MASTER OF ENGINEERING (GEOTECHNICS)

PROGRAMME SPECIFICATIONS

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

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 field of engineering.
5.	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	Lectures, seminars, projects, directed reading, tutorials independent study, active learning	Examinations, group and individual project reports, presentations, assignments, problem-based exercises

	planning, analysis, design and supervision of works related to the civil engineering discipline.		
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 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.	Computer hands-on sessions, laboratory/field works, lectures, independent study, seminars, active learning, projects	Examinations, presentations, assignments, problem-based exercises, project reports, design tasks, 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 Lecture/Project/Design studio Master Thesis Project	 30 10	87%
	Total credit hours for Part A	40	
B.	Related Subjects Management/Law/Humanities/Ethics	 6	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 & ELECTIVE ENGINEERING SUBJECTS OFFERED		LEARNING OUTCOME					
Code	Course	PO1	PO2	PO3	PO4	PO5	PO6

Core Course							
MKAJ 1013	Advanced Soil Mechanics	√	√	√			
MKAJ 1023	Advanced Geotechnical Analysis and Design	√		√	√		
MKAJ 1033	Advanced Foundation Engineering	√		√		√	
MKAJ 1043	Slope Engineering	√		√		√	
MKAJ 1073	Advanced Rock Mechanics and Engineering Geology	√		√		√	√
MKAJ 1103	Geological Engineering and Environmental Hazard	√		√	√		
MKAJ 1514	Master Project 1	√	√	√	√	√	√
MKAJ 1526	Master Project 2	√	√	√	√	√	√

CORE & ELECTIVE ENGINEERING SUBJECTS OFFERED		LEARNING OUTCOME					
Code	Course	PO1	PO2	PO3	PO4	PO 5	PO6
Elective Course							
MKAJ 1053	Advanced Software Application in Geotechnical Engineering	√		√		√	
MKAJ 1083	Environmental Geotechnics	√		√			
MKAJ 1093	Unsaturated Soil Mechanics	√		√			
MKAJ 1113	Tunnel Engineering	√		√			

18. Our Uniqueness

No. of graduates
Employability rate
Leaders in industry
Diversity of lecturers
Biggest Civil Engineering School in the world
One of the biggest Civil Engineering lab/facilities in the region

19. Career Prospects and Career Path

Graduates of the programme can work as a Project Engineer, Construction Engineer or Geotechnical Engineer.

20. Facilities available

List of laboratories:
Geotechnical Laboratory
Geology Laboratory
Computer Laboratory
Surveying Unit

CURRICULUM STRUCTURE

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

COURSE SYNOPSIS

CORE COURSES

MKAJ 1013 - Advanced Soil Mechanics

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

MKAJ 1023 - Advanced Geotechnical Analysis and Design

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

MKAJ 1033 - Advanced Foundation Engineering

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

MKAJ 1043 - Slope Engineering

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

MKAJ 1073 - Advanced Rock Mechanics & Engineering Geology

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

MKAJ 1103 - Geological Engineering and Environmental Hazard

Geological Engineering and Environment is concerned with the applications of geological knowledge to the siting, design, construction, operation and maintenance of civil engineering structures and facilities. It is one of the rapidly growing fields of engineering reflecting society's developing interest in the stewardship of the environment, managing risk, and creating a safer

world. The field of Geological Engineering and Environment encompasses a wide range of activities including the geological characterization of complex foundations of major buildings and structures, development of natural resources, groundwater, the engineering safety of major infrastructure, geohazard and environment. Geological Engineering and Environment is an attractive discipline for students who wish to pursue the challenge of combining the complexity of nature and engineering design, who are interested in the physical mechanics of the earth's surface and subsurface. Students are also enlightened on the importance of geological environments on various construction works and understanding the characteristics and behavior of geological elements.

ELECTIVE COURSE

MKAM 1033 – Construction Technology

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

MKAJ 1053 - Software Application in Geotechnical Engineering

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

MKAJ 1063 – Geotechnical Earthquake Engineering

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

MKAJ 1083 - Environmental Geotechnics

This course introduces environmental awareness with respect to geotechnical engineering amongst civil engineering students. The topics covered in the course include characterization and regulatory requirements for disposal of hazardous and non-hazardous solid wastes (site selection, geo-environmental/site investigation); Liner types, materials (clay liners, geosynthetics and amended soils or composite materials) and their properties; leakage

through liners; design of leachate collection systems; contaminant transport modeling; effects of pollutants on soil properties and behavior; and remediation methods for contaminated soils.

MKAJ 1093 – Unsaturated Soil Mechanics

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

MKAJ 1113 - Tunnel Engineering

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