SC

SCHOOL OF
COMPUTING

# POSTGRADUATE HANDBOOK

## ACADEMIC SESSION 2021/2022

**DOCTOR OF PHILOSOPHY**
**FIELD: COMPUTER SCIENCE**

**PROGRAMME SPECIFICATIONS**

The Doctor of Philosophy, Field: Computer Science is offered on a full-time basis. The programme is offered only at the UTM Main Campus in Johor Bahru. The duration of study for the programme is subjected to the student's entry qualifications and lasts between three (3) years to a maximum of six (6) years.

The programme is offered on full-time only and are based on a 2-Semester per academic session. This is a full research programme. The candidate is supervised by a qualified academic staff. The directed research work introduces candidates to the process by which new knowledge is developed and applied accordingly. Assessment is done by examining first assessment reports (research proposal), each semester's progress reports, and thesis examination (viva-voce).

**General Information**

| 1. **Awarding Institution** | **Universiti Teknologi Malaysia** |
|---|---|
| 2. Teaching Institution | Universiti Teknologi Malaysia |
| 3. Programme Name | Doctor of Philosophy in Computer Science |
| 4. Final Award | Doctor of Philosophy in Computer Science |
| 5. Programme Code | PCSSA2AJA |
| 6. Professional or Statutory Body of Accreditation | Ministry of Higher Education |
| 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 Scheme | Full Time |
| 11. Study Duration | Minimum : 6 semesters<br>Maximum:12 semesters |

| Type of Semester | No. of Semesters | | No of Weeks/Semester | |
|---|---|---|---|---|
| | **Full Time** | **Part Time** | **Full Time** | **Part Time** |
| Normal | 6 | - | 12 | - |
| **Short** | - | - | - | - |

**Course Classification**

| No. | Classification | Credit Hours | Percentage |
|---|---|---|---|
| i. | University Courses | 3 | 100% |
| ii. | Core Courses | 0 | 0% |
| iii. | Research | 0 | 0% |
| | **Total** | **3** | **100%** |
| **Total Credit Hours to Graduate** | | **3 credit hours** | |

## COURSE MENU

Doctor of Philosophy students are required to register and pass the following courses before their first assessment (proposal defense).

   i.    Research Methodology course (course code UCSP0010).

   ii.   One University Elective Course (course code U*** ***3).

| YEAR 1: SEMESTER 1 | | | |
|---|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| UCSM1263 | IT Project Management | | |
| UHAP6013 | Seminar on Development, Economics and Global | 3 | |
| UICW6023 | Philosophy Science and Civilization | | |
| UHAZ6123 | Malaysian Society and Culture | | |
| UCSP0010 | Research Methodology | 0 | |
| PCSS1100 | * Research | 0 | |
| | **TOTAL CREDIT** | **3** | |
| | **CUMULATIVE CREDITS** | **3** | |

| YEAR 1: SEMESTER 2 | | | |
|---|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| PCSS1200 | * Research | 0 | |
| | **TOTAL CREDIT** | 0 | |
| | **CUMULATIVE CREDITS** | 3 | |

* Research (course code PCSS**00), to be taken every semester until the submission of thesis. The progress of a candidate in any semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website http://spsapp3.utm.my:8080/gsmsv4/.

**RESEARCH CODE**

| Semester | Research Course Code |
|----------|---------------------|
| 1 | PCSS1100 |
| 2 | PCSS1200 |
| 3 | PCSS2100 |
| 4 | PCSS2200 |
| 5 | PCSS3100 |
| 6 | PCSS3200 |
| 7 | PCSS4100 |
| 8 | PCSS4200 |

**Programme Educational Objectives (PEO)**

This programme is aimed to produce computer science experts who have a skill and knowledge to apply and research the state-of-the-art computer science techniques, methods and tools. These skills are important to support a research and development towards the development of a novel computer science solution(s), either for local use or export that can generate national income.

After having exposed to a number of years working experience, our graduates should become professionals who demonstrate the following competencies:

| Code | Intended Educational Objectives |
|------|--------------------------------|
| PEO1 | Competent in computer science and digital technologies that foster research and development of new knowledge in specific areas. |
| PEO2 | Has good character, ethics and high integrity and demonstrate behavior that is consistent to professional ethics. |
| PEO3 | Has promote the technological, social and cultural progress in a knowledge based society in the academic and professional contexts. |

**Programme Learning Outcomes (PLO)**

After having completed the programme, graduates should be able to demonstrate the following competencies:

| Code | Intended Learning Outcomes |
|------|---------------------------|
| PLO1 | Ability to identify various computer science theories suitable for particular research context, and justify and verify the proposed solution using computer science theories creatively |
| PLO2 | Ability to conduct computer science research in a systematic and scientific way independently |
| PLO3 | Ability to give suggestion on computer science solutions to the society |
| PLO4 | Ability to demonstrate behaviour that is consistent with the Code of Professional Ethics and Responsibilities |
| PLO5 | Ability to defend critically technical solutions and research findings to a range of audience orally and in writing |
| PLO6 | Ability to identify and analyse real problems critically related to organisational, governmental and social |
| PLO7 | Ability to undertake lifelong learning and actively participate in change |
| PLO8 | Ability to turn ideas into innovative computer science solution to meet the real world needs |

**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.

| NO. | CODE | COURSE | CREDIT EARNED (JKD) | CREDIT COUNTED (JKK) | TICK (√) IF PASSED |
|---|---|---|---|---|---|
| **CORE COURSES (0 CREDITS)** | | | | | |
| 1 | UCSP0010 | Research Methodology | 0 | 0 | |
| **TOTAL CREDIT OF CORE COURSES (a)** | | | **0** | **0** | |
| **UNIVERSITY ELECTIVE COURSES** | | | | | |
| 1 | UCSM1263 | IT Project Management | 3 | 3 | |
| | UHAP6013 | Seminar on Development, Economics and Global | | | |
| | UICW 6023 | Philosophy Science and Civilization | | | |
| | UHAZ 6123 | Malaysian Society and Culture | | | |
| **TOTAL CREDIT of UNIVERSITY GENERAL COURSES (b)** | | | 3 | 3 | |
| **TOTAL CREDIT TO GRADUATE (a + b)** | | | 3 | 3 | |
| **RESEARCH** | | | | | |
| 1 | Hard-Bound Thesis endorsed by supervisor – 3 copies | | | | |
| 2 | Copy of CD for Each Thesis – Extra 1 unit | | | | |
| 3 | Copy of All Semester Results (Pre-Transcript) | | | | |
| 4 | Copy of Registration Slip (current semester) | | | | |
| 5 | Abstract and Title Page Approval Form (original copy) | | | | |
| 6 | Course Checklist (endorsed by coordinator) | | | | |
| 7 | Copy of IC (local student) / first page of Passport (international student) | | | | |
| 8 | Fee Release Letter (UTM Bendahari) | | | | |
| 9 | Exit Survey | | | | |
| 10 | Submission of Thesis Form – 3 copies | | | | |
| 11 | Verification of Graduate Information Form – 1 copy | | | | |

**COURSE SYNOPSIS**

**CORE COURSES**

**UCSP0010 - Research Methodology**
This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Amongst topics that will be covered are introduction to research and its philosophy, problem formulation and research objective, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

**UNIVERSITY ELECTIVE COURSES**

**UCSM 1263 - IT Project Management**
This course presents a hands-on perspective to Information Technology project management. This course will assist post-graduate students to plan and implement their post-graduate 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)

**UHAP 6013 - Seminar on Development, Economics and Global**
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 details.

**UICW 6023 - Philosophy 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.

**UHAZ 6123 - Malaysian 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.

**DOCTOR OF PHILOSOPHY**
**FIELD: INFORMATICS ENGINEERING**

**PROGRAMME SPECIFICATIONS**

The Doctor of Philosophy, Field: Informatics Engineering is offered on a full-time basis. The full-time programme is offered only 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 three (3) years to a maximum of eight (8) years.

The programme is offered on full-time basis and is based on a 2-Semester per academic session. This is a full research programme. The candidate is supervised by a lecturer. The directed research work introduces candidates to the process by which new knowledge is developed and applied accordingly. Assessment is done by examining first assessment reports (research proposal), each semester's progress reports, and thesis examination (viva-voce).

**General Information**

| | | |
|---|---|---|
| 1. | **Awarding Institution** | **Universiti Teknologi Malaysia** |
| 2. | Teaching Institution | Universiti Teknologi Malaysia |
| 3. | Programme Name | Doctor of Philosophy |
| 4. | Final Award | Doctor of Philosophy |
| 5. | Programme Code | PCSIA3AJA |
| 6. | Professional or Statutory Body of Accreditation | Ministry of Higher Education |
| 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 Scheme | Full Time |
| 11. | Study Duration | Minimum : 6 semesters Maximum:12 semesters |

| Type of Semester | No. of Semesters | | No of Weeks/Semester | |
|---|---|---|---|---|
| | **Full Time** | **Part Time** | **Full Time** | **Part Time** |
| Normal | 6 | - | 12 | - |
| **Short** | - | - | - | - |

**Course Classification**

| No. | Classification | Credit Hours | Percentage |
|-----|----------------|--------------|------------|
| i. | University Courses | 3 | 100% |
| ii. | Core Courses | 0 | 0% |
| iii. | Research | 0 | 0% |
| | **Total** | **3** | **100%** |
| **Total Credit Hours to Graduate** | | **3 credit hours** | |

## COURSE MENU

Doctor of Philosophy students are required to register and pass the following courses before their first assessment (proposal defense).

iii. Research Methodology course (course code UCSP0010).
iv. One University Elective Course (course code U*** ***3).

| YEAR 1: SEMESTER 1 | | | |
|-----|-----|-----|-----|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| UCSM1263 | IT Project Management | | |
| UHAP6013 | Seminar on Development, Economics and Global | 3 | |
| UICW 6023 | Philosophy Science and Civilization | | |
| UHAZ 6123 | Malaysian Society and Culture | | |
| UCSP0010 | Research Methodology | 0 | |
| PCSI 1100 | *Research | 0 | |
| | **TOTAL CREDIT** | **3** | |
| | **CUMULATIVE CREDITS** | **3** | |

| YEAR 1: SEMESTER 2 | | | |
|-----|-----|-----|-----|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| PCSI 1200 | * Research | 0 | |
| | **TOTAL CREDIT** | 0 | |
| | **CUMULATIVE CREDITS** | 3 | |

* Research (course code PCSI **00), to be taken every semester until the submission of thesis. The progress of a candidate in any semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website http://spsapp3.utm.my:8080/gsmsv4/.

