MASTER OF ENGINEERING (STRUCTURE)

PROGRAMME SPECIFICATIONS

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

12. Programme Educational Objectives (PEO)

1. Mastery of competencies and integration of knowledge required in the engineering profession.
2. An appreciation of the value of lifelong learning and possessing enthusiasm and strong commitment to continued acquisition of new knowledge and skills.
3. Advanced leadership and team working skills that allow environmental engineers and professionals to become visionary and inspirational leaders.
4. Highly developed oral and written communications skills that fit at all level, appropriate to the
5. field of engineering.
   An appreciation of the ethics and integrity in management, leadership and good governance.

13. Programme Learning Outcomes (PLO)

Code	Intended Learning Outcomes	Teaching and Learning Methods	Assessment
(a)Technical Knowledge and Competencies			
PLO1	**Advanced Knowledge** Graduates are able to incorporate in-depth relevant knowledge in professional practices for the benefits of both national and international communities. Graduates are able to apply their knowledge and skills in the planning, analysis, design and supervision of works related to the civil engineering discipline.	Lectures, seminars, projects, directed reading, tutorials independent study, active learning	Examinations, group and individual project reports, presentations, assignments, problem-based exercises
PLO2	**Research Skills** Graduates are able to formulate hyphothesis, design and perform experiments/research scientifically to solve and explain observed phenomena.	Lectures, seminars, projects, directed reading, tutorials independent study, active learning	Examinations, presentations, assignments, problem-based exercises, project reports, design tasks, simulation exercises
PLO3	**Critical Thinking & Problem Solving** Graduates are able to manage conducive working environment	Computer hands-on sessions, laboratory/field works, lectures, independent study, seminars, active learning,	Examinations, presentations, assignments, problem-based exercises, project reports, design tasks,

	qualities problem solving and higher order thinking skills. Graduate are technically competent in solving problems logically, analytically and creatively based on sound facts and ideas.	projects	simulation exercises
(b) Generic Skills			
PLO4	**Ethics, Values and Professionalism** Graduates are able to balance professional and ethical responsibilities including contemporary issues and environmental awareness.	Pre-Projects and Masters Project, lectures, tutorials, group projects, independent study	Masters Project thesis, project reports, design tasks, examinations, presentations, assignments
PLO5	**Communication** Graduates are able to apply a wide range of relevant knowledge through effective oral and written communication. Graduate are able to communicate effectively across a range of contexts and audiences.	Lectures, tutorials, directed reading, simulation exercises, group project, independent study, problem-based learning, projects	Masters Project thesis, project reports, design tasks, examinations, presentations, assignments
PLO6	**Lifelong Learning** Graduates are able to adopt the latest relevant knowledge and cutting-edge technologies through life-long learning process.	Group projects, independent study, field trips	Oral presentations, project reports

14. Classification of Subjects

No.	Classification	Credit Hours	Percentage
1.	University	6	13%
2.	Programme Core	28	61%
3.	Programme Electives	6	13%
4.	Free Electives	6	13%
	TOTAL	**46**	**100%**

For engineering programme please fill up the following classification. (Others please refer to the Statutory Body guidelines)

A.	Engineering Subjects (a) Lecture/Project/Design studio (b) Masters Thesis Project	 30 10	87%
	Total credit hours for Part A	**40**	
B.	Related Subjects (a) Principle of Engineering Management (b) Research Methodology	 3 3	13%

	Total credit hours for Part B	**6**	
Total Credit Hours for Parts A and B		46	100%
15. Total credit hours to graduate		**46 credit hours**	

16. Programme structures and features, curriculum and award requirements

The course is offered on full-time mode and is based on a 2-Semester Academic Session with several subjects being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester.

Award requirements:
To graduate, students should:
- Attain a total of no less than 46 credit hours with minimum CPA of 3.0.
- Complete and pass the Master Project.

