UTM
UNIVERSITI TEKNOLOGI MALAYSIA

POSTGRADUATE ACADEMIC HANDBOOK

SESSION 2023/2024

FACULTY OF SCIENCE

...where great minds are nurtured

science.utm.my

Edition: 2023/2024

Attention

All information in this version of the guide is true at time of publishing.
The Faculty of Science reserves the right to make amendments to the guide as needed without prior announcement. This Academic Guide is a reference for students from the 2023/2024 Session intake and remains valid until the end of their study. The synopses of courses offered by the Faculty of Science are only available in English, as per the language used in their instruction.

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DEAN'S FOREWORD

ُالسَّلاَمُ عَلَيْكُمْ وَرَحْمَةُ اللهِ وَبَرَكَاتُه and Salam Sejahtera,

بِسْـــــــــــــــمِ االلهالرَّحْمَنِ االرَّحِيم

It is with great pleasure that, on behalf of the entire Faculty of Science staff, I extend my warmest greetings to all new Postgraduate candidates for the academic year 2023/2024. I would like to extend my warmest congratulations to all of you who have been accepted as postgraduate candidates for the Academic Year 2023 /2024 at the Faculty of Science, Universiti Teknologi Malaysia.

This handbook serves as your guide on academic matters and provides you with the information you need to successfully conduct your postgraduate studies at the faculty. We encourage you to read through the contents of this handbook so as to better assist you as a postgraduate candidate at the faculty.

Faculty of Science's mission is to create a stimulating research atmosphere for postgraduate candidates, fostering intellectual and social interactions between students, supervisors and collaborative partners from higher learning institutions, industries, and communities, both nationally and globally. The faculty offers both research-based and coursework postgraduate degrees. The research-based degree allows you to immerse in your chosen field of interest, while the course-work based degree enables you to master advanced knowledge, beyond your undergraduate study.

The faculty tagline *"..where great minds are nurtured"* signifies our commitment in our endeavour of learning and teaching in bringing out the best in our students. The faculty aims to develop scientists and technologists who possess the basic academic competencies in theory and practice that can make a positive impact on society. I hope that your postgraduate experience at the Faculty of Science and Universiti Teknologi Malaysia will enable you to play a more important role as scientists in the society.

Once again congratulations, and we wish you all the best as you pursue your postgraduate studies at the Faculty of Science, Universiti Teknologi Malaysia.

Wassalam

Kerana Tuhan Untuk Manusia
'In the Name of God for Mankind'

Assoc. Prof. Dr. Shafinaz Shahir
Dean Faculty of Science

BACKGROUND OF UNIVERSITI TEKNOLOGI MALAYSIA

Universiti Teknologi Malaysia (UTM) was first established on the 14th of March 1972 under the name of Institut Teknologi Kebangsaan (ITK). On the 1st of April 1975, the name was changed to Universiti Teknologi Malaysia. Although UTM was considered as a new university then, as a technical institution, it had actually existed since 1925 by the name of Kuala Lumpur Technical School. The School initially trained technicians for the Public Works Department and was later opened to other civil servants in 1930.

In 1946, the government upgraded the status of the Technical School to a Technical College. However, the construction of the college only started in 1951 at Jalan Gurney, Kuala Lumpur and completed in 1955.

In 1960, the Technical College began to offer engineering courses on a professional level. Students pursuing these courses were required to sit for professional examinations conducted by the Institution of Civil Engineers, Institution of Mechanical Engineers and the Institution of Electrical Engineers, United Kingdom.