**RESEARCH CODE**

| Semester | Research Course Code |
|----------|---------------------|
| 1 | PCSI 1100 |
| 2 | PCSI 1200 |
| 3 | PCSI 2100 |
| 4 | PCSI 2200 |
| 5 | PCSI 3100 |
| 6 | PCSI 3200 |
| 7 | PCSI 4100 |
| 8 | PCSI 4200 |

**RESEARCH AREAS**

- Information Systems Application and Development
- Information Retrieval
- Data Mining and Knowledge Discovery
- Text Mining and Sentiment Analysis
- Web Mining
- Natural Language Processing
- Information and Knowledge Management
- Database Management
- Business Intelligence Application and Development
- Data Engineering
- Social Media Analytics
- Enterprise Information Systems

**Programme Educational Objectives (PEO)**

This programme is aimed to produce computer science experts who have a skill and knowledge to apply and research the state-of-the-art computer science and informatics techniques, methods and tools. These skills are important to support a research and development towards the development of a novel informatics & computer science solution(s), either for local use or export that can generate national income.

After having exposed to a number of years working experience, our graduates should become professionals who demonstrate the following competencies:

| Code | Intended Educational Objectives |
|------|--------------------------------|
| PEO1 | Competent in computer science and digital technologies that foster research and development of new knowledge in specific areas. |
| PEO2 | Has good character, ethics and high integrity and demonstrate behavior that is consistent to professional ethics. |
| PEO3 | Has promote the technological, social and cultural progress in a knowledge based society in the academic and professional contexts. |

**Programme Learning Outcomes (PLO)**

After having completed the programme, graduates should be able to demonstrate the following competencies:

| Code | Intended Learning Outcomes |
|------|---------------------------|
| PLO1 | Ability to identify various computer science theories suitable for particular research context, and justify and verify the proposed solution using computer science theories creatively |
| PLO2 | Ability to conduct computer science research in a systematic and scientific way independently |
| PLO3 | Ability to give suggestion on computer science solutions to the society |
| PLO4 | Ability to demonstrate behaviour that is consistent with the Code of Professional Ethics and Responsibilities |
| PLO5 | Ability to defend critically technical solutions and research findings to a range of audience orally and in writing |
| PLO6 | Ability to identify and analyse real problems critically related to organisational, governmental and social |
| PLO7 | Ability to undertake lifelong learning and actively participate in change |
| PLO8 | Ability to turn ideas into innovative computer science solution to meet the real world needs |

**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.

| NO. | CODE | COURSE | CREDIT EARNED (JKD) | CREDIT COUNTED (JKK) | TICK (√) IF PASSED |
|---|---|---|---|---|---|
| **CORE COURSES (0 CREDITS)** | | | | | |
| 1 | UCSP0010 | Research Methodology | 0 | 0 | |
| **TOTAL CREDIT OF CORE COURSES (a)** | | | **0** | **0** | |
| **UNIVERSITY ELECTIVE COURSES** | | | | | |
| 1 | UCSM1263 | IT Project Management | 3 | 3 | |
| | UHAP6013 | Seminar on Development, Economics and Global | | | |
| | UICW 6023 | Philosophy Science and Civilization | | | |
| | UHAZ 6123 | Malaysian Society and Culture | | | |
| **TOTAL CREDIT of UNIVERSITY GENERAL COURSES (b)** | | | 3 | 3 | |
| **TOTAL CREDIT TO GRADUATE (a + b)** | | | 3 | 3 | |
| **RESEARCH** | | | | | |
| 1 | Hard-Bound Thesis endorsed by supervisor – 3 copies | | | | |
| 2 | Copy of CD for Each Thesis – Extra 1 unit | | | | |
| 3 | Copy of All Semester Results (Pre-Transcript) | | | | |
| 4 | Copy of Registration Slip (current semester) | | | | |
| 5 | Abstract and Title Page Approval Form (original copy) | | | | |
| 6 | Course Checklist (endorsed by coordinator) | | | | |
| 7 | Copy of IC (local student) / first page of Passport (international student) | | | | |
| 8 | Fee Release Letter (UTM Bendahari) | | | | |
| 9 | Exit Survey | | | | |
| 10 | Submission of Thesis Form – 3 copies | | | | |
| 11 | Verification of Graduate Information Form – 1 copy | | | | |

# COURSE SYNOPSIS

## CORE COURSES

### UCSP0010 - Research Methodology
This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Amongst topics that will be covered are introduction to research and its philosophy, problem formulation and research objective, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

## UNIVERSITY ELECTIVE COURSES

### UCSM 1263 - IT Project Management
This course presents a hands-on perspective to Information Technology project management. This course will assist post-graduate students to plan and implement their post-graduate 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)

### UHAP 6013 - Seminar on Development, Economics and Global
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 details.

### UICW 6023 - Philosophy 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.

**UHAZ 6123 - Malaysian 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.

**DOCTOR of PHILOSOPHY**
**FIELD: SOFTWARE ENGINEERING**

**PROGRAMME SYNOPSIS**
The Doctor of Philosophy, Field: Software Engineering is offered on a full-time basis. The full-time programme is offered only 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 three (3) years to a maximum of eight (8) years.

The programme is offered on full-time basis and is based on a 2-Semester per academic session. This is a full research programme. The candidate is supervised by a lecturer. The directed research work introduces candidates to the process by which new knowledge is developed and applied accordingly. Assessment is done by examining first assessment reports (research proposal), each semester's progress reports, and thesis examination (viva-voce).

**General Information**

| 1. **Awarding Institution** | **Universiti Teknologi Malaysia** |
|---|---|
| 2. Teaching Institution | Universiti Teknologi Malaysia |
| 3. Programme Name | Doctor of Philosophy |
| 4. Final Award | Doctor of Philosophy |
| 5. Programme Code | PCSQA3AJA |
| 6. Professional or Statutory Body of Accreditation | Ministry of Higher Education |
| 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 Scheme | Full Time |
| 11. Study Duration | Minimum : 6 semesters Maximum:12 semesters |

| Type of Semester | No. of Semesters | | No of Weeks/Semester | |
|---|---|---|---|---|
| | **Full Time** | **Part Time** | **Full Time** | **Part Time** |
| Normal | 6 | - | 12 | - |
| **Short** | - | - | - | - |

**Course Classification**

| No. | Classification | Credit Hours | Percentage |
|---|---|---|---|
| i. | University Courses | 3 | 100% |
| ii. | Core Courses | 0 | 0% |
| iii. | Research | 0 | 0% |
| | **Total** | **3** | **100%** |
| **Total Credit Hours to Graduate** | | **3 credit hours** | |

**COURSE MENU**

Doctor of Philosophy students are required to register and pass the following courses before their first assessment (proposal defense).

    v.     Research Methodology course (course code UCSP0010).

    vi.    One University Elective Course (course code U*** ***3).

| YEAR 1: SEMESTER 1 | | | |
|---|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| UCSM1263 | IT Project Management | | |
| UHAP6013 | Seminar on Development, Economics and Global | 3 | |
| UICW 6023 | Philosophy Science and Civilization | | |
| UHAZ 6123 | Malaysian Society and Culture | | |
| UCSP0010 | Research Methodology | 0 | |
| PCSQ 1100 | * Research | 0 | |
| | **TOTAL CREDIT** | **3** | |
| | **CUMULATIVE CREDITS** | **3** | |

| YEAR 1: SEMESTER 2 | | | |
|---|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| PCSQ 1200 | *Research | 0 | |
| | **TOTAL CREDIT** | **0** | |
| | **CUMULATIVE CREDITS** | **3** | |

* Research (course code PCSQ **00), to be taken every semester until the submission of thesis. The progress of a candidate in any particular semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website http://spsapp3.utm.my:8080/gsmsv4/.

**RESEARCH CODE**

| Semester | Research Course Code |
|----------|----------------------|
| 1 | PCSQ 1100 |
| 2 | PCSQ 1200 |
| 3 | PCSQ 2100 |
| 4 | PCSQ 2200 |
| 5 | PCSQ 3100 |
| 6 | PCSQ 3200 |
| 7 | PCSQ 4100 |
| 8 | PCSQ 4200 |

**RESEARCH AREAS**

- Software Modeling and Specification
- Software Quality and Testing
- Software Usability and Reusability
- Software as Service
- Dependable Embedded Real-Time Systems
- Agile Software Development
- Intelligent Software Systems
- Model Driven Architecture
- Software Product Line
- Software Maintenance and Evolution.
- Human Computer Interaction
- Intelligent System

**Programme Educational Objectives (PEO)**

This programme is aimed to produce computer science experts who have a skill and knowledge to apply and research the state-of-the-art computer science techniques, methods and tools. These skills are important to support a research and development towards the development of a novel computer science solution(s), either for local use or export that can generate national income.

After having exposed to several years working experience, our graduates should become professionals who demonstrate the following competencies:

| Code | Intended Educational Objectives |
|------|--------------------------------|
| PEO1 | Competent in computer science and digital technologies that foster research and development of new knowledge in specific areas. |
| PEO2 | Has good character, ethics and high integrity and demonstrate behavior that is consistent to professional ethics. |
| PEO3 | Has promote the technological, social and cultural progress in a knowledge based society in the academic and professional contexts. |

**Programme Learning Outcomes (PLO)**

After having completed the programme, graduates should be able to demonstrate the following competencies:

| Code | Intended Learning Outcomes |
|------|---------------------------|
| PLO1 | Ability to identify various computer science theories suitable for particular research context, and justify and verify the proposed solution using computer science theories creatively |
| PLO2 | Ability to conduct computer science research in a systematic and scientific way independently |
| PLO3 | Ability to give suggestion on computer science solutions to the society |
| PLO4 | Ability to demonstrate behaviour that is consistent with the Code of Professional Ethics and Responsibilities |
| PLO5 | Ability to defend critically technical solutions and research findings to a range of audience orally and in writing |
| PLO6 | Ability to identify and analyse real problems critically related to organisational, governmental and social |
| PLO7 | Ability to undertake lifelong learning and actively participate in change |
| PLO8 | Ability to turn ideas into innovative computer science solution to meet the real world needs |

**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.

| NO. | CODE | COURSE | CREDIT EARNED (JKD) | CREDIT COUNT-ED (JKK) | TICK (√) IF PASSED |
|---|---|---|---|---|---|
| **CORE COURSES (0 CREDITS)** | | | | | |
| 1 | UCSP0010 | Research Methodology | 0 | 0 | |
| **TOTAL CREDIT OF CORE COURSES (a)** | | | **0** | **0** | |
| **UNIVERSITY ELECTIVE COURSES** | | | | | |
| 1 | UCSM1263 | IT Project Management | 3 | 3 | |
| | UHAP6013 | Seminar on Development, Economics and Global | | | |
| | UICW 6023 | Philosophy Science and Civilization | | | |
| | UHAZ 6123 | Malaysian Society and Culture | | | |
| **TOTAL CREDIT of UNIVERSITY GENERAL COURSES (b)** | | | 3 | 3 | |
| **TOTAL CREDIT TO GRADUATE (a + b)** | | | 3 | 3 | |
| **RESEARCH** | | | | | |
| 1 | Hard-Bound Thesis endorsed by supervisor – 3 copies | | | | |
| 2 | Copy of CD for Each Thesis – Extra 1 unit | | | | |
| 3 | Copy of All Semester Results (Pre-Transcript) | | | | |
| 4 | Copy of Registration Slip (current semester) | | | | |
| 5 | Abstract and Title Page Approval Form (original copy) | | | | |
| 6 | Course Checklist (endorsed by coordinator) | | | | |
| 7 | Copy of IC (local student) / first page of Passport (international student) | | | | |
| 8 | Fee Release Letter (UTM Bendahari) | | | | |
| 9 | Exit Survey | | | | |
| 10 | Submission of Thesis Form – 3 copies | | | | |
| 11 | Verification of Graduate Information Form – 1 copy | | | | |

## COURSE SYNOPSIS

## CORE COURSES

### UCSP0010 - Research Methodology

This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Amongst topics that will be covered are introduction to research and its philosophy, problem formulation and research objective, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

## UNIVERSITY ELECTIVE COURSES

### UCSM 1263 - IT Project Management

This course presents a hands-on perspective to Information Technology project management. This course will assist post-graduate students to plan and implement their post-graduate 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)

### UHAP 6013 - Seminar on Development, Economics and Global

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 details.

