MASTER OF SCIENCE (DATA SCIENCE)

PROGRAMME SPECIFICATIONS

The Master of Science, Field: Data Science is offered on a full-time basis. The full-time programme is offered at the UTM Main Campus in Johor Bahru. The duration of study for the full-time programme is subjected to the student's entry qualifications and lasts between one and half (1 1/2) years to a maximum of four (4) years.

The programme is offered on full-time basis and is based on a 2-Semester per academic session. This is a coursework programme. In this programme, the candidate will learn not only to apply data science, but they will acquire insight into how and why methods work so they will be able to construct solutions to new challenges in data science. Furthermore, student will also be able to work on problems specific to a scientific discipline and to combine knowledge domain with the latest data analysis methods and tools.

General Information

1. Awarding Institution	Universiti Teknologi Malaysia
2. Teaching Institution	Universiti Teknologi Malaysia
3. Programme Name	Master of Science (Data Science)
4. Final Award	Master of Science (Data Science)
5. Programme Code	MCSDA1AJA
6. Professional or Statutory Body of Accreditation	*Malaysian Qualification Agency (MQA)*
7. Language(s) of Instruction	English and Bahasa Melayu
8. Mode of Study (Conventional, Distance Learning, etc)	Conventional
9. Mode of Operation (Franchise, Self-govern, etc)	Self-governing
10. Study Scheme (Full Time/Part Time)	Full Time
11. Study Duration	Minimum : 1 year 6 months (3 semesters) Maximum : 4 years (8 semesters)

Type of	No. of Semesters	No of Weeks/Semesters

Semester	Full Time	Part Time	Full Time	Part Time
Normal	3	-	8	-
Short		-		-

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses	3	6.66%
ii.	Core Courses	21	46.67%
iii.	Elective Courses	9	20.00%
iv.	Master Project	12	26.67%
	Total	**45**	**100%**
	Total Credit Hours to Graduate	**45 credit hours**	

COURSE MENU

SYLLABUS	SEM 1	SEM 2	SEM 3	TOTAL
University Elective Course			UHAP 6013 UHAW 6023 UCSM 1263 UHAZ 6123	3
Faculty Compulsory Courses	MCDS 1113 MCDS 1013 MCDS 1123 MCDS 1043 MCDS 1053	MCDS 2123 MCDS 2213		21
Faculty's Elective Courses	MCDS 1123	MCDS 1133/ MCDS 1143	MCDS 1153	9
Master Project		MCDS 6215	MCDS 6227	12
Total Credits	**18**	**14**	**13**	**45**

Programme Educational Objectives (PEO)

The aim of the program is to produce data scientists with advanced knowledge and skills in the field of analytic, data architecture and the intelligence of data integration leading to big data. To meet this goal, after 3 to 5 years of graduates, the program graduates will be able to:

Code	Intended Educational Objectives

PEO1	Able to demonstrate academic and technological excellence as data professional leaders or technical key players that can make or assist decision making based on data-driven evolution.
PEO2	Able to be active researchers, innovators and/or consultants in the area of data science and data analytics.
PEO3	Able to be data experts that can leverage full potential of data using appropriate technologies in different fields in the era of 4th Industrial Revolution.
PEO4	Able to consistently perform responsibilities professionally and ethically as data scientists, data analysts or other given jobs, and can communicate effectively as leaders or members of multi-disciplinary teams.

Programme Learning Outcomes (PLO)

This Master of Science (Data Science) programme offers learning outcomes that cumulatively reflects eight (8) learning outcomes based on MQF (2007, Paragraph 15) and the Programme Standards for Computing. Graduates from this programme will be able to:

Code	Intended Learning Outcomes
PLO1	Able to use advanced knowledge in data science and analytics to formulate solution for big data problem.
PLO2	Able to apply methods in data science for analyzing, modeling and proposing solution to solve voluminous structured and unstructured data in complex environment.
PLO3	Able to extrapolate data using advanced analytic methods to solve real world problem with data driven decisions.
PLO4	Able to disseminate data analytics information in ethical manner.
PLO5	Able to communicate the outcomes of data analytics and visualization to a wide range of audience for better decision making.
PLO6	Able to continuously digest, manage and integrate current data science knowledge and analytic skills through the lifelong learning process.
PLO7	Able to demonstrate behaviour that potrays social responsibility in conducting project to solve data driven problems in real-world.

PLO8	Able to work cooperatively with all internal and external stakeholders to solve data driven problems in real-world.

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.