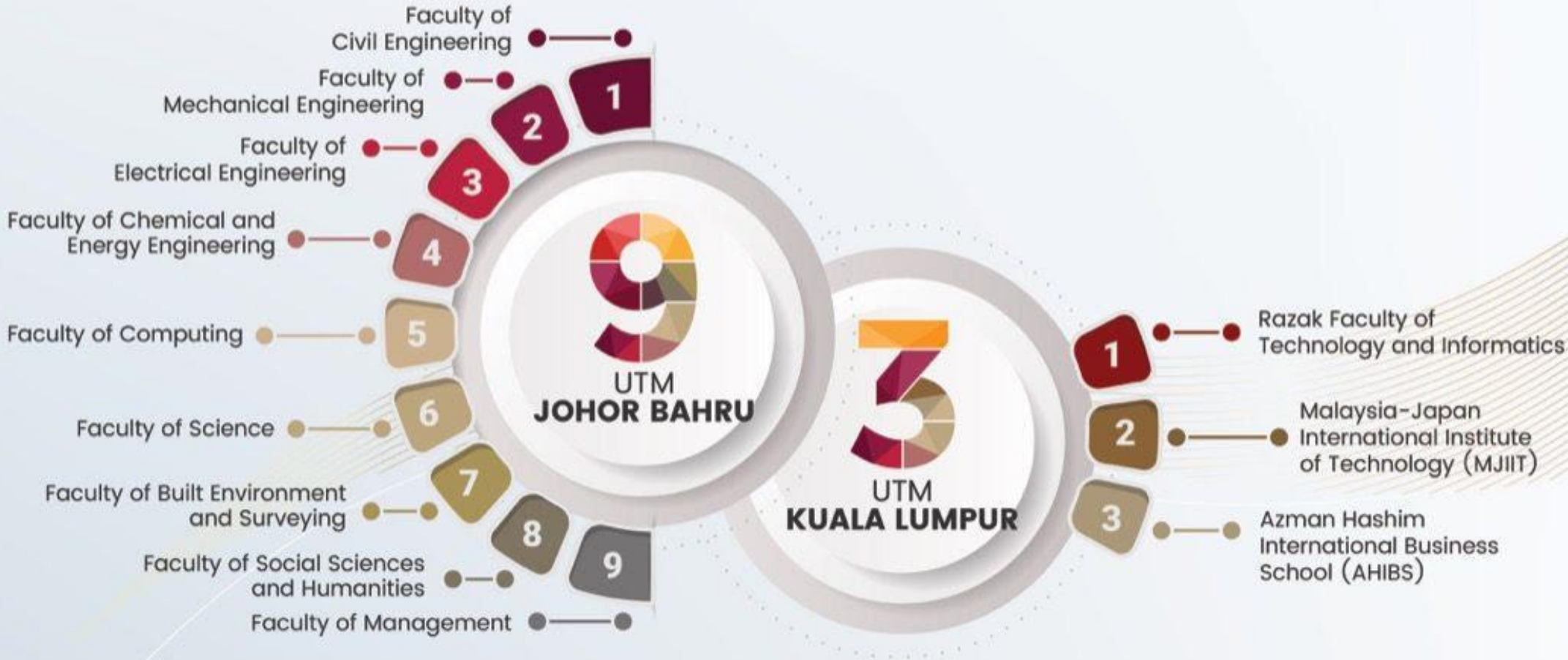
Degree courses were first offered in 1969, when the Planning Committee for Higher Learning recognized the college as a university-level technical institute. On the 14th of March 1972, His Majesty Yang Di Pertuan Agong proclaimed the establishment of Institut Teknologi Kebangsaan, which was later renamed Universiti Teknologi Malaysia. The university was recognized as a technical university focusing on technology, with Bahasa Malaysia as the medium of instruction.

In June 2010, UTM received recognition and status as a Research University (RU).