### UICW 6023 - Philosophy 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.

**UHAZ 6123 - Malaysian 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 OF PHILOSOPHY**
**FIELD: SOFTWARE ENGINEERING**

**PROGRAMME SPECIFICATIONS**

The Master of Philosophy, Field: Software Engineering is offered on a full-time basis. The full-time programme is offered only 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 two (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 full research programme. The candidate is supervised by a lecturer. The directed research work introduces candidates to the process by which new knowledge is developed and applied accordingly. Assessment is done by examining first assessment reports (research proposal), each semester's progress reports, and thesis examination (viva-voce).

**General Information**

| 1. **Awarding Institution** | **Universiti Teknologi Malaysia** |
|---|---|
| 2. Teaching Institution | Universiti Teknologi Malaysia |
| 3. Programme Name | Master of Philosophy |
| 4. Final Award | Master of Philosophy |
| 5. Programme Code | MCSQA3AJA |
| 6. Professional or Statutory Body of Accreditation | Ministry of Higher Education |
| 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 Scheme (Full Time/Part Time) | Full Time |
| 11. Study Duration | Minimum :  2 yrs (4 semesters)<br>Maximum : 4 yrs (8 Semesters) |

| Type of Semester | No. of Semesters | | No of Weeks/Semester | |
|---|---|---|---|---|
| | **Full Time** | **Part Time** | **Full Time** | **Part Time** |
| Normal | 4 | - | 8 | - |
| **Short** | **-** | **-** | **-** | **-** |

**Course Classification**

| No. | Classification | Credit Hours | Percentage |
|-----|----------------|--------------|------------|
| i. | University Courses | 3 | 33% |
| ii. | Core Courses | 6 | 67% |
| iii. | Research | 0 | 0% |
| | **Total** | **9** | **100%** |
| Total Credit Hours to Graduate | | 9 credit hours | |

**COURSE MENU**

Master of Philosophy students are required to register and pass the following courses before their first assessment (proposal defense)

  vii.   One University Elective Course (course code U*** ***3).
  viii.  Software Engineering Research Methodology
   ix.   Advanced Software Engineering

| YEAR 1: SEMESTER 1 | | | |
|--------------------|--------|--------|----------------|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| UCCM1263 | IT Project Management | | |
| UHAP6013 | Seminar on Development, Economics and Global | 3 | |
| UICW 6023 | Philosophy Science and Civilization | | |
| UHAZ 6123 | Malaysian Society and Culture | | |
| MCSQ1103 | Software Engineering Research Methodology | 3 | |
| MCSQ1203 | Advanced Software Engineering | 3 | |
| MCSQ1100 | * Research | 0 | |
| | **TOTAL CREDIT** | **9** | |
| | **CUMULATIVE CREDITS** | **9** | |

| YEAR 1: SEMESTER 2 | | | |
|--------------------|--------|--------|----------------|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| MCSQ1200 | * Research | 0 | |
| | **TOTAL CREDIT** | 0 | |
| | **CUMULATIVE CREDITS** | 9 | |

* Research (course code MCSQ **00), to be taken every semester until the submission of thesis. The progress of a candidate in any particular semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website http://spsapp3.utm.my:8080/gsmsv4/.

**RESEARCH CODE**

| Semester | Research Course Code |
|----------|----------------------|
| 1 | MCSQ1100 |
| 2 | MCSQ1200 |
| 3 | MCSQ2100 |
| 4 | MCSQ2200 |
| 5 | MCSQ3100 |
| 6 | MCSQ3200 |
| 7 | MCSQ4100 |
| 8 | MCSQ4200 |

## Programme Educational Objectives (PEO)

After having exposed to 3 to 5 years working experience, our graduates should become professionals who demonstrate the following competencies:

| Code | Intended Educational Objectives |
|------|--------------------------------|
| PEO1 | Competent in software engineering and digital industry and contribute to national development. |
| PEO2 | Has character and ethics, as well as high professionalism and contributes to current and future needs. |
| PEO3 | Creative, innovative, entrepreneurial and able to become leader or team member in an organisation and society. |

## Programme Learning Outcomes (PLO)

After having completed the programme, graduates should be able to demonstrate the following competencies:

| Code | Intended Learning Outcomes |
|------|---------------------------|
| PLO1 | Ability to integrate and acquire in-depth knowledge in professional practices for the benefits of Software Engineering discipline. |
| PLO2 | Ability to formulate hyphotesis, design and perform scientific research in Software Engineering using appropriate methods and tools. |
| PLO3 | Ability to evaluate and make decision taking into consideration social responsibilities related to organization, society and individual to fulfill needs of mankind. |
| PLO4 | Ability to demonstrate behaviours that are consistent with the code of Professional Ethics and Responsibilities. |
| PLO5 | Ability to communicate technical solutions and research findings to a range of audience orally and in writing. |
| PLO6 | Ability to explore in solving scientific problem to produce an innovative software solution. |
| PLO7 | Ability to adapt current knowledge and manage information effectively through the life long learning process. |
| PLO8 | Ability to identify commercial value in software solution. |

## 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.

| NO. | CODE | COURSE | CREDIT EARNED (JKD) | CREDIT COUNTED (JKK) | TICK (√) IF PASSED |
|---|---|---|---|---|---|
| **CORE COURSES (6 CREDITS)** | | | | | |
| 1 | MCSQ1103 | Software Engineering Research Methodology | 3 | 3 | |
| 2 | MCSQ1203 | Advanced Software Engineering | 3 | 3 | |
| **TOTAL CREDIT OF CORE COURSES (a)** | | | **6** | **6** | |
| **UNIVERSITY ELECTIVE COURSES** | | | | | |
| 1 | UCSM1263 | IT Project Management | 3 | 3 | |
| | UHAP6013 | Seminar on Development, Economics and Global | | | |
| | UICW6023 | Philosophy Science and Civilization | | | |
| | UHAZ6123 | Malaysian Society and Culture | | | |
| **TOTAL CREDIT of UNIVERSITY GENERAL COURSES (b)** | | | 3 | 3 | |
| **TOTAL CREDIT TO GRADUATE (a + b)** | | | 9 | 9 | |
| **RESEARCH** | | | | | |
| 1 | Hard-Bound Thesis endorsed by supervisor – 3 copies | | | | |
| 2 | Copy of CD for Each Thesis – Extra 1 unit | | | | |
| 3 | Copy of All Semester Results (Pre-Transcript) | | | | |
| 4 | Copy of Registration Slip (current semester) | | | | |
| 5 | Abstract and Title Page Approval Form (original copy) | | | | |
| 6 | Course Checklist (endorsed by coordinator) | | | | |
| 7 | Copy of IC (local student) / first page of Passport (international student) | | | | |
| 8 | Fee Release Letter (UTM Bendahari) | | | | |
| 9 | Exit Survey | | | | |
| 10 | Submission of Thesis Form – 3 copies | | | | |
| 11 | Verification of Graduate Information Form – 1 copy | | | | |

**COURSE SYNOPSIS**

**CORE COURSES**

**MCSQ1103 - Software Engineering Research Methodology**
This course explores the roles of empiricism in software engineering research, and prepares students for advanced research in software engineering by examining how to plan, conduct, and report on empirical investigations. The course covers all of the principal methods applicable to SE: controlled experiments, case studies, surveys, archival analysis, action research, and ethnographies, and relates these methods to relevant meta-theories in the philosophy and sociology science. The course critically reviews published examples of work that use each of the principal methods, both from within SE and from other disciplines. The course also covers techniques applicable to each of the steps of a research project, including formulating research questions, theory building, data analysis (using both qualitative and quantitative methods), building evidence, assessing validity, and publishing. Having successfully completed the module, students will be able to demonstrate knowledge and understanding on the process of creating engineering and scientific knowledge.

**MCSQ1203 - Advanced Software Engineering**
This course will expose students to the concepts, principles, and state-of-the-art methods and approaches in the main knowledge areas in software engineering. It includes software process, software quality, domain & requirements engineering, architectural & detailed design, software measurement & testing, and software maintenance & evolution. It also provides opportunities for the students to explore and systematically evaluate the currently available approaches.

**UNIVERSITY ELECTIVE COURSES**

**UCSM 1263 - IT Project Management**
This course presents a hands-on perspective to Information Technology project management. This course will assist post-graduate students to plan and implement their post-graduate 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)

**UHAP 6013 - Seminar on Development, Economics and Global**
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 details.

**UICW 6023 - Philosophy 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.

**UHAZ 6123 - Malaysian 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 OF PHILOSOPHY**
**FIELD: COMPUTER SCIENCE**

**PROGRAMME SPECIFICATIONS**

The Master of Philosophy, Field: Computer Science is offered on a full-time basis. The full-time programme is offered only 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 two (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 full research programme. The candidate is supervised by a lecturer. The directed research work introduces candidates to the process by which new knowledge is developed and applied accordingly. Assessment is done by examining first assessment reports (research proposal), each semester's progress reports, and thesis examination (viva-voce).

