technology and fuel & propellant. The versatility of this program allows students a variety of career options.

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 maximum period for the completion of this programme is eight normal semesters (nominally 4 years). 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 (Aeronautical Engineering)	
4. Final Award			Master of Science (Aeronautical Engineering)	
5. Programme Code			MKMK	
6. Professional or Statutory Body of Accreditation			Malaysian Qualification Agency, MQA	
7. Language(s) of Instruction			English	
8. Mode of Study			Conventional	
9. Mode of operation			Self-governing	
10. Study Scheme (Full Time/Part Time)			Full Time / Part Time	
11. Study Duration			Minimum : 1 year Maximum : 4 years	
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	8	8	14	14
Short	4	4	8	8

Course Classification

Course Category	Code	Course	Credit	Percentage
University General Courses	U### ###3	University Electives	3	7.5%
Programme Core	MKMF 1213	Advanced Mathematics for Aeronautical Engineering Applications	3	30%
	MKMF 1313	Advanced Aerodynamics	3	
	MKMF 1903	Research Methodology	3	
	MKMF 2013	Computational Method for Aerostructures	3	
Project	MKMF 1914	Master Project I	4	25%
	MKMF 2926	Master Project II	6	
Programme Electives (choose 5 courses only)	MKMF 2113	Advanced Aircraft Structures and Materials	3	37.5%
	MKMF 2123	Structural Dynamics & Aeroelasticity	3	
	MKMF 2213	Advanced Aircraft Dynamics & Control	3	
	MKMF 2223	Aircraft Instrumentation and Avionics	3	
	MKMF 2323	Computational Aerodynamics	3	
	MKMF 2333	Compressible Fluid Flow	3	
	MKMF 2343	Industrial Aerodynamics and Wind Engineering	3	
	MKMF 2353	Experimental Aerodynamics	3	
	MKMF 2363	Helicopter Aerodynamics	3	
	MKMF 2413	Fuel and Propellant	3	
	MKMF 2423	Jet Propulsion	3	
	MKMF 2433	Rocket Technology	3	
	MKMF 2443	Gas Turbine Technology	3	
	MKMF 2513	Helicopter System & Performance	3	
	MKMF 2613	Aviation Management and Airworthiness	3	
	MKMF 2763	Advanced Manufacturing	3	
Total Credit Value			**40**	**100%**

Program Educational Objectives (PEO)

PEO1: Graduates are able to apply the knowledge gained to identify, develop solution and solve problems related to **aeronautical** engineering in various situations, effectively and ethically.

PEO2: Graduates are able to communicate and present ideas intellectually and effectively.

PEO3: Graduates are able to conduct research, manage and publish information and continue life-long learning

Program Learning Objectives (PLO)

PLO1: Demonstrate advanced knowledge and capabilities to further develop or use these for new situations in **aeronautical** engineering.

PLO2: Demonstrate research skills in appraising available information and research evidence, and applying them in **aeronautical** engineering contexts

PLO3: Apply critical thinking and problem solving skills in addressing **aeronautical** engineering problems utilizing relevant tools and techniques.

PLO4: Perform research on **aeronautical** engineering problems professionally, ethically and responsibly.

PLO5: Communicate technical knowledge and ideas effectively in written and oral forms.

PLO6: Adopt the latest relevant knowledge and technologies through life-long learning.

GRADUATION CHECKLIST

Students must pass all the stated courses in this checklist to graduate. It is the

responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the courses are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
UNIVERSITY GENERAL COURSES					
1	U### ###3	University Course Electives	3	3	
TOTAL CREDIT of UNIVERSITY GENERAL COURSES (a)			3	3	
PROGRAMME CORE COURSES					
1	MKMF 1213	Advanced Mathematics for Aeronautical Engineering Application	3	3	
2	MKMF 1313	Advanced Aerodynamics	3	3	
3	MKMF 2013	Computational Method for Aerostructures	3	3	
4	MKMF 1903	Research Methodology	3	3	
TOTAL CREDIT OF PROGRAMME CORE COURSES (b)			12	12	
MASTER PROJECT COURSES					
1	MKMF 1914	Master Project I	4	4	
2	MKMF 2926	Master Project II	6	6	
TOTAL CREDIT OF MASTER PROJECT COURSES (c)			10	10	
PROGRAMME ELECTIVES (5 COURSES)					
1	MKMF 2##3	Elective 1	3	3	
2	MKMF 2##3	Elective 2	3	3	
3	MKMF 2##3	Elective 3	3	3	
4	MKMF 2##3	Elective 4	3	3	
5	MKMF 2##3	Elective 5	3	3	
TOTAL CREDIT OF ELECTIVES COURSES (d)			15	15	
TOTAL CREDIT TO GRADUATE (a + b + c + d)			**40**	**40**	