17. Mapping of Programme Learning Outcomes to Subjects

CORE SUBJECTS (24 CREDITS)- CHOOSE 8 SUBJECTS FROM THE LIST OFFERED IN THE MAKE PROGRAM. AT LEAST 2 SUBJECTS MUST BE CHOSEN FROM EACH OF GROUP A, B AND C

CORE & ELECTIVE ENGINEERING SUBJECTS OFFERED (GROUP A- CHOOSE 2 SUBJECTS)		**LEARNING OUTCOME**					
Code	**Course**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
MKAE1013	Advanced Structural Analysis	√		√			√
MKAE1143	Finite Element Method	√	√			√	√
MKAE1163	Theory of Plate and Shell		√				√
MKAE1173	Structural Dynamics	√		√			√
MKAE1133	Advanced Mechanics of Materials	√	√				√
MKAE1203	Structural Reliability	√		√			√
CORE & ELECTIVE ENGINEERING SUBJECTS OFFERED (GROUP B- CHOOSE 2 SUBJECTS)		**LEARNING OUTCOME**					
Code	**Course**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
MKAE1073	Advanced Design of Steel Structures	√		√			√
MKAE1083	Advanced Design of Reinforced Concrete	√					√
MKAE1183	Design of Pre stressed Concrete	√					√
MKAE1193	Design of Precast Concrete	√		√			√
CORE & ELECTIVE ENGINEERING SUBJECTS OFFERED (GROUP C- CHOOSE 2 SUBJECTS)		**LEARNING OUTCOME**					
Code	**Course**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
MKAE1043	Advanced Construction Materials	√					√
MKAE1153	Concrete Technology	√		√			√
MKAE1033	Structural Assessment & Repairs	√		√			√
MKAE1053	Bridge Engineering	√					√
MKAE1093	Offshore Structures	√		√			√
MKAE1023	Analysis and Design of Structural System	√		√			√
MKAE1063	Tall Building System: Analysis and Design	√		√			√
MKAE1113	Earthquake & Wind Engineering	√		√			√
MKAE1123	Maintenance of Seismic Structures and Materials	√		√			√
MKAE1213	Structural Fire Engineering	√		√			√

18. Our Uniqueness

1. No. of graduates
2. Employability rate
3. Leaders in industry
4. Diversity of lecturers
5. Biggest Civil Engineering Faculty in the world
6. One of the biggest Civil Engineering lab/facilities in the region
7. ISO 9001:2000 and ISO 17025 accreditations (the only one in the world for Civil Engineering)

19. Career Prospects and Career Path

Graduates of the programme can work as a Civil Engineer with specialized expert in Structural Engineering.

20. Facilities available
List of laboratories: Structural Engineering Laboratory Material Engineering Laboratory Hydraulics and Hydrology Laboratory Environmental Laboratory Geotechnical Laboratry Highway & Transportation Laboratory Computer Laboratory CETU ITUCE Resource Centre Surveying Unit

CURRICULUM STRUCTURE

University's General Elective Courses(Total : 6 credits)		
UABA0013	Principal Engineering Management	3 credits
UAPA 0013	Research Methodology	3 credits
CORE SUBJECTS (24 CREDITS)- CHOOSE 8 SUBJECTS FROM THE LIST OFFERED IN THE MKAE PROGRAM. AT LEAST 2 SUBJECTS MUST BE CHOSEN FROM EACH OF GROUP A, B AND C		
CORE & ELECTIVE ENGINEERING SUBJECTS OFFERED (GROUP A-CHOOSE 2 SUBJECTS)		
MKAE1013 MKAE1143 MKAE1163 MKAE1173 MKAE1133 MKAE1203	Advanced Structural Analysis Finite Element Method Theory of Plate and Shell Structural Dynamics Advanced Mechanics of Materials Structural Reliability	3 credits 3 credits 3 credits 3 credits 3 credits 3 credits
CORE & ELECTIVE ENGINEERING SUBJECTS OFFERED (GROUP B-CHOOSE 2 SUBJECTS)		