**General Information**

| 1. Awarding Institution | Universiti Teknologi Malaysia |
|---|---|
| 2. Teaching Institution | Universiti Teknologi Malaysia |
| 3. Programme Name | Master of Philosophy |
| 4. Final Award | Master of Philosophy |
| 5. Programme Code | MCSSA3AJA |
| 6. Professional or Statutory Body of Accreditation | Ministry of Higher Education |
| 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 Scheme (Full Time/Part Time) | Full Time |
| 11. Study Duration | Minimum : 2 yrs (4 semesters) <br> Maximum : 4 yrs (8 Semesters) |

| Type of Semester | No. of Semesters | | No of Weeks/Semester | |
|---|---|---|---|---|
| | Full Time | Part Time | Full Time | Part Time |
| Normal | 4 | - | 8 | - |
| Short | - | - | - | - |

**Course Classification**

| No. | Classification | Credit Hours | Percentage |
|-----|---------------|--------------|------------|
| i. | University Courses | **3** | 100% |
| ii. | Core Courses | 0 | 0% |
| iii. | Research | 0 | 0% |
| | **Total** | **3** | **100%** |
| Total Credit Hours to Graduate | | 3 credit hours | |

**COURSE MENU**

Master of Philosophy students are required to register and pass the following courses before their first assessment (proposal defence).

x.  Research Methodology course (course code UCSP0010).

xi.  One University Elective Course (course code U*** ***3).

| YEAR 1: SEMESTER 1 | | | |
|--------------------|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| UCSM1263 | IT Project Management | | |
| UHAP6013 | Seminar on Development, Economics and Global | 3 | |
| UICW 6023 | Philosophy Science and Civilization | | |
| UHAZ 6123 | Malaysian Society and Culture | | |
| UCSP0010 | Research Methodology | 0 | |
| MCSS1100 | * Research | 0 | |
| | **TOTAL CREDIT** | **3** | |
| | **CUMULATIVE CREDITS** | **3** | |

| YEAR 1: SEMESTER 2 | | | |
|--------------------|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| MCSS1200 | * Research | 0 | |
| | **TOTAL CREDIT** | **0** | |
| | **CUMULATIVE CREDITS** | **3** | |

* Research (course code MCSS **00), to be taken every semester until the submission of thesis. The progress of a candidate in any particular semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website http://spsapp3.utm.my:8080/gsmsv4/.

**RESEARCH CODE**

| Semester | Research Course Code |
|----------|---------------------|
| 1 | MCSS 1100 |
| 2 | MCSS 1200 |
| 3 | MCSS 2100 |
| 4 | MCSS 2200 |
| 5 | MCSS 3100 |
| 6 | MCSS 3200 |
| 7 | MCSS 4100 |
| 8 | MCSS 4200 |

**Programme Educational Objectives (PEO)**

After having exposed to 3 to 5 years working experience, our graduates should become professionals who demonstrate the following competencies:

| Code | Intended Educational Objectives |
|------|--------------------------------|
| PEO1 | Competent in computer science and digital industry and contribute to national development. |
| PEO2 | Has character and ethics, as well as high professionalism and contributes to current and future needs. |
| PEO3 | Creative, innovative, entrepreneurial and able to become leader or team member in an organisation and society. |

**Programme Learning Outcomes (PLO)**

After having completed the programme, graduates should be able to demonstrate the following competencies:

| Code | Intended Learning Outcomes |
|------|----------------------------|
| PLO1 | Ability to demonstrate a mastery of knowledge in the field of computer science |
| PLO2 | Ability to conduct Computer Science research in a systematic and scientific way with minimal supervision |
| PLO3 | Ability to demonstrate ability to contribute idea in solving problems related to computer science to society |
| PLO4 | Ability to demonstrate behaviours that are consistent with the code of Professional Ethics and Responsibilities |
| PLO5 | Ability to communicate technical solutions and research findings to a range of audience orally and in writing |
| PLO6 | Ability to generate solutions to problems using scientific and critical thinking skills |
| PLO7 | Ability to manage information for lifelong long learning |
| PLO8 | Ability to identify commercial value in the research output |

**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.

| NO. | CODE | COURSE | CREDIT EARNED (JKD) | CREDIT COUNTED (JKK) | TICK (√) IF PASSED |
|---|---|---|---|---|---|
| **CORE COURSES (0 CREDITS)** | | | | | |
| 1 | UCSP0010 | Research Methodology | 0 | 0 | |
| **TOTAL CREDIT OF CORE COURSES (a)** | | | **0** | **0** | |
| **UNIVERSITY ELECTIVE COURSES** | | | | | |
| 1 | UCSM1263 | IT Project Management | 3 | 3 | |
| | UHAP6013 | Seminar on Development, Economics and Global | | | |
| | UICW 6023 | Philosophy Science and Civilization | | | |
| | UHAZ 6123 | Malaysian Society and Culture | | | |
| **TOTAL CREDIT of UNIVERSITY GENERAL COURSES (b)** | | | 3 | 3 | |
| **TOTAL CREDIT TO GRADUATE (a + b)** | | | 3 | 3 | |
| **RESEARCH** | | | | | |
| 1 | Hard-Bound Thesis endorsed by supervisor – 3 copies | | | | |
| 2 | Copy of CD for Each Thesis – Extra 1 unit | | | | |
| 3 | Copy of All Semester Results (Pre-Transcript) | | | | |
| 4 | Copy of Registration Slip (current semester) | | | | |
| 5 | Abstract and Title Page Approval Form (original copy) | | | | |
| 6 | Course Checklist (endorsed by coordinator) | | | | |
| 7 | Copy of IC (local student) / first page of Passport (international student) | | | | |
| 8 | Fee Release Letter (UTM Bendahari) | | | | |
| 9 | Exit Survey | | | | |
| 10 | Submission of Thesis Form – 3 copies | | | | |
| 11 | Verification of Graduate Information Form – 1 copy | | | | |

**COURSE SYNOPSIS**

**CORE COURSES**

**UCSP0010 - Research Methodology**
This course covers the general principles of Research Methodology that are applicable to any discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Amongst topics that will be covered are introduction to research and its philosophy, problem formulation and research objective, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

**UNIVERSITY ELECTIVE COURSES**

**UCSM 1263 - IT Project Management**
This course presents a hands-on perspective to Information Technology project management. This course will assist post-graduate students to plan and implement their post-graduate 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)

**UHAP 6013 - Seminar on Development, Economics and Global**
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.

**UICW 6023 - Philosophy 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.

**UHAZ 6123 - Malaysian 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 OF COMPUTER SCIENCE**

**PROGRAMME SPECIFICATIONS**

The Master of Science, Field: Computer Science is offered on a full-time basis. The full-time programme is offered only 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 to a maximum of four (4) years.

The programme is offered on full-time and is based on a 2-Semester per academic session. This is a mixed-mode master programme. Academic load for each semester depends on total number of credits. Students can take a minimum of one course (equivalent to 3-4 credits) up to a maximum of twenty (20 credits) for full-time. Students are required to finish all course works before starting dissertation. Students with a minimum CGPA of 3.5 can register one (1) elective course together with dissertation. Students who register courses with UM status can also register dissertation. Assessment method for academic achievement is the combination of two (2) parts, that is based on GPA/CGPA and research progress report. The research progress report needs to be submitted by week 12 of the semester through GSMS. Dissertation evaluation is graded based on three categories i.e. satisfactory (MM), Unsatisfactory (TM) and Fail (GG).

**General Information**

| 1. **Awarding Institution** | **Universiti Teknologi Malaysia** |
|---|---|
| 2. Teaching Institution | Universiti Teknologi Malaysia |
| 3. Programme Name | Master of Computer Science |
| 4. Final Award | Master of Computer Science |
| 5. Programme Code | MECSA2AJA |
| 6. Professional or Statutory Body of Accreditation | Ministry of Higher Education |
| 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 Scheme (Full Time/Part Time) | Full Time |
| 11. Study Duration | Full-time : Minimum - 3 semesters<br>: Maximum - 8 semesters |

| Type of Semester | No. of Semesters | | No of Weeks/Semester | |
|---|---|---|---|---|
| | **Full Time** | **Part Time** | **Full Time** | **Part Time** |
| Normal | 3 | - | 8 | - |
| Short | - | - | - | - |

**Course Classification**

| No. | Classification | Credit Hours | Percentage |
|---|---|---|---|
| i. | University Courses | 3 | 6.7% |
| ii. | Programme Core Courses | 12 | 26.7% |
| iii. | Programme Electives | 6 | 13.3% |
| iii. | Research | 24 | 53.3% |
| | **Total** | **45** | **100%** |
| Total Credit Hours to Graduate | | 45 credit hours | |

## COURSE MENU

Master of Computer Science students are required to register and pass the following courses before their first assessment (proposal defense).

   i.   **FOUR** Core Courses
   ii.   **TWO** Elective Courses
   iii.   **ONE** University Elective Course (course code M*** ***3).
   iv.   Research (course code MECS xx80)

## COURSE MENU 1

| YEAR 1: SEMESTER 1 | | | |
|---|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| MECS1023 | Advanced Data Structure and Algorithm | 3 | |
| MECS1033 | Advanced Artificial Intelligence | | |
| MECS1043 | Research Methodology in Computer Science (Dissertation I) | | |
| Mxxx xxx3 | Elective I | 3 | |
| Uxxx xxx3 | University Common Elective | 3 | |
| | **TOTAL CREDIT** | **15** | |
| | **CUMULATIVE CREDITS** | **15** | |

| YEAR 1: SEMESTER 2 | | | |
|---|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| MECS1013 | Advanced Theory of Computer Science | **3** | |
| Uxxx xxx3 | Elective II | 3 | |
| MECSxx80 | Dissertation II | 9 | |
| | **TOTAL CREDIT** | **15** | |
| | **CUMULATIVE CREDITS** | **30** | |

| YEAR 2: SEMESTER 1 | | | |
|---|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| MECSxx80 | Dissertation III | 15 | |
| | **TOTAL CREDIT** | **15** | |
| | **CUMULATIVE CREDITS** | **45** | |

**COURSE MENU 2**

| YEAR 1: SEMESTER 1 | | | |
|---|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| MECS1023 | Advanced Data Structure and Algorithm | | |
| MECS1033 | Advanced Artificial Intelligence | 3 | |
| MECS1043 | Research Methodology in Computer Science (Dissertation I) | | |
| | **TOTAL CREDIT** | **9** | |
| | **CUMULATIVE CREDITS** | **9** | |

| YEAR 1: SEMESTER 2 | | | |
|---|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| MECS1013 | Advanced Theory of Computer Science | 3 | |
| Mxxx xxx3 | Elective I | 3 | |
| Uxxx xxx3 | University Common Elective | 3 | |
| | **TOTAL CREDIT** | **9** | |
| | **CUMULATIVE CREDITS** | **18** | |

| YEAR 2: SEMESTER 1 | | | |
|---|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| Mxxx xxx3 | Elective II | 3 | |
| MECSxx80 | Dissertation II | 9 | |
| | **TOTAL CREDIT** | **12** | |
| | **CUMULATIVE CREDITS** | **30** | |

| YEAR 2: SEMESTER 2 | | | |
|---|---|---|---|
| **Code** | **Course** | **Credit** | **Pre-requisite** |
| MECSxx80 | Dissertation III | 15 | |
| | **TOTAL CREDIT** | **15** | |
| | **CUMULATIVE CREDITS** | **45** | |

\* Research (course code MECS \*\*80), to be taken every semester until the submission of thesis. The progress of a candidate in any particular semester is assessed through research progress reports submitted at the end of each semester. It is important for the students to know that the submission of the progress report needs to be done by the student themselves via GSMS website http://spsapp3.utm.my:8080/gsmsv4/.