COURSE SYNOPSIS

CORE COURSES

MKMF 1213 - Advanced Mathematics for Aeronautical Engineering Applications

This course takes students into a mathematical realm needed by engineers to describe and solve advanced engineering problems. It first introduces Laplace transforms, series and several approximation schemes as tools for solving IVP in ordinary differential equations. The course also lays emphasis on partial differential equations as mathematical models, using wave, heat and potential equations to connect with engineering applications. Complex functions and conformal mappings are also addressed. Vectors and tensors are included to study the analytical geometry of space and extended to paths (lines, planes, surfaces and curves) and motions of objects (velocities and accelerations) moving in a plane or in space, and quantities that describe how an object's path can turn and twist in space.

MKMF 1313 - Advanced Aerodynamics

This course gives a foundation for advanced study in aerodynamics by focusing 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.

MKMF 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.

MKMF 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 engineering problems. After completing the course, students should be able to explain the theoretical and mathematical basis of finite element method and the basic principles in its implementation; interpret real-life engineering problems accurately, analyse them using the finite element method and evaluate the results obtained correctly; design a simple finite element computer program to solve specific problems; display capability to communicate knowledge and ideas effectively; and demonstrate capability for life-long learning and manage information.

ELECTIVE COURSES

MKMF 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.

MKMF 2123 - Structural Dynamics and Aeroelasticity
This course focuses on the dynamic response analysis of aircraft structures especially in interaction with aerodynamic loadings, and covers the theory of structural dynamics, static aeroelasticity and aeroelastic flutter and dynamic responses.

MKMF 2213 - Advanced Aircraft Dynamics and Control
This course is about the dynamics behavior 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 behavior can be demonstrated by using a flight simulator.

MKMF 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.

MKMF 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 modeling.

MKMF 2333 - Compressible Fluid Flow
The student will gain knowledge of the basic elements of compressible flow. Compressible flows are high speed flows in which the fluid velocities are higher compared to the velocity of sound in that fluid, that variations in pressure,

temperature and density are significant. Knowledge of compressible flow fundamentals are essential for understanding supersonic flow (supersonic wind tunnel, gas pipeline), the aerodynamics of high speed aircrafts and other flying objects (aircrafts, rockets, satellites), and flow in gas turbine engines and rocket engines, etc.

MKMF 2343 - Industrial Aerodynamics 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 induce vibration.

MKMF 2353 - Experimental Aerodynamics
Wind-tunnel testing is the traditional tool to determine the aerodynamic forces acting on an aircraft. In this course you will perform a number of tests, mainly to compare computational and experimental results when this is possible, but also to show that experimental methods can be used to determine aerodynamic forces in cases where computational results are inaccurate or impossible to obtain. Theory and application of experimental techniques and instrumentation for aerodynamics and fluid mechanics. Computer data acquisition, wind tunnels, force balances, flow visualization, pressure probes, hot wire anemometry, laser Doppler velocimetry, and turbulence measurements.

MKMF 2363 - Helicopter Aerodynamics
This course dealt with helicopter aerodynamics where contents of learning include the momentum and blade element theory, wake analysis, rotor aerodynamics, aerodynamic design, performance, stability, control and vibration problems of helicopter.

MKMF 2413 - Fuel and Propellant
This course prepares the students to grasp the fundamentals of fuel and propellant, thermochemistry and their applications, the course shall cover the foundations of pyrodynamics, thermochemistry of combustion, energetic propellant and combustion of various fuel and propellant.

MKMF 2423 - Jet Propulsion
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.

MKMF 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.

MKMF 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.

MKMF 2513 - Helicopter System and Performance
This course presents a comprehensive introduction to rotorcraft technology covering a range of disciplines. Student will be exposed to the theory of helicopter flight which is relevant to the helicopter performance as well as systems configuration. Each student will be given a mini project to enhance his/her understanding in the principle work of helicopter technology.

MKMF 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.

MKMF 2763 - Advanced Manufacturing
This course introduces automation and advanced techniques used in the modern manufacturing. Types of automation systems, applications, advantages and disadvantages are discussed. It also includes discussion on the principle of CAD/CAM/CNC and other applications in various manufacturing automation systems such as GT, FMS and CIM. This course will also allow student to carry out small case studies in the real environments for exposing them on certain issues related to manufacturing automation.

Registered as Graduate Engineer with BEM

Students from the ***Technologist Track*** are eligible to be registered as Graduate Engineer with BEM provided they pass the following elective courses:

1. MKMF 2323 Computational Aerodynamics
2. MKMF 2223 Aircraft Instrumentation and Avionics
3. MKMF 2213 Advanced Aircraft Dynamics and Control