MKAE1073 MKAE1083 MKAE1183 MKAE1193	Advanced Design of Steel Structures Advanced Design of Reinforced Concrete Design of Pre stressed Concrete Design of Precast Concrete	3 credits 3 credits 3 credits 3 credits
CORE & ELECTIVE ENGINEERING SUBJECTS OFFERED (GROUP C-CHOOSE 2 SUBJECTS)		
MKAE1043 MKAE1153 MKAE1033 MKAE1053 MKAE1093 MKAE1023 MKAE1063 MKAE1113 MKAE1123 MKAE1213	Advanced Construction Materials Concrete Technology Structural Assessment & Repairs Bridge Engineering Offshore Structures Analysis and Design of Structural System Tall Building System: Analysis and Design Earthquake & Wind Engineering Maintenance of Seismic Structures and Materials Structural Fire Engineering	3 credits 3 credits 3 credits 3 credits 3 credits 3 credits 3 credits 3 credits 3 credits 3 credits
Free Elective Courses (Total : 6 credits)		
Choose any two subjects offered by other programmes, faculties or from the above elective subjects		6 credits
Masters Project (Total : 10 credits)		
MKAE1514 MKAE1526	Masters Project 1 Masters Project 2	4 credits 6 credits
TOTAL CREDITS		**46 credits**
Duration of Study		
Full Time	:	3 – 8 semester

COURSE SYNOPSIS

MKAE 1013 - Advanced Structural Analysis

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

MKAE 1143 - Finite Element Method

This is an elective subject for Masters programme delivered by coursework. This course is developed to expose students to the fundamental theory and application of the finite element method. The course covers linear analyses for

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

MKAE 1163 - Theory of Plate and Shell
This course exposes the students to the analyses of plate-bending structures and shell structures. Two approaches in the theory of plates will are discussed - classical methods and finite difference method. Only elastic property of plate's material is considered. The theory is applied to analyse various shape plate structure such as rectangular and circular plates. In the theory of shells, students will learn about the membrane theory of spherical and cylindrical shells and the bending theory of cylindrical shells. In each topic, students will be given a number of work examples where the above theories can be applied.

MKAE 1173 - Structural Dynamics
The topic in structural dynamics course covers introduction, natural frequency, single degree of freedom, multi-degree of freedom system, Eigenvalues and Eigenvectors, free vibration response as well as time and frequency domain. Students will further, be exposed to experiment under the free vibration topic. At the end of the course the students should be able to solve numerous problems which involves dynamics. The students will also be able to develop and master the skills of reducing problems from its physical description to a model or symbolic representation to which the principles may be applied.

MKAE 1133 - Advanced Mechanics of Materials
This course concerns with the tensorial approach for solid mechanics, which is more general as compared to the strength of material approach previously discussed at the undergraduate level. This course is designed to discuss the theories of elasticity and to provide the mathematical background for finite element applications. The course begins with the discussion of the basic concepts in elasticity covering tensors notations, analysis of stress and strain, as well as the constitutive equations. At the end of the course, students should be able to understand multidimensional states and analyses through the ability to utilize the compact notations of tensors.

MKAE 1203 - Structural Reliability
This course aims to give students a comprehensive exposure to structural

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

MKAE 1073 - Advanced Design of Steel Structures

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

MKAE 1083 - Advanced Reinforced Concrete Design

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

MKAE 1183 - Design of Pre stressed Concrete

This is an elective subject, which will provide students an understanding and ability to analyse and design prestressed concrete structural elements. Topics

discussed include the concept and principles of prestressed, methods of prestressing, stress limits, losses of prestress, selection of section, serviceability and strength requirements. Students will also be exposed to the complete analysis and design procedure of simply supported prestressed concrete non-composite and composite beams, and design principles of continuous beams.