**RESEARCH CODE**

| Semester | Research Course Code |
|---|---|
| 1 | MECS xx80 |
| 2 | MECS xx80 |

**Programme Educational Objectives (PEO)**

After having exposed to 3 to 5 years working experience, our graduates should become professionals who demonstrate the following competencies:

| Code | Intended Educational Objectives |
|------|--------------------------------|
| PEO1 | Acquire mastery and competency in advanced computing knowledge |
| PEO2 | Become computer scientists who are effective communicators, professional and imbued with high standards of ethical conducts within their organization and society |
| PEO3 | Be analytical thinkers who are responsive to the changing environment and practice lifelong learning |

**Programme Learning Outcomes (PLO)**

After having completed the programme, graduates should be able to demonstrate the following competencies:

| Code | Intended Learning Outcomes |
|------|----------------------------|
| PLO1 | Apply advanced knowledge to solve critical issues in the field of Computer Science. (Knowledge and Understanding) |
| PLO2 | Manage and solve complex problems efficiently using systematic and standard approaches. (Cognitive Skills) |
| PLO3 | Adapt technical and scientific skills to solve real world problems. (Practical Skills) |
| PLO4 | Perform effective collaboration with stakeholders professionally. (Interpersonal Skills) |
| PLO5 | Use a broad range of information, media and technology to support study or research findings. (Communication Skills) |
| PLO6 | Use digital technologies and software competently to support study or research works. (Digital Skills) |
| PLO7 | Analyse numerical or graphical data using quantitative or qualitative methods for solving problems. (Numeracy Skills) |
| PLO8 | Demonstrate leadership, autonomy and responsibility in a team by managing resources and tasks fairly. (Leadership, Autonomy and Responsibility) |
| PLO9 | Perform independent studies for self-advancement through continuous academic or professional development. (Personal Skills) |
| PLO10 | Propose entrepreneurial project based on relevant knowledge and expertise. (Entrepreneurial Skills) |
| PLO11 | Conduct respectable, ethical and professional practices in organization and society. (Ethics and Professionalism Skills) |

## 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.

| NO. | CODE | COURSE | CREDIT EARNED (JKD) | CREDIT COUNTED (JKK) | TICK (√) IF PASSED |
|---|---|---|---|---|---|
| (a) | CORE COURSES (12 CREDITS) - ALL | | | | |
| 1 | MECS1013 | Advanced Theory of Computer Science | 3 | 3 | |
| | MECS1023 | Advanced Data Structure and Algorithm | | | |
| | MECS1033 | Advanced Artificial Intelligence | | | |
| | MECS1043 | Research Methodology in Computer Science (Dissertation I) | | | |
| TOTAL CREDIT OF CORE COURSES (a) | | | 12 | 12 | |
| (b) | ELECTIVE COURSES (6 CREDITS) – CHOOSE 2 ONLY | | | | |
| 2 | MCSD2213 | Advanced Analytics for Data Science | 3 | 3 | |
| | MCSD1233 | Big Data Management | | | |
| | MCSD2123 | Massive Data Mining and Streaming | | | |
| | MECR1073 | Cryptographic Engineering | | | |
| | MECR2213 | Cyber Threat Intelligence | | | |
| | MECR1023 | Information Security Governance and Risk Management | | | |
| | MECS2423 | Virtual and Augmented Reality Environment | | | |
| | MECS2433 | Advanced Computer Graphics and Image Processing | | | |
| | MECS2413 | Advanced Human Computer Interaction | | | |
| | MECR2323 | Advanced Computer Network and Cloud Computing | | | |
| | MECR2313 | Advanced Computer System & Architecture | | | |
| | MECR2343 | Blockchain Technology | | | |
| | MEEH1293 | Intelligent Engineering Solution | | | |
| | MKET1423 | Wireless Communication systems | | | |
| | MKET1523 | Internet of Things Technology | | | |
| TOTAL CREDIT OF ELECTIVE COURSES (b) | | | 6 | 6 | |

| (c) | **UNIVERSITY GENERAL COURSES (3 CREDITS) – CHOOSE 1 ONLY** | | | | | |
|---|---|---|---|---|---|---|
| 1 | UBSS6013 | Organization Behavior and Development | | | | |
| | UBSS6023 | Business Ethics, Responsibility and Sustainability | | | | |
| | UHMS6013 | Seminar on Global Development, Economic and Social Issues | | | | |
| | UHMZ6023 | Malaysian Society and Culture | | | | |
| | UHIS6013 | Philosophy of Science and Civilization | 3 | 3 | | |
| | UHPS6013 | Dynamics of Leadership | | | | |
| | UHLM6013 | Malay Language for Postgraduates | | | | |
| | URTS6013 | Environmental Ethics | | | | |
| | UECS6013 | IT Project Management | | | | |
| | UECS6023 | Introduction to Technopreneurship | | | | |
| | UMJJ6013 | Basic Japanese Language and Culture | | | | |
| **TOTAL CREDIT OF UNIVERSITY GENERIC COURSES (c)** | | | **3** | **3** | | |
| **(d)** | **RESEARCH (24 CREDITS)** | | | | | |
| 1 | MECS xx80 | Dissertation II | 9 | 9 | | |
| 2 | MECS xx80 | Dissertation III | 15 | 15 | | |
| **TOTAL CREDIT OF CORE COURSES (d)** | | | **24** | **24** | | |
| | | | | | | |
| **TOTAL CREDIT TO GRADUATE (a + b + c + d)** | | | **45** | **45** | | |

| **RESEARCH** | |
|---|---|
| 1 | Binded Thesis endorsed by supervisor – 1 copy |
| 2 | Copy of CD for Each Thesis – Extra 1 unit |
| 3 | Copy of All Semester Results (Pre-Transcript) |
| 4 | Copy of Registration Slip (current semester) |
| 5 | Copy of Publication |
| 6 | Course Checklist (endorsed by coordinator) |
| 7 | Copy of IC (local student) / first page of Passport (international student) |
| 8 | Fee Release Letter (UTM Bendahari) |
| 9 | Exit Survey |
| 10 | Verification Correction Form (Dissertation III) |
| 11 | Verification of Graduate Information Form – 1 copy |

**COURSE SYNOPSIS**

**CORE COURSES**

**MECS1013 – Advanced Theory of Computer Science**
The course presents the most fundamental theories and concepts that provide a mathematical sense to answer some of the basic question as can the given problems be solved by computation and how efficiently can a given problem be solved by computation. The course provides an in-depth study to the main models and concepts of the mathematical theory of computation, including automata and languages, computability and complexity. The emphasis of the course will be on the ability to move from a concrete problem to a mathematical model, and after proving things about the mathematical model to correctly interpret what we have learned about the concrete problem.

**MECS1023 – Advanced Data Structure and Algorithm**
This course provides a solid or advanced understanding to theory and practice of data structure and the study of algorithms analysis. Students will learn the most common data structures and the advanced concepts of the data structure such as B-trees, heaps and priority queues. Further, students will be exposed to the techniques used in the development and analysis of data structures and its algorithms. The analytical abilities of the students in this course are to analyze the performance of data structures and algorithms. At the end of the course, students should be able to implement and apply the theory and concepts of the advanced data structure in assignments.

**MECS1033 – Advanced Artificial Intelligence**
Increasing practical implementation of several Soft Computing approaches in real world problems has grounded this course to explore the intensity of SC techniques. As such, Neural Computing, Nature Inspired Computing and Granular Computing provide foundations for the conception, design and development of the intelligent systems. By hybridizing such paradigms, it has been possible to create a number of successful and sophisticated solutions to complex real-world problems. The aim of this course is to provide the student with knowledge of the principles, mechanisms and theory behind SC and their applications. The theory of each SC techniques is given in a conceptual and in a mathematical way; the practice is discussed with stress on the outcomes of successful applications and on the intricacies of the actual implementations

**MECS1043 – Advanced Computer System and Architecture**
This course covers the general principles of Research Methodology that are applicable to Computing and Digital Technology discipline. It discusses the fundamental process in conducting an academic research. The theoretical and practical aspects of preparing a research proposal presented. Among topics that will be covered are introduction to research and its philosophy, problem formulation and research objectives, literature review, research methodology and design, data collection procedures, data analysis, research proposal and thesis preparation and research management.

**ELECTIVE COURSES**

**MCSD2213 – 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.

**MCSD1233 – 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.

**MCSD2123 – Massive Data 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 analysing 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 analysing 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.

**MECR1073 – Cryptographic Engineering**
This is a survey and seminar course that gives an overview on the concepts of advanced database topics such as databases to handle objects, unstructured data, semi-structured data; distributed databases and data warehouses.   The course opens with a sequence of lectures by the instructor to provide background on post relational database systems.  This sets the stage for student review paper on their topic of interest and a practical group project in

databases to expose them to issues and research solutions regarding emerging database technologies.


**MECR2213 – Cyber Threat Intelligence**
With the rapid increase of cyber attacks, accurate security information is becoming more difficult to obtain. This course exposes the students to a complete cycle of CTI which includes hunting, behavioral patterns extraction, clustering and correlation, threat actor attribution until taking it down. Besides, it also explains the Cyber Kill Chain process in launching an attack. Understanding CKC is important in detecting cyberthreat. CTI will be explained in 3 different levels; strategic, tactical and operational.


**MECR1023 – Information Security Governance and Risk Management**
The subject is aimed at imparting knowledge and skill sets required to assume the overall responsibilities of administration and management of security of an information system. This subject covers issues related to administration, management and governance of security of information systems. Topics include auditing and data management, risk management (risk identification, risk analysis, risk control), contingency planning, incident handling and risk governance. The subject will study in detail principles and tools related to these topics. The subject will also cover security standards, evaluation and certification process, security planning, ethical and legal issues in information and privacy.


**MECS2423 – Virtual and Augmented Reality Environment**
This course focuses on Virtual and Augmented Reality (AR) systems, algorithms, and applications. With the proliferation of powerful, always-on, Internet-connected mobile devices such as smartphones, tablets and newer head-worn displays, sophisticated applications that combine location-specific content with the current user view are becoming more possible. Application developers for these devices require a broad set of technical and design skills to create effective interactive AR experiences. Topics will include vision-based marker and feature tracking, model-to-view space transformations, mobile application development, and AR interaction techniques


**MECS2433 – Advanced Computer Graphics and Image Processing**
The aim of the course is to give understanding of sound knowledge and theory of Computer Graphics & Image Processing. First part of the lecture will cover basic and advanced theory of Computer Graphics. Second part of the lecture will deal with Image Processing and Pattern Recognition.


**MECS2413 – Advanced Human Computer Interaction**
This course provide the students with advanced topics in Human Computer Interaction (HCI). The course give students practice and theoretical knowledge of the use of HCI methodologies for both design and evaluation, different types of HCI experimentation, including both

quantitative and qualitative methods. Students are expected to participate in group activities, student-led presentations and discussion of several research papers in HCI.

**MECR2323 – Advanced Computer Network and Cloud Computing**
This course focuses on advanced topics in the computer network. Topics covered include the technical knowledge of IPv6, concept of SDN, and implementation of wireless, sensored, Adhoc and 5G network. The second part is Students will have an opportunity to perform research in these and other areas of computer network and cloud computing.