Currently, UTM's main campus is located on a land spanning 1,120 hectares in Skudai, Johor. It is situated about 18 km from Johor Bahru City centre. The branch campus is located at UTM Kuala Lumpur, Jalan Sultan Yahya Petra (Jalan Semarak), Kuala Lumpur and UTM Pagoh, Pagoh Higher Education Hub. The move from the original campus at Jalan Semarak, Kuala Lumpur, to the main campus in Skudai began in 1985 and proceeded in stages. At present, the Skudai campus houses 9 faculties and 3 faculties in UTM Kuala Lumpur, as follows:

LIST OF FACULTIES
UNIVERSITI TEKNOLOGI MALAYSIA

EFFECTIVE FROM **1 OCTOBER 2022**



PHILOSOPHY, VISION, MISSION AND MOTTO OF UTM

PHILOSOPHY

The divine law of Allah is the foundation for knowledge. In line with His Will, UTM strives with total commitment to attain excellence in science, technology and engineering for the well-being and prosperity of mankind.

Hukum Allah adalah dasar kepada ilmu. Sejajar dengan kehendak-Nya, UTM komited secara menyeluruh dan bersepadu demi mencapai kecemerlangan dalam sains, teknologi dan kejuruteraan untuk kemakmuran dan kesejahteraan sejagat.

VISION

A Premier University Providing World-Class Education and Research

Universiti Terkemuka Menyediakan Perkhidmatan Pendidikan dan Penyelidikan Bertaraf Dunia

MISSION

To Develop Holistic Talents and Prosper Lives Through Knowledge and Innovative Technologies

Untuk Membangun Bakat Holistik dan Mensejahtera Kehidupan Menerusi Ilmu dan Inovasi Teknologi

CORE VALUE

Integrity / *Integriti*

Synergy / *Sinergi*

Excellence / *Kecemerlangan*

Sustainability / *Kelestarian*

MOTTO

"KERANA TUHAN UNTUK MANUSIA"

In the Name of God for Mankind

ABOUT FACULTY OF SCIENCE

THE CHRONOLOGICAL DEVELOPMENT OF FACULTY OF SCIENCE

YEAR	EVENT
1972	• The Science Service Unit teaches Physics, Chemistry and Mathematics for the Engineering Faculties of Institut Teknologi Kebangsaan (ITK). • The Centre for Science and Humanities Studies, consisting of four departments (Physics, Chemistry, Mathematics and Humanities) was established. • A Diploma of Science and Education was initiated in cooperation with the Ministry of Education, Malaysia.
1978	• The split of the Centre of Science and Humanities Studies resulted in the formation of the Centre of Science Studies (PPS), which consisted of 3 Departments (Physics, Chemistry and Mathematics).
1978	• The Diploma of Science with Education was renamed as the Integrated Science with Education Course (ISP).
1979	• Enrolment of the first batch of undergraduate students for the Bachelor of Science with Education program (SSP).
1980	• The Department of Computer Science was established and placed under PPS.
1981	• The Centre for Science Studies (PPS) was upgraded and renamed as the Faculty of Science (FS).
1982	• The Education Department and the Department of Technical Science were transferred from the Centre of Humanities Studies into the Faculty of Science.
1983	• The Bachelor of Computer Science Programme was initiated.
1984	• The Department of Computer Science separated from the Faculty of Science to form an independent faculty.
1986	• The Bachelor of Science in Technology with Education (Civil, Electrical, Mechanical) was established.
1987	• The Bachelor of Industrial Science (SSI) course was started. The programmes offered were Industrial Chemistry, Industrial Physics and Industrial Mathematics.
1988	• The Faculty of Science moved to Skudai. • The Bachelor of Computer Science with Education (SPK) was initiated, followed by the Diploma in Education.