University Common Elective (Choose 1 course)		Credit
UHAP 6013	Seminar on Global Development, Economics and Social Issues	3
UHAW 6023	Philosophy of Science and Civilization	3
UCSM 1263	IT Project Management	3
UHAZ 6123	Malaysian Society and Culture	3
Core Subject (Compulsory)		
MCDS 1013	Business Intelligence and Analytics	3
MCDS 1043	Research Design and Analysis in Data Science	3
MCDS 1053	Data Science Governance	3
MCDS 1113	Statistic for Data Science	3
MCDS 1123	Big Data Management	3
MCDS 2123	Massive Mining and Streaming	3
MCDS 2213	Advanced Analytics for Data Science	3
Elective Subject (Choose 3 courses)		
MCDS 1103	Computational Data Visualization	3
MCDS 1123	Big Data Computing	3
MCDS 1133	Operational Research and Optimization	3
MCDS 1143	Supply Chain Analytic	3
MCDS 1153	Human Based Computing	3
Master Projects		
MCDS 6215	Master Project I	5
MCDS 6227	Master Project II	7
Total		45

COURSE SYNOPSIS

CORE COURSES

MCDS1013 - Business Intelligence and Analytics

Business analytics refers to the ways in which enterprises such as businesses, non-profits and governments can use data to gain insights and make better decisions. Business analytics is applied in operations, marketing, finance and strategic planning among other functions. The ability to use data effectively to drive rapid, precise and profitable decision has been critical strategic

advantages for companies. With the increasing availability of broad and deep sources of information-so called "Big data"-business analytics are becoming an even more critical capability for enterprises of all types and all sizes. It combines statistical analysis and predictive modelling to identify trends and understand the information that can drive business change and support sustained successful business practices.

MCDS1043 - Research Design and Analysis in Data Science

This course will cover the fundamental steps and implementation on developing the initial ideas to formal academic writing accordingly. Students will be given the mechanisms on how to transform and digest the literature reviews that leads to the proposed title. The theoretical and practical aspects of implementing draft project proposal will be the milestone of this course. Ordered, Critical and Reasoning Exposition of knowledge through student efforts.

MCDS1053 - Data Science Governance

Data governance is a mandatory requirement for a successful organization which aims to achieve master data management, build business intelligence, improve data quality or manage documents. This course provides an overview of the data governance lifecycle. Students will learn why data governance is needed, how to design, initiate, and execute a program and how to keep the program sustainable. The big data management will be explored for the best practice in managing and manipulating large amount of data. At the end of the course, students should be able to understand the management and governance of big data.

MCDS1113 - Statistic for Data Science

This course provides a fundamental concept in statistics for data science. Students will learn statistical inference including estimation, hypothesis testing and nonparametric tests. Further, students will be introduced to Bayesian inference, linear regression and classification. R will be used to apply these statistical methods. At the end of the course, students should be able to apply the statistical methods to real large data sets.

MCDS1123 - Big Data Management

This course provides a basic fundamental of big data architecture and management. Students will learn the big data processes and the current big data technologies that are available. Further, students will be exposed to the big data platform ecosystem for big data manipulation. The big data management will be explored for the best practice in managing and manipulating large amount of data. At the end of the course, students should be able to understand the architecture and management of big data and also can develop simple application of big data handling using particular platform in assignment.

MCDS2123 - Massive Mining and Streaming

This course aims to introduce students to basic principles and methods of machine learning algorithms that are typically used for mining large data sets. This course also will provide students with the skill and knowledge to build system and capable of analyzing huge amount of data. It explains the principle of distributed file systems and shows map reduce as a tool for creating parallel algorithms. Typically, it covers the algorithms that used for analyzing networks, fundamental principles of techniques such as decision trees and support vector machines and finally neural network architecture. The students will gain practical understanding through a coding exercise where they will implement and apply one machine learning algorithm on a particular large dataset.

MCDS2213 - Advanced Analytics for Data Science

This course provides a solid or advanced understanding on the use of analytics approach in the examination of data or content to discover deeper insights, make predictions or generate recommendations using sophisticated techniques and tools on real world problems. Students will learn descriptive analytics using advance tools to gain insight into the past. Students will also acquire understanding of predictive analytics using statistical and machine learning techniques to understand future outcome. The prescriptive analytics provides knowledge in simulation and optimization to quantify the effect of future decision to advise possible outcomes before decision is made. The analytical abilities to be acquired by students in this course are to reliably select analytic techniques or method and specify steps involve in the analysis process and to interpret analytically the results obtained from data analytics techniques or tools. At the end of the course, students should be able to implement and apply the knowledge on analytical techniques or tools in real world problems and able to make an informed decisions or recommendation through analytical interpretations of results.

ELECTIVE COURSES

MCDS1103 - Computational Data Visualization

This course is an introduction to the principles and techniques for visualization to transform and model the large datasets to aid knowledge discovery and decision making. Students will learn the principles, techniques, practical skill necessary to communicate information about data clearly and effectively through data visualization. Further, students will expose to techniques for acquire, parse, analyzing and visualizing different types of data including multivariate, temporal, text-based, spatial, hierarchical, and network/graph-based data. Additionally, students will utilize *D3*, *R* and *ggplot2*, and many other tools to visualize the dataset. At the end of the course students should be able to implement and apply the theory and use tools to communicate information out of the data clearly and effectively through graphical means.