**MECR2413 – Advanced Computer System & Architecture**
This course focuses on advanced topics in the design and analysis of computer architectures. Topics covered include instruction set design, pipelining, instruction-level parallelism, high-speed memory systems, storage systems, interconnection networks, and multiprocessor architectures. Students will have an opportunity to perform research in these and other areas in the field of computer architecture.

**MECR2343 – Blockchain Technology**
This course focuses on the introduction to blockchain technology and its applications. Block chain is a technology which will lead majority of data storage and information sharing for upcoming many industries. In this course students will understand about fundamentals of blocks, blockchain protocol as well as the fundamental of cryptographic primitives used in the Blockchain and smart contract. The protocol behind the chain formation of blocks with data stored will be understood with practical implementations. Consensus Protocol creation for blockchain formation will be created using python script to understand blockchain from very core. As a hands on, students will be introduced with a development of blockchain application through Solidity Smart Contract platform.

**MEEH1293 – Intelligent Engineering Solution**
In an increasingly competitive world where more and more data is becoming available from web documents, digital media, financial markets, and wireless sensors, there is a great need for new intelligent systems that can analyse the huge amounts of data and make the right decisions. These intelligent systems can analyse the stock markets and make robust predictions, control and optimize factory productions in an uncertain environment, improve transportation safety, improve the quality of life of the elderly or entertain the children. This course provides students a solid theoretical foundation, a set of practical tools and project that allow the understanding and the design of intelligent systems and services that fulfils the needs for a dynamic and everchanging industry and offer exciting opportunities for research.

**MKET1423 – Wireless Communication Systems**
This course introduces students to introductory and advanced level of wireless communication technologies. In the beginning students will be presented with the concept of wireless communication systems and mobile radio propagation. Students will then be illuminated on

MIMO technology in mobile communication. Next, the course will describe on cellular concepts that will include small cell networks. This is followed by details on the overall evolution of mobile communication system. Finally, this course will cover on different multiple access techniques used in wireless communication systems.

### MKET1523 – Internet of Things Technology
The course provides students with a technical background to the Internet of Things (IoT) which includes its concept, architecture and applications. It also gives the underlying communication protocols and technologies. The course has a significant practical element that will be delivered during lab sessions in which students are expected to complete exercises involving system design, device programming and cloud development.

### RESEARCH

### MECS XX80 – Dissertation II
This is the initial part of a 2-part Master dissertation that every student must fulfil 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.

### MECS XX80 – Dissertation III
This is the second part of a 2-part Master dissertation that every student must fulfil successfully. In this installation, students are required to execute the next phases of their development plan from Part 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 software 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.

# MASTER OF SCIENCE (DATA SCIENCE)

## PROGRAMME SPECIFICATIONS

The Master of Science (Data Science) is a coursework programme offered on a full-time basis 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 coursework programme is offered based on a 2-Semester per academic session. 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 Semester | No. of Semesters | | No of Weeks/Semesters | |
|---|---|---|---|---|
| | 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<br>UHAW 6023<br>UCSM 1263<br>UHAZ 6123 | **3** |
| Faculty Compulsory Courses | MCSD 1113<br>MCSD 1013<br>MCSD 1123<br>MCSD 1043<br>MCSD 1053 | MCSD 2123<br>MCSD 2213 | | **21** |
| Faculty's Elective Courses | MCSD 1103 | MCSD 1133 | MCSD 1143 | **9** |
| Master Project | | MCSD 6215 | MCSD 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 | Mastery of knowledge and competency in advanced areas of Data Science field. |
| PEO2 | Practice professionalism and high standards of ethical conducts within organization and society. |
| PEO3 | Responsive to changing situations by continuously acquiring new knowledge and skills. |

**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 | Synthesize complex information, specialized concepts, theories, methods and practice independently in the field of Data Science. (Knowledge and Understanding) |
| PLO2 | Solve complex problems critically and integratively using systematic approaches. (Cognitive Skills) |
| PLO3 | Apply practical skills to solve problems in the field of Data Science. (Practical Skills) |
| PLO4 | Demonstrate effective collaboration with stakeholders professionally. (Interpersonal Skills) |
| PLO5 | Communicate effectively the knowledge, skills and ideas using appropriate methods to peers, experts and communities. (Communications Skills) |
| PLO6 | Use digital technologies and appropriate softwares competently to enhance study and practice. (Digital Skills) |
| PLO7 | Evaluate numerical and graphical data critically using quantitative or qualitative tools in solving problems. (Numeracy Skills) |
| PLO8 | Demonstrate leadership, autonomy and responsibility in managing resources. (Leadership, Autonomy and Responsibility) |
| PLO9 | Engage self-advancement through continuous learning or professional development. (Personal Skills) |
| PLO10 | Initiate entrepreneurial projects supported by relevant knowledge and skills. (Entrepreneurial Skills) |
| PLO11 | Demonstrate respectable ethical conducts and professionalism skills in an organization and society. (Ethics and Professionalism Skills) |

## 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.

| *Please attach a copy of results for previous semesters and a copy of registration slip for current semester. | | | | |
|---|---|---|---|---|
| **University Common Elective (Choose 1 course)** | | **Credit** | **Grade** | **Pass** |
| 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)** | | | | |
| MCSD 1013 | Business Intelligence and Analytics | 3 | | |
| MCSD 1043 | Research Design and Analysis in Data Science | 3 | | |
| MCSD 1053 | Data Science Governance | 3 | | |
| MCSD 1113 | Statistic for Data Science | 3 | | |
| MCSD 1123 | Big Data Management | 3 | | |
| MCSD 2123 | Massive Data Mining and Streaming | 3 | | |
| MCSD 2213 | Advanced Analytics for Data Science | 3 | | |
| **Elective Subject (Choose 3 courses)** | | | | |
| MCSD 1103 | Data Visualization | 3 | | |
| MCSD 1133 | Operational Research and Optimization | 3 | | |
| MCSD 1143 | Supply Chain Analytic | 3 | | |
| MCSD 1153 | Human Based Computing | 3 | | |
| MCSD 1123 | Big Data Computing | 3 | | |
| **Master Projects** | | | | |
| MCSD 6215 | Master Project I | 5 | | |
| MCSD 6227 | Master Project II | 7 | | |
| **Total** | | **45** | | |

**COURSE SYNOPSIS**

**CORE COURSES**

**MCSD1013 - Business Intelligence and Analytics**
Business intelligence and analytics refers to the solutions implemented by enterprises such as businesses, non-profits and governments using data to gain insights for making better decisions. Business intelligence and 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 intelligent and analytics are becoming an even more critical capability for enterprises of all types and all sizes to identify trends and understand the information that can drive business change and support sustained successful business practices.

**MCSD1043 - 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.

**MCSD1053 - Data Science Governance**
Data governance is a mandatory requirement for a successful organization which aims to be data driven, achieve master data management, build business intelligence, improve data quality or efficiently manage documents. This course provides an overview of the data governance life cycle. Students will learn why data governance is needed, how to design, initiate, and execute a program and how to keep the program sustainable. The governance in the aspect of big data 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 design and the implementation of data governance and its importance to an organization

**MCSD1113 - 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.

**MCSD1123 - 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.

### MCSD2123 - 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.

### MCSD2213 - Advanced Analytics for Data Science

This course provides a basic yet solid understanding on the use of analytics approach in the examination of data or content to discover deeper insights and make predictions using sophisticated techniques and tools on real world problems. Students will learn descriptive analytics using analytics 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 for descriptive and predictive analysis. At the end of the course, students should be able to apply the knowledge on analytical techniques or tools in real world problems to be able to make an informed decision through analytical interpretations of results.

### ELECTIVE COURSES

### MCSD1103 - Data Visualization

This course is an introduction to the principles and techniques for visualization to transform and visualize the large datasets to aid knowledge discovery and decision-making. Students will learn the principles, techniques, and practical skill necessary to communicate information about data clearly and effectively through data visualization. Further, students will be exposed to techniques for visualizing different types of data including categorical, time series, spatial, and multiple variables data. Additionally, students will utilize available 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.

**MCSD1133 - 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

**MCSD1143 - 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.

**MCSD1153 - 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.

**MCSD1163 - 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).

**UNIVERSITY COURSES**

**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).

**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.

**UHAW6023 Philosophy of Science and Civilization**
This course contains two sections. This subject discusses the world view of its role and importance in the formation of a living culture and civilization; The concept of revelation, knowledge, humanity, nature and happiness; Comparative Study in Philosophy of Science: Epistemology, Ontology and Axiology in education. Discussion on current issues and challenges, among others; civilizational challenges between the West and the East; Development and the environment; Economy and trade; State Administration and management; Scientific research; Communications and information technology; Ethics and morals; Crime and terrorism; Family education

**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**

**MCSD6215 - 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.

**MCSD6227 - 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.

**MASTER OF CYBER SECURITY**

**PROGRAMME SPECIFICATIONS**

The Master of Cyber Security is offered on a full-time basis. The full-time mode is offered only at the UTM main campus in Johor Bahru. The duration of study for the full-time programme is 3 semesters (1.5 years), subjected to the student's entry qualifications with total number of credits is 45.

This programme bridges the gap between those cyber security aspects with the real world requirements. The aim of this programme is to support the global need in producing professional, dedicated and ethical cyber security experts who will effectively plan, design, manage and practice reliable cyber security mechanisms and technologies. The programme is designed based on top cyber security professional certifications such as CISSP (Certified Information Systems Security Professional), CPT (Certified Penetration Tester), CSAP (Certified Secure Application Professional), CDSP (Certified Data Security Professional) and CHFI (Computer Hacking and Forensic Investigation).