1989	• The Faculty officially started its postgraduate program in Chemistry, Physics and Mathematics.
1992	• The Faculty started the Bachelor of Science in Technology with Education (Living Skills) course.
1994	• The Department of Education and the Department of Science and Technical Education were dissolved following the establishment of the Faculty of Education. Three departments remained in the Faculty of Science: The Departments of Chemistry, Physics and Mathematics.
1997	• The Faculty started offering the Bachelor of Industrial Science (Biology) programme.
1998	• The Faculty started offering the Bachelor of Industrial Science (Material Physics) programme.
1999	• The Faculty started offering the Bachelor of Industrial Science (Health Physics) programme.
2000	• The Biology Department was established in the Faculty.
2002	• The Faculty of Science began offering a special programme known as the Excellent Scientists Programme (Pure Physics, Chemistry and Mathematics).
2003	• The enrolment of students for the Undergraduate Programme was limited to only post-matriculation, post-STPM and diploma holders only.
2005	• The Faculty began offering Undergraduate Degree Programmes in Pure Sciences (Biology, Chemistry, Physics and Mathematics).
2010	• Enrolment of students for the Bachelor of Science (Material Physics) and Bachelor of Science (Health Physics) was stopped.
2012	• The Department of Mathematics was renamed the Department of Mathematical Sciences.
2018	• UTM Synergy 4.0 • The Department of Biosciences, previously from the Faculty of Biosciences and Medical Engineering merged together with the Faculty of Science.
2022	• The Faculty started offering the Master of Forensic Science (Taught Course) programme.

VISION, MISSION, MOTTO, PHILOSOPHY AND OBJECTIVES

VISION

To be a world renowned faculty in the advancement of science and mathematics

MISSION

To lead in the development of holistic talents and knowledge through learning and teaching, research and innovation for universal well-being

MOTTO

"WHERE GREAT MINDS ARE NURTURED"

PHILOSOPHY

Faculty of Science is committed to provide the pillar of strength through fundamental knowledge for the advancement and sustainability of other disciplines for UTM to continue soaring high.

OBJECTIVES

(Educational Goals)

1. To provide quality academic programmes in science and mathematics to meet both local and global education needs.
2. To facilitate the dissemination of knowledge in science and mathematics through innovative and effective teaching and learning.
3. To produce competent and versatile graduates guided by high moral and ethical values.
4. To undertake frontier and transformative research and development in biology, chemistry, physics, and mathematics.
5. To engage in interdisciplinary and collaborative research.
6. To provide an environment conducive to the exchange of knowledge, views, and innovative ideas.
7. To contribute to the advancement of knowledge through scholarly publications.
8. To engage in scientific based smart partnership and global networking.
9. To contribute to the generation of the nation's wealth through research and innovation.
10. To contribute to the improvement of the quality of life, protection of the environment and conservation of natural resources.

BUSINESS, STATEMENT OPPORTUNITY AND COMPETENCY

BUSINESS

To conduct teaching-learning, research and consultancy activities in the field of science and mathematics.

STATEMENT OF OPPORTUNITY

1. Capitalizing on the staff expertise in realizing a culture of intellectual excellence to attract high quality students.
2. Maximizing smart partnership and professional networking with public and private sectors to enhance research, students internship, and graduate employability.
3. Optimizing the usage of state of the art facilities to conduct Faculty's programs, research activities, consultation work, and professional development programs.
4. Implementing market driven academic programs ensures quality graduates and employers satisfaction.
5. Support visionary leadership drives innovative and transformative ideas in achieving management excellence thus increasing Faculty's academic ranking.

FACULTY'S COMPETENCY

1. Conducting quality teaching and learning in science and mathematics through creative and innovative techniques.
2. Designing science and mathematics based programs in line with local and global trends and needs.
3. Undertaking frontier research in science and mathematics.
4. Engaging in interdisciplinary and collaborative research.
5. Producing scholarly publications consistently.
6. Providing scientific consultancy and advisory services.

CLIENTS CHARTER

The Faculty of Science is committed to:

1. Design quality academic programmes which are market-driven, adaptable to the nation's needs and are able to inculcate ethical values to the students.
2. Fulfil academic duties with full responsibility and dedication in accordance with the standards, rules and regulations as stipulated by the University.
3. Execute fair and just assessment in the evaluation of students' academic performance.
4. Provide well-equipped laboratories and regularly maintained facilities conducive to laboratory work and research.
5. Provide professional guidance, supervision and efficient management in laboratory work and research.
6. Provide training and consultation towards the improvement of skills and professionalism.
7. Practise a friendly, open and caring attitude, always ready to provide necessary assistance related to the Faculty's core business.
8. Provide assistance within five (5) minutes of arrival to all clients at the Faculty's service counter.
9. Ensure a safe and healthy working environment in the faculty.