MCDS1123 - Big Data Computing

This course is designed to be suitable for an introductory course at master levels. This course covers intensive exploration on GPU computing with CUDA

programming. The foundations of the CUDA programming will be addressed in terms of the concept, design, architecture and programming model to deal with the needs of big data computing. Students will also be exposed to the current needs of big data era in which the big data computing accessory will be given especially on the implementation of high-performance computing in executing GPU Machine Learning Library (GPUMLib).

MCDS1133 - Operational Research and Optimization

The aim of the course is to introduce students to some applications of data science that can be formulated and solved by operational research and optimization techniques. Students will learn the theory and how to practice it for modeling (formulate, analyze and solve) optimization problems arising in data intensive environments. Further, students will be exposed to use appropriate operational research or optimization software such as R programming, Python to solve formulated data science problem. At the end of the course, students should be familiar with literature of operational research and optimization for data science.

MCDS1143 - Supply Chain Analytics

The course aims to improve operational efficiency and effectiveness by enabling data-driven decisions at strategic, operational and tactical levels. The student will able to perform analysis using data analytics methods and analytical tools necessary in the areas of predictive, descriptive and prescriptive analytics to efficiently manage demand and supply networks. Through the analysis and discussion of case studies they will discover business insights in order to optimize the value of supply chain processes and operations. The topics covered including designing the supply chain network, planning demand and supply in a supply chain, retail analytics, inventory management and transport analytics. Software packages such as R, Python and Tableau will be utilized.

MCDS1153 - Human-based Computing

This course offers students a new perspective on the study of human biological systems to human computing system. This course will emphasis on the theoretical of human computing aspect which includes dendrite, immune, membrane and cell computing. The fundamental concept of this course will be designed to come out with algorithmic computing based for solving meta complex data in chaotic environment.

UNIVERSITY COURSES

UHAP6013 - Seminar on Global Development, Economics and Social Issues

Discussion on this subject includes issues related to globalization and development, economic and social crisis that has become a global concern. It aims in developing skills in understanding and analyzing global issues and recommending relevant solutions. Issues will be discussed in detail.

UICW6023 - Philosophy of Science and Civilization

This course is offered to international students in advanced scholar and doctoral programs from Malay societies such as Indonesia, Brunei, South Thailand and Malay-Singapore. This course contains two sections. This subject discusses the world view of its role and importance in shaping the culture of life and civilization; The concepts of revelation, science, humanity, nature and happiness; and Comparative Studies in the Philosophy of Science: Epistemology, Ontology and Axiology in Education. Discussions on current issues and challenges, among others; the challenge of civilization between the West and the East; Development and the environment; Economy and trade; National administration and management; Scientific research; Communication and information technology; Ethics and morals; Crime and violence; and Family education.

UCSM1263 - IT Project Management

This course presents a hands-on perspective to Information Technology Project Management. This course will assist postgraduate students to plan and implement their postgraduate projects as well as other IT projects effectively. The subject is organized into three main sections, that covers I) Basic concepts, life cycle and framework of project management II) Detailed description of each project management knowledge areas under the Project Management Institute (PMI) Body of Knowledge (PMBOK) and its applications, and III) Real Project Initiation, Planning, Executing, Monitoring and Closing. The Project Management areas include – project integration, scope, time, cost, quality, human resource, communications, risks and procurement management. Students are expected to perform real projects with teams and achieve agreed Key Performance Indicators (KPI).

UHAZ6123 - Malaysia Society and Culture

This course is designed for international postgraduates from countries of non-Malay origins. Students will be exposed to various aspects of the Malaysian culture such as belief system, religious festivals, customs and etiquettes of different ethnic groups in Malaysia. Emphasis will be given to the Malay culture as it makes the core for the *Dasar Kebudayaan Kebangsaan*. Students will also be briefly introduced to basics of Malay language as the national language of Malaysia.

MASTER PROJECT

MCDS6215 - Master Project 1

This is the initial part of a 2-part Master project that every student must fulfill successfully. Students are required to propose a suitable research topic under the supervision of a lecturer as a supervisor. Students must meet regularly with supervisor who will monitor their continuous progress. At the end of this course, students are required to prepare a report and present their proposal.

MCDS6227 - Master Project 2
This is the second part of a 2-part Master project that every student must fulfill successfully. In this phase, students are required to execute the next phases of their development plan from Part 1 (Project 1). Students are now required to code and integrate the different modules that make up the proposed project. Students will test the developed modules and the final fully-integrated project following programming code development and research testing practices. Students must meet regularly with supervisor(s) who will monitor their continuous progress. Students are required to prepare a report and present their final work.