**General Information**

| 1. **Awarding Institution** | **Universiti Teknologi Malaysia** |
|---|---|
| 2. Teaching Institution | Universiti Teknologi Malaysia |
| 3. Programme Name | Master of Cyber Security |
| 4. Final Award | Master of Cyber Security |
| 5. Programme Code | MECRA1AJA |
| 6. Professional or Statutory Body of Accreditation | Ministry of Higher Education |
| 7. Language(s) of Instruction | English |
| 8. Mode of Study (Conventional, distance learning, etc) | Conventional, Open Distance Learning (ODL). |
| 9. Mode of operation (Franchise, self-govern, etc) | Self-governing |
| 10. Study Scheme (Full Time/Part Time) | Full Time |
| 11. Study Duration | **Full Time**<br>Minimum : 1.5 years<br>Maximum : 4 years |

| Type of Semester | No. of Minimum Semesters | | No. of Maximum Semesters | |
|---|---|---|---|---|
| | **Full Time** | **Part Time** | **Full Time** | **Part Time** |
| Normal | 3 | - | 8 | - |
| Short | - | - | - | - |

**Course Classification**

| No. | Classification | Credit Hours | Percentage |
|-----|----------------|--------------|------------|
| i. | University Common Elective Course | 3 | 6% |
| ii. | Core Faculty Course | 3 | 6% |
| iii. | Core Courses | 18 | 41% |
| iv. | Elective Courses | 9 | 20% |
| v. | Project (1 and 2) | 12 | 27% |
| | **Total** | **45** | **100%** |
| **Total Credit Hours to Graduate** | | **45 credit hours** | |

**COURSE MENU**

| **Additional Courses (for Non CS backgroud)** | |
|------|------|
| MECR 0013 | Cryptography |
| MECR 0023 | Computer Security |

| **University Common Elective Courses (Choose 1 Only)** | |
|------|------|
| UECS 6013 | IT Project Management |
| UHIS 6013 | Philosophy of Science and Civilization |
| UHLM 6013 | Malay Language for Post Graduates |
| UHMS 6013 | Seminar on Global Development, Economic and Social Issues |
| UHMZ 6023 | Malaysian Society and Culture |
| UBSS 6013 | Organization Behavior and Development |
| UBSS 6023 | Business Ethics, Responsibility and Sustainability |
| UHPS 6013 | Dynamics of Leadership |
| URTS 6013 | Environmental Ethics |
| UECS 6023 | Introduction to Technopreneurship |
| UMJJ 6013 | Basic Japanese Language and Culture |
| **Core Faculty Course (Compulsory)** | |
| MECR 1013 | Research Methodology |
| **Core Courses (Compulsory)** | |
| MECR 1023 | Information Security Governance and Risk Management |
| MECR 1033 | Digital Forensics |
| MECR 1043 | Cloud Computing Security |
| MECR 1053 | Secure Software Engineering |
| MECR 1063 | Cryptographic Engineering |
| MECR 1073 | Penetration Testing |
| **Elective Courses (Choose 3 only)** | |
| MECR 2113 | Business Continuity Planning |
| MECR 2123 | Security Audit & Assessment |
| MECR 2213 | Cyber Threat Intelligence |
| MECR 2223 | Security Data Exploration |
| MECR 2233 | Security Data Analytics & Visualization |
| MECR 2313 | Software Exploitation |
| MECR 2323 | Malware Analysis |

| Projects (Compulsory) | |
|---|---|
| MECR 2415 | Project 1 |
| MECR 2427 | Project 2 |

**Programme Structure (Full Time)**

| SYLLABUS | SEMESTER 1 | SEMESTER 2 | SEMESTER 3 | TOTAL CREDITS |
|---|---|---|---|---|
| University Common Elective Courses | | **(Choose 1)**<br>U*** 6**3 | | **3** |
| Core Faculty Course | MECR 1013 | | | **3** |
| Core Courses | MECR 1023<br>MECR 1033<br>MECR 1043<br>MECR 1053 | MECR 1063<br>MECR 1073 | | **18** |
| Elective Courses | | **(Choose 1)**<br>MECR 2113<br>MECR 2123<br>MECR 2213<br>MECR 2223<br>MECR 2233<br>MECR 2313<br>MECR 2323 | **(Choose 2)**<br>MECR 2113<br>MECR 2123<br>MECR 2213<br>MECR 2223<br>MECR 2233<br>MECR 2313<br>MECR 2323 | **9** |
| Project 1 | | MECR 2415 | | **5** |
| Project 2 | | | MECR 2427 | **7** |
| **Total Credits** | **15** | **17** | **13** | **45** |

**Programme Educational Objectives (PEO)**

After having exposed to 3 to 5 years working experience, our graduates should become professionals who demonstrate the following competencies:

| Code | Intended Educational Objectives |
|---|---|
| PEO1 | Mastery of knowledge and competency in advanced areas of Cyber Security field. |
| PEO2 | Practice professionalism and high standards of ethical conducts within organization and society. |
| PEO3 | Responsive to changing situations by continuously acquiring new knowledge and skills. |

**Programme Learning Outcomes (PLO)**

At the end of studies, students have the competencies to:

| Code | Intended Learning Outcomes |
|------|----------------------------|
| PLO1 | Synthesize complex information, specialized concepts, theories, methods and practice independently in the field of Cyber Security. (Knowledge and Understanding) |
| PLO2 | Solve complex problems critically and integratively using systematic approaches. (Cognitive Skills) |
| PLO3 | Apply practical skills to solve problems in the field of Cyber Security. (Practical Skills) |
| PLO4 | Demonstrate effective collaboration with stakeholders professionally. (Interpersonal Skills) |
| PLO5 | Communicate effectively the knowledge, skills and ideas using appropriate methods to peers, experts and communities. (Communications Skills) |
| PLO6 | Use digital technologies and appropriate softwares competently to enhance study and practice. (Digital Skills) |
| PLO7 | Evaluate numerical and graphical data critically using quantitative or qualitative tools in solving problems. (Numeracy Skills) |
| PLO8 | Demonstrate leadership, autonomy and responsibility in managing resources. (Leadership, Autonomy and Responsibility) |
| PLO9 | Engage self-advancement through continuous learning or professional development. (Personal Skills) |
| PLO10 | Initiate entrepreneurial projects supported by relevant knowledge and skills. (Entrepreneurial Skills) |
| PLO11 | Demonstrate respectable ethical conducts and professionalism skills in an organization and society. (Ethics and Professionalism Skills) |

## 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.

| *Please attach a copy of results for previous semesters and a copy of registration slip for current semester. | | | |
|---|---|---|---|
| **Courses** | | **Credit** | **Grade** | **Pass** |
| **Additional Courses (for Non-CS backgroud)** | | | | |
| MECR 0013 | Cryptography | 3 | | |
| MECR 0023 | Computer Security | 3 | | |
| **University Common Elective Courses (Choose 1 only)** | | | | |
| UECS 6013 | IT Project Management | 3 | | |
| UHIS 6013 | Philosophy of Science and Civilization | 3 | | |
| UHLM 6013 | Malay Language for Post Graduates | 3 | | |
| UHMS 6013 | Seminar on Global Development, Economic and Social Issues | 3 | | |
| UHMZ 6023 | Malaysian Society and Culture | 3 | | |

| | | | | |
|---|---|---|---|---|
| UBSS 6013 | Organization Behavior and Development | 3 | | |
| UBSS 6023 | Business Ethics, Responsibility and Sustainability | 3 | | |
| UHPS 6013 | Dynamics of Leadership | 3 | | |
| URTS 6013 | Environmental Ethics | 3 | | |
| UECS 6023 | Introduction to Technopreneurship | 3 | | |
| UMJJ 6013 | Basic Japanese Language and Culture | 3 | | |
| **Core Faculty Course (Compulsory)** | | | | |
| MECR 1013 | Research Methodology | 3 | | |
| **Core Courses (Compulsory)** | | | | |
| MECR 1023 | Information Security Governance and Risk Management | 3 | | |
| MECR 1033 | Digital Forensics | 3 | | |
| MECR 1043 | Cloud Computing Security | 3 | | |
| MECR 1053 | Secure Software Engineering | 3 | | |
| MECR 1063 | Cryptographic Engineering | 3 | | |
| MECR 1073 | Penetration Testing | 3 | | |
| **Elective Courses (Choose 3 only)** | | | | |
| MECR 2113 | Business Continuity Planning | 3 | | |
| MECR 2123 | Security Audit & Assessment | 3 | | |
| MECR 2213 | Cyber Threat Intelligence | 3 | | |
| MECR 2223 | Security Data Exploration | 3 | | |
| MECR 2233 | Security Data Analytics & Visualization | 3 | | |
| MECR 2313 | Software Exploitation | 3 | | |
| MECR 2323 | Malware Analysis | 3 | | |
| **Projects (Compulsory)** | | | | |
| MECR 2415 | Project 1 | 5 | | |
| MECR 2427 | Project 2 | 7 | | |
| | **TOTAL CREDITS:** | | | |

## CAREER OPPORTUNITIES

Security Specialist/ Administrator/ Architect/ Analyst/ Auditor/ Director/ Consultant/ Engineer/ Manager; Cryptographer; Cryptanalyst; Chief Information Security Officer; Vulnerability Assessor; Incident Responder; Forensic Expert; Penetration Tester; Source Code Auditor.

**COURSE SYNOPSIS**

**ADDITIONAL COURSES**

**MECR 0013 Cryptography**
Cryptography addresses the principles, means, and methods of disguising information to ensure its integrity, confidentiality and authenticity. This course provides the background for the application and implementation of security mechanisms covered in the other courses. It deals with both theoretical and practical aspects of cryptography, to give an insight to the problems that arise in cryptography and the tools used to solve them. It introduces both symmetric key cipher system and public key cryptography, covering methods of obtaining the objectives of CIA (Confidentiality, Integrity and Availability).

**MECR 0023 Computer Security**
This course covers the body of knowledge on technologies, processes, and practices designed to protect networks, devices, programs, and data from attack, damage, or unauthorized access. The types of computer security that will be covered are application security, network security, internet security, data security, information security and end user security.

**CORE FACULTY COURSE**

**MECR 1013 Research Methodology**
This course covers 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 research title. This course helps students to prepare the research proposal for Projects. The theoretical and practical aspects of implementing the proposal will be the milestone of this course.

**CORE COURSES**

**MECR 1023 Information Security Governance and Risk Management**
The course is aimed at imparting knowledge and skill sets required to assume the overall responsibilities of administration and management of security of an information system. This course covers issues related to administration, management and governance of security of information systems. Topics include auditing and data management, risk management (risk identification, risk analysis, risk control), contingency planning, incident handling and risk governance. The course will study in detail principles and tools related to these topics. The course will also cover security standards, evaluation and certification process, security planning, ethical and legal issues in information and privacy.

**MECR 1033 Digital Forensics**

This course takes a detailed approach to the use of computers and computer technology in the investigation of incidents, both criminal and civil, in which computer technology play a significant or interesting role. Students completing this course will be familiar with the core computer science theory and practical skills necessary to perform elementary computer/digital forensic investigations, understand the role of technology in investigating computer-based crime, and be prepared to deal with investigative bodies at an elementary level.

**MECR 1043 Cloud Computing Security**

In this course, we are going to learn about common cloud misconfigurations, how to perform a risk assessment and verify compliance for various Cloud Services. Further, we will delve deeper into identifying security risks in these cloud services and to implement best practices to mitigate the common cloud misconfigurations. Other topics include topics of data ownership, privacy protections, data mobility, quality of service and service levels, bandwidth costs, data protection, and support.

**MECR 1053 Secure Software Engineering**

This course provides the principles of Secure Software Engineering and practical methods to secure requirements, design, implementation, testing, deployment and maintenance in software development. Students will also review policy specific requirements necessary to implement a secure development program within enterprise organizations. The students will also be able to understand software vulnerability, and how to evaluate, and address security risks to software.

**MECR 1063 Cryptographic Engineering**

This course is a continuation from the introductory cryptography. All networked computers and devices must have cryptographic layers implemented, and must be able to access to cryptographic functions in order to provide security features. In this context, efficient (in terms of time, area, and power consumption) hardware and software structures will have to be designed, implemented, and deployed. Discussion and analysis on how to resist cryptanalytic attacks by protecting access to primary (communication) and secondary (power, electromagnetic, acoustic) channels. Learn the algorithms, methods, and techniques in order to create latest cryptographic embedded software and hardware using common platforms and technologies. In addition to that, ethical issues in cryptography is discussed as well.