FACULTY OF SCIENCE'S MANAGEMENT TEAM

The Faculty of Science is headed by a Dean, assisted by two Deputy Deans, three Assistant Deans, four Directors, one Laboratory Manager, one Deputy Registrar and two Assistant Registrars.

Name : Associate Professor Dr. Shafinaz Shahir
Position : Dean
Email : shafinazshahir@utm.my

Name : Associate Professor ChM. Dr. Mohd Bakri Bakar
Position : Acting Deputy Dean (Academic & Student Affairs)
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Name : Professor Dr. Suhairul Hashim
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Name : ChM. Dr. Mohd. Firdaus Abd Wahab
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Name : Mdm. Syahida Fadilla Moktar
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Name : Mdm. Hamidah Mat Arif
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Name : Dr. Mohamad Hamdi Zainal Abidin
Position : Generic Programme Coordinator
Department : Chemistry
Email : mohamadhamdi@utm.my

At present, the faculty consists of four major divisions:

i. Department of Biosciences
ii. Department of Chemistry
iii. Department of Mathematical Sciences
iv. Department of Physics

Currently, the Faculty has 167 highly qualified and experienced academic staff, assisted by 121 dedicated and hardworking supporting staff.

In terms of facilities and equipment, the faculty has 4 lecture halls, 25 lecture rooms. As for laboratories, there are 43 laboratories under the management of the Bioscience Department, 69 laboratories under the Chemistry Department, 3 computer laboratories under the Mathematical Sciences Department and 43 laboratories and 2 workshops under the management of Physics Department. These laboratories and workshops are used for teaching purposes as well as scientific research projects.

UTM
UNIVERSITI TEKNOLOGI MALAYSIA
Faculty of Science

ORGANISATIONAL STRUCTURE
Faculty of Science

ASSOC. PROF. DR. SHAFINAZ SHAHIR
DEAN

PROF. DR. SUHAIRUL HASHIM
DEPUTY DEAN
RESEARCH, DEVELOPMENT & INNOVATION

ASSOC. PROF. CHM. DR. MOHD. BAKRI BAKAR
ACTING DEPUTY DEAN
ACADEMIC & STUDENT AFFAIRS

HAJI ABDUL RAZAK ABDUL AZIZ
DEPUTY REGISTRAR

CHM. DR. MOHD FIRDAUS ABDUL WAHAB
ASSISTANT DEAN
EXTERNAL & GLOBAL ENGAGEMENT

ASSOC. PROF. CHM. DR. MOHD. BAKRI BAKAR
ASSISTANT DEAN
CONTINUING & TRANSNATIONAL EDUCATION

DR. FAEZAH MOHD SALLEH
ASSISTANT DEAN
QUALITY & STRATEGY

DR. ROSLINDA ZAINAL
DIRECTOR
PHYSICS

ASSOC. PROF.CHM. DR. NORAZAH BASAR
DIRECTOR
CHEMISTRY

ASSOC. PROF. DR. ZARINA MOHD KHALID
DIRECTOR
MATHEMATICAL SCIENCES

ASSOC. PROF. DR. ALINA WAGIRAN
DIRECTOR
BIOSCIENCES

DR. YAP YUN SZEN
LAB MANAGER

MDM. SYAHIDA FADILLA MOKTAR
SENIOR ASSISTANT REGISTRAR

MDM. HAMIDAH MAT ARIF
SENIOR ASSISTANT REGISTRAR

IBNU SINA INSTITUTE FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (ISI-SIR)

ASSOC. PROF. TS. CHM. DR. NIK AHMAD NIZAM NIK MALEK
DIRECTOR
CENTRE FOR SUSTAINABLE NANOMATERIALS (CSNANO)