MKAE 1193 - Design Precast Concrete

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

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

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

MKAE 1043 - Advanced Construction Materials

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

MKAE 1153 - Concrete Technology

This course is designed for students to gain knowledge on advanced concrete technology in Civil Engineering. It will emphasize of materials properties and various mix proportions of concrete, different types of supplementary cementing materials, special concretes including high performance concrete, high strength concrete, lightweight concrete, flowable concrete, self-consolidating concrete, and polymer concrete, concrete deformations, durability aspects of concrete, causes of concrete deterioration and repair techniques, and developments in current concrete technology. At the end of

the course students should be able to describe, identify, and discuss the properties and behaviour of different types of concrete materials together with the selection and applications of the materials in practice. In addition, students should also understand the current trend in concrete technology.

MKAE 1033 - Structural Assessment & Repairs
This is a core subject that provides an understanding and ability to visualize and analyze the causes of distress in structures, to confirm the causes of distress and able to suggest most suitable repair methods. Among the topics discussed are types and causes of distress in structures, corrosion - mechanism, assessment and repair, methods of testing of structures, semi-destructive and non destructive testing, strength assessment technique, durability assessment techniques, integrity assessment techniques, static and dynamic load testing instrumentation and procedures, repair strategy and techniques, repair material selection, strengthening techniques, post repair assessment, structural health monitoring, risk based inspection (RBI), structural reliability theory, risk analysis, monte carlo simulation modelling, probabilistic evaluation of existing structure, case studies. An introduction to forensic engineering and related case studies are also discussed.

MKAE 1053 - Bridge Engineering
This is an elective course intended to give the basic knowledge in bridge engineering. The course covers topics on basic bridge conception, structural system, bridge loading, deck analysis, selection and design of bridge substructure and superstructure, bridge management and maintenance and rehabilitation. The main part of the course focuses on the modelling, analysis and design of various types of concrete bridges. Application of design loads and load combinations based on EN 1991-2 is delivered in the grillage analysis using finite element software.

MKAE 1093 - Offshore Structures
This course emphasizes on the important principles of analysis, design and construction practices of marine structural engineering related to oil and gas industry. Marine structures include oil and gas production platform and pipeline system. The course covers vast amount of structural and material engineering topics such as Front-End Engineering Design (FEED), Environmental Loads, Response of Structures to Environmental Loading, Analysis and Design of Oil and Gas Production Platforms, Analysis and Design of Offshore Topside Modules, Components of Oil Rig Platform, Construction of Steel Platforms, Load-out and Installation Procedure, Hook-up and Commissioning of Offshore Structures, Inspection and Repair, Structural Assessment of Existing Structures, Removal of Disused Structures and Pipeline Engineering Introduction to Reliability Engineering to expose student to fundamental concept of structure reliability, risk and structure maintainability.

MKAE 1023 - Analysis and Design of Structural System
This is an elective subject for Masters programme delivered by coursework. The

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

MKAE 1063 - Tall Building System: Analysis and Design

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

MKAE 1113 - Earthquake & Wind Engineering

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

MKAE 1123 - Maintenance of Seismic Structures and Materials

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

MKAE 1213 - Structural Fire Engineering

This course emphasizes on specific fire behavior in buildings and introduces simple methods of quantifying the threat it poses to structures. This will involve the fire behavior, fire safety, fire hazard, management fire in building and estimating the temperatures in building compartments and the temperatures that individual structural members get exposed to as a function of time. Fundamentals of the behaviour of common construction materials and estimation of the variation of mechanical properties of construction materials affected by fire (i.e. temperature rise). Structural analysis principles are then applied to the fire problem. Simple methods to carry out calculations to determine structural behaviour in the event of a fire will be presented followed by an introduction to advanced analytical and computational tools for analysing structural behaviour in fire. Introduction to current (code based) design procedures and performance based design and assessment and repair of fire-damaged structures will be provided