**MECR 1073 Penetration Testing**

This course will discuss issues pertaining to penetration testing which covers areas like finding vulnerabilities in various computer systems, exploiting them in an ethical manner. Emphasis is given on the fundamental theory and as well as hands on practice. Topics covered include information reconnaissance, web application pentesting, wireless pentesting, network pentesting, and current issues in pentesting.

**ELECTIVE COURSES**

**MECR 2113 Business Continuity Planning**
The course is aimed at imparting knowledge and skill sets required to prepare to respond to a disaster and restore normal operations afterward. This subject covers issues related to administration and management of disaster recovery program. The important plan for disaster recovery includes the contingency plans: i) the Incident Response Planning (IRP), ii) Disaster Recovery Planning (DRP), iii) Business Impact Analysis (BIA) and iv) Business Continuity Planning (BCP). Topics include preparing to develop disaster recovery plan, assessing risk, prioritizing system and functions for recovery, developing plans and procedure and organizational relationships in disaster recovery. The subject will study in detail principles and tools related to these topics. The subject will also cover procedures to response to attacks on computer, implementing disaster recovery plans, testing and rehearsal, assessment of needs, threats and solutions and living through a disaster.

**MECR 2123 Security Audit & Assessment**
The aim of this course is to provide students with knowledge of how security audits and assessment are being performed against company's information security system. Security audits are often used to determine regulatory compliance, in the wake of legislation (such as HIPAA, the Sarbanes-Oxley Act or etc.) that specifies how organizations must deal with information. The purpose is to evaluate, assess and measure how well the security conforms to a set of established criteria. Within the broad scope of auditing information security there are multiple types of audits, multiple objectives for different audits. Most commonly the controls being audited can be categorized to technical, physical (e.g. system's physical configuration) and administrative (e.g. information handling processes and user practices). Also, auditing information security covers topics from auditing the physical security of data centers to auditing the logical security of databases and highlights key components to look for and different methods for auditing these areas.

**MECR 2213 Cyber Threat Intelligence**
With the rapid increase of cyber attacks, accurate security information is becoming more difficult to obtain. This course exposes the students to a complete cycle of CTI which includes hunting, behavioral patterns extraction, clustering and correlation, threat actor attribution until taking it down. Besides, it also explains the Cyber Kill Chain process in launching an attack. Understanding CKC is important in detecting cyberthreat. CTI will be explained in 3 different levels; strategic, tactical and operational.

**MECR 2223 Security Data Exploration**
This course is essential to help the CTI analyst to dissect data to find clues in detecting the cyberthreats. It covers techniques commonly used to explore and understand data obtained from various sources. Exploratory Data Analysis in general is an approach to analyzing data sets to summarize their main characteristics, usually visual methods are used. Primarily, data is explored to see what the data can tell us beyond the formal modeling or hypothesis testing task. It ranges from pre-processing techniques for detection, validation, error correction, and

filling up of missing or incorrect data. Emphasis on finding the relationship among variables and Clustering to find patterns and associations among groups of data is also covered.

**MECR 2233 Security Data Analytics & Visualization**

This course consists of security analytics and visual analytics. Security analytics is an approach to cyber security focused on the analysis of data to produce proactive security measures. For example, monitored network traffic could be used to identify indicators of compromise before an actual threat occurs. Classification, regression and clustering we will be explored in analysing security data. Model evaluation is also covered. Data visualization is the only approach that scales to the ever-changing threat landscape and infrastructure configurations. Using data visualization techniques, we can gain a far deeper understanding of what's happening on our network. We can uncover hidden patterns of data, identify emerging vulnerabilities and attacks, and respond decisively with countermeasures that are far more likely to succeed than conventional methods. Visual analytics and its concept and design will be covered. Security data will be visualized using selected visualization tool.

**MECR 2313 Software Exploitation**

This course will discuss issues pertaining to software exploitation, finding vulnerabilities in various computer programs and exploiting them in an ethical manner. Topics covered include vulnerability discovery, stack overflow exploitation, format string exploitation, head overflow exploitation, shellcoding, and current issues in exploitation.

**MECR 2323 Malware Analysis**

This course will discuss issues pertaining to analysis of malicious software code. Emphasis is given on the fundamental theory and as well as hands on practice. Topics covered include static analysis, dynamic analysis, defensive mechanism of malware, and some topics on malware research.

**PROJECTS**

**MECR 2415 Project 1**

This is the initial part of a 2-parts Master project that every student must fulfil 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 to be evaluated and present their proposal.

**MECR 2427 Project 2**

This is the second part of a 2-parts Master project that every student must fulfil successfully. Students are required to execute the next phases of their development plan in 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 the

project following software 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 to be evaluated and present their final work. The corrected report will be printed as a Master's thesis.

## UNIVERSITY COMMON ELECTIVE COURSES

### UECS 6013 IT Project Management
This course presents a hands-on perspective to Information Technology project management. This course will assist post-graduate students to plan and implement their post-graduate 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 will also be utilizing latest tools for understanding, reviewing, communicating and developing Business Model for a project. Teams of students are expected to perform real projects and achieve agreed Key Performance Indicators (KPI).

### UHIS 6013 Philosophy of Science and Civilization
This course discusses the meaning and nature of the philosophy of science and civilization. It seeks first to explore the different denotation, connotation, and cognitive substance of philosophy, science, and civilization, as independent concepts. It then seeks to understand these terminologies individually in their historical perspectives and their relationship to each other. Understanding the meaning and import of culture is necessary to our understanding of civilization. The study of the nature and meaning of religion is therefore significant in our appreciation of culture and civilization. Historically, Islam and the Muslims have always been intricately connected to the Western world. Thus, the discussion also includes comparative studies of Islamic and western philosophy and universal values. The final discussion is about the contribution of Islam to the world's civilization, education, culture and scientific development.

### UHLM 6013 Malay Language for Post Graduates
This course is offered to international students of the Masters and PhD programmes, from Indonesia, Brunei, Southern Thailand and Singapore. In this course students are given exposure on how to write scientific works (in Malay). The focus of this course is the spelling aspect, punctuation, sentence variety, language adjustment, paragraph writing and writing style. In addition, students will be exposed on writing formats such as literature writing, citations, bibliographies, abstracts and editing.

### UHMS 6013 Seminar on Global Development, Economic and Social Issues
This course focuses on different approaches to economic development with reference to economic growth. Discussion on this course also includes issues related to globalization, technology and digital divides as well as the 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.

### UHMZ 6023 Malaysian Society and Culture

This course is designed for international postgraduates. This course discusses on the various aspects of the Malaysian culture and society. Topics on belief system, religious festivals, customs and etiquettes of different ethnic groups in Malaysia will be introduced to the students. In addition, students will also been introduced to the Malay Language. At the end of the course students should be able to understand the cultures practiced among Malaysians and adapt themselves to these new cultures.

### UHPS 6013 Dynamics of Leadership

This course is intended to encourage students discover and develop their personal leadership qualities. Students will be exposed to leadership theories so that they could develop an insight that leadership itself is a dynamic relationship based on mutual influence and common purpose between leaders and followers. Topics covered include Introduction to Leadership, Leadership Traits & Ethics, Leadership Behaviour and Motivation, Influencing: Power, Politics, Networking and Negotiation, Contingency Leadership Theories, Communication, Coaching, and Conflict Skills, The LeaderFollower Relationship, Team Leadership, Leading Self-Managed Teams, Transformational and Level 5 Leadership. Students will be evaluated based on their class leadership role, short talk and personal learning portfolios.

### URTS 6013 Environmental Ethics

Environmental ethics is the discipline in philosophy that studies the moral relationship of human beings to, and also the value and moral status of, the environment and its nonhuman contents. It covers the challenge of environmental ethics to the anthropocentrism (i.e., human-centeredness) embedded in traditional western ethical thinking; the early development of the discipline in the 1960s and 1970s; the connection of deep ecology, feminist environmental ethics, and social ecology to politics; and the attempt to apply traditional ethical theories, and virtue ethics, to support contemporary environmental concerns. It focus on environmental literature on wilderness, and possible future developments of the discipline.

### UMJJ 6013 Basic Japanese Language and Culture

At this course, students will be introduced to a simple yet useful familiar everyday expressions and very basic phrases using basic grammars to develop oral communication skills for social purposes. This course is suitable for beginners who wish to develop basic conversational skills in a short period. E-learning will be introduced and students must complete some Kana and communication courses within the time frame by self-learning. After this course, students are expected to speak common phrases in different situations and make simple conversation in Japanese language.

### UECS 6023 Introduction to Technopreneurship

This course provides an overview of the basic concepts on entrepreneurship focusing on the nature, environment, and risks of new venture formation and building of businesses with IT in the Malaysian context. Students will learn on how to analyse and evaluate the business

opportunities using knowledge and skills taught in this course and suggest innovative business ideas, business planning, self-assessment and operating strategies required to start a new small business. Students will also be exposed to current case studies of existing companies involved in the IT business. Active participation by students during class discussions and activities is encouraged & expected so that students can gain hands on experience with conducting research, develop, write, evaluate, presenting and defending segments of a business plan.

## UBSS 6023 Business Ethics, Responsibility and Sustainability

Business plays a significant role in societal and environmental well-being. Private and public organizations are no longer responsible to shareholders and those inside the organizations, but to external parties including consumers, politicians, regulators, communities and ordinary citizens. To fulfil the conflicting needs of these stakeholders, business leaders and managers often encounter complex situations that require them to make difficult decisions whereby the lines between right and wrong are blurry. This course aims to provide students the fundamental knowledge about the role of organizations in a society and to develop their skills to sustainably manage organizations that integrate legal, ethical, economic, environmental, and social dimensions into their decision-making. The course intends to develop responsible managers who have high integrity, professionalism and interpersonal skills. The course will also teach strategies on how managers can promote responsible conducts in their companies. The course objectives will be achieved through various teaching and learning methods specifically through critical examination of case studies involving ethical issues and dilemmas on complex and controversial business problems. This course is integrative in nature built upon the understanding and reflection of the main disciplines covered in the core courses in the MBA program.

## UBSS 6013 Organization Behavior and Development

This course helps students integrate behavioural science theories, tools, concepts, and techniques learned in the lab to an OB application in a "real" organization. Students are expected to conceptualize and apply Organization Behaviour three-level of analysis and synthesize it with the theory and practice of Planned Change for individuals, groups and organizations. Throughout the course, participants are exposed to the important topics central to behaviours of organization and its holistic process for development and change. Some of the topics include multiple views of organizations that influence organizational change, the evolution of organizational development and its challenges. The course also covers the nature of planned change, theories and types of change, the role of values and ethics in organizational change, and the concept of emergent change to enable participants to have an overall view of how available approaches to planned change management can be applied in organizational settings.