TS. DR. MUHAMMAD SAFWAN ABD. AZIZ
DIRECTOR
LASER CENTRE

ASSOC. PROF. DR. ARIFAH BAHAR
DIRECTOR
UTM CENTRE FOR INDUSTRIAL AND APPLIED MATHEMATICS (UTM CIAM)

...where great minds are nurtured

FACULTY RESEARCH AREAS

Within the Faculty of Science, the academic staff stands out for their exceptional excellence in research. To provide insight into their research pursuits, the area of expertise are as follows:

CHEMISTRY	MATHEMATICAL SCIENCES
• Natural Products & Organic Synthesis • Polymer Chemistry • Biotechnology & Biochemistry • Photocatalysis and Heterogeneous Catalysis • Nanostructures, Nanomaterials & Energy Materials • Organometallic Chemistry • Separation Science and Environmental Chemistry • Spectrometric Analysis and Electroanalytical Chemistry • Computational chemistry & chemometrics • Forensic Sciences and Food Chemistry • Electrochemistry • Optical chemical sensor • Surface and colloid chemistry	• Algebra & Group Theory • Mathematical Modelling (Fluid Flow & Fuzzy) • Non-linear Waves & Soliton • Numerical Analysis & Computational Methods • Operational Research & Optimization. • Statistical modelling & Analysis • Time Series & Forecasting
PHYSICS	**BIOSCIENCE**
• Material Physics • Nuclear and Radiation Physics • Optical Physics • Space Physics	• Biological Science • Bioinformatics • Environmental Biotechnology • Genome Biology • Industrial and Food Biotechnology • Medical Biotechnology • Nanobiotechnology • Plant and Agriculture Biotechnology • Tissue Culture Technology • Halal Industry Practices

RESEARCH FACILITIES

The faculty has a range of well-equipped research laboratories and computing facilities to support research and teaching. Some of the research facilities are as follows:

- Nuclear Magnetic Resonance Spectrometer (liquid and MAS NMR)
- Gas Chromatography (GC) and Liquid Chromatography (LC) Systems
- Ion Chromatography (IC)
- Capillary Electrophoresis Unit
- Gas Chromatography-Mass Spectrometer (GC- MS)
- Inductively Coupled-Mass Spectrometer (ICP-MS)
- Transmission Electron Microscope (TEM)
- Field Emission Scanning Electron Microscope (FESEM) and X-Ray Diffractometer (XRD)
- Atomic Absorption Spectrometer (AAS)
- Surface Analyzer
- Thermogravimetric Analyzer (TGA)
- Voltammetric Equipment
- Crystal Growth and Ultrasonic Equipment
- Thin Film Coating
- Fiber Bragg Grating Fabricator
- Fiber Coupler Machine
- Laser Welding Machine
- Nd;YAG laser
- Nitro-Dye laser
- CO_2 Laser
- Photonic Training Facilities
- Thin Film Fabrication
- PECVD, MOVPE, NDT Ultrasonic Testing
- Material Analysis Laboratory
- Crystal Growth Laboratory; Crystal Growth & Fabrication
- Nuclear Laboratory
- Zeta Potential, Rapid Sugardetector
- Nanodrop
- Deep Freezers
- Centrifuges
- Incubator Shaker
- Granulator
- High-Performance Liquid Chromatography (HPLC)
- Flow Cytometer
- Dissolved Oxygen Meter
- Electrochemistry Startup System
- Luminescence UV-Vis Spectrophotometer
- Seed Storage Chamber Pelletizer Bailing Granulator
- Mini Whole Gel Eluter
- Interactive Microscopy System
- Concentrator Plus
- Gradient PCR
- Real-Time PCR
- Multiporator
- Biological Hood
- Automated Glass Washer
- Glass Desiccator
- Nitrogen Sparger
- Freeze Dryer
- Dynamic Simulation
- Hybridization Oven
- Crystallization Chamber
- AKTA Liquid Chromatography
- Gas Chromatography
- Vilver Lourmat UV Irradiation
- Thermo Hygrometer
- Vivaflow
- Plant Tissue Culture Chamber
- Portable Photosynthesis System
- Quickstand Membrane System
- Refrigerated Shaker
- Precipator
- Water Purification System
- HACH Spectrophotometer
- WGS Annotation
- Electronic Cell Distrupter
- Microscope Stereozoom
- Viscometer, Tissue Lyser
- Inverted Fluorescence Microscope
- Microplate Reader
- Rotary Evaporator
- SDS Page
- Western Blot
- Qubit
- Fermentor
- Isothermal Titration Calorimetry
- Bioinformatic facility

The research facilities are supported by a team of qualified and trained technical staff.

STUDENT SUPPORT

There is an excellent student support system in the Faculty of Science, UTM. Students of the Faculty receive close personal guidance from experienced academic supervisors in addition to student-to-student mentoring. Graduate students are also encouraged to participate in activities organized by the Postgraduate Student Society Faculty of Science (PGSSFS). Apart from that, students also have access to the department Postgraduate Activity Room which is equipped with computers and internet facilities.

POSTGRADUATE STUDENT SOCIETY FACULTY OF SCIENCE
(PGSSFS)

The Postgraduate Student Society Faculty of Science (PGSSFS) is a representative society concerning all interests of postgraduate students in the Faculty of Science, Universiti Teknologi Malaysia (UTM). The committee members of PGSS Faculty are selected by a polling process during the Annual General Meeting (AGM) Faculty. Meanwhile, the committee members of PGSS UTM (Centre) are selected among the PGSS Faculty Presidents by another polling process during the Annual General Meeting of PGSS with the School of Graduate Studies (SPS) UTM. The existence of PGSSFS becomes the main initiator towards interpersonal and soft skills development as well as to voice the needs of all Master and PhD students in the faculty.

VISION

To be the voice of postgraduate students and acts as a bridge between administration/staff and postgraduate students in the Faculty of Science

OBJECTIVES

1. To showcase and promote the interests of its members in all aspects, both within and outside the faculty.
2. To facilitate communication between members and faculty authorities, as well as between members and any other bodies.
3. To aid members while they are enrolled in a course of study.
4. To encourage members' cooperation for educational, social, and cultural activities, as well as for other community-beneficial purposes.

POSTGRADUATE STUDENT SOCIETY (PGSS UTM)

MISSION

To be an optimal, responsible and holistic postgraduate representation body in UTM

VISION

To be a catalyst in creating a world class leading and exemplary postgraduate society

MOTTO

From Students to Students

PGSS FS ACADEMIC ACTIVITIES

1. Postgraduate Structured Course (PGSC)
2. Postgraduate Coffee Session (PGCS)
3. Postgraduate Compulsory Course (PGCC)
4. Competition
5. Faculty of Science Postgraduate Seminar Series

POSTGRADUATE PROGRAMMES

ENTRY REQUIREMENTS

MASTER'S DEGREE

- A Bachelor's Degree with good honours from Universiti Teknologi Malaysia or any other institution of higher learning recognised by the Senate; ***OR***

- A qualification equivalent to a Bachelor's Degree and experience in the relevant field recognised by the Senate.

DOCTOR OF PHILOSOPHY

- A Master's Degree from Universiti Teknologi Malaysia or any other Institutions of higher learning recognised by the Senate; ***OR***

- Other qualifications equivalent to a Master's degree and experience in the relevant field recognised by the Senate; ***OR***

- Candidates who are currently registered in a Master's Degree programme at Universiti Teknologi Malaysia, and approved by the Graduate Studies Committee of the respective faculty and the Senate.

MASTER BY COURSEWORK PROGRAMME

Obtained Bachelor Degree with the following grade		
• First Class • Second Class Upper • Second Class Lower • Excellent Pass	**Scale**	**Working Experience**
CPA Scale of 4	2.50 or higher	No Working Experience Needed
CPA Scale of 5	3.13 or higher	
CPA Scale of 20	12.5 and higher	
Percentage	62.5% or higher	
1000 Marks	625 or higher	

Obtained Bachelor Degree with the following grade		
Good Pass Third Class	**Scale**	**Working Experience**
CPA Scale of 4	CPA below 2.50	5 years working experience in the related field
CPA Scale of 5	CPA below 3.13	
CPA Scale of 20	CPA below 12.5	
Percentage	CPA below 62.5%	
1000 Marks	CPA below 625	

MASTER BY MIXED-MODE AND RESEARCH PROGRAMME

Obtained Bachelor Degree with the following grade		
First Class Second Class Upper Excellent Pass	**Scale**	**Working Experience**
CPA Scale of 4	2.75 or higher	No Working Experience Needed
CPA Scale of 5	3.38 or higher	
CPA Scale of 20	13.75 and higher	
Percentage	68.75% or higher	
1000 Marks	687.5 or higher	

Obtained Bachelor Degree with the following grade		
Second Class Lower Very Good Pass	**Scale**	**Working Experience**
CPA Scale of 4	$2.50 \leq CPA < 2.75$	Subject to rigorous internal assessment
CPA Scale of 5	$3.13 \leq CPA < 3.43$	
CPA Scale of 20	$12.5 \leq CPA < 13.75$	
Percentage	$62.5\% \leq CPA < 68.75\%$	
1000 Marks	$625 \leq CPA < 687.5$	

Obtained Bachelor Degree with the following grade		
Good Pass Third Class	**Scale**	**Working Experience**
CPA Scale of 4	CPA below 2.50	5 years working experience in the related field
CPA Scale of 5	CPA below 3.13	
CPA Scale of 20	CPA below 12.5	
Percentage	CPA below 62.5%	
1000 Marks	CPA below 625	

APPLICATION CLOSING DATES

POSTGRADUATE ADMISSION

Postgraduate students may apply at any time. Applications received after the closing date will be offered for next registration.

Application for **February** intake is open from September to November (for international students) and from September to December (for local students).

Application for **September** intake is open from March to June (for international students) and from March to July (for local students).

For further information, please refer
https://admission.utm.my/postgraduate-entry-requirements/.

PROGRAMME FEES

PROGRAMME FEES FOR MALAYSIAN STUDENTS

Fees do not include hostel, convocation (MYR250) & Viva-voce

* Subject to changes

PROGRAMME	TUITION FEES (MYR For New Students)
Master (Coursework & Mixed-Mode) 3 Semesters	10,660.00
Master (Research) 2 semesters	9,560.00
Doctor of Philosophy (Research) 6 semesters	18,350.00

Viva-voce fees RM1,500 (Master) and RM2,500 (PhD) to be paid during thesis submission

For further information, please refer https://admission.utm.my/fees-pg-malaysian/.

PROGRAMME FEES FOR INTERNATIONAL STUDENTS

Fees do not include hostel, convocation, VISA & Personal Bond.
* Subject to changes

PROGRAMME	TUITION FEES (MYR For New Students)
Master (Mixed-Mode) 3 Semesters	28,500.00
Master (Research) 2 semesters	28,400.00
Doctor of Philosophy (Research) 6 semesters	48,600.00

Viva-voce fees RM1,500 (Master) and RM2,500 (PhD) to be paid during thesis submission

For further information, please refer https://admission.utm.my/fees-pg-inter/.

MODES OF STUDY

Faculty of Science students may enroll in **any one** of the three modes of study:

- Mixed-Mode (Taught Course and Research)
- Taught Course
- Full Research (R)

MIXED-MODE (TAUGHT COURSE AND RESEARCH)

Students must complete a minimum of 21 credits of courses and an equivalent 21-credit research component, and must obtain a final academic grade of at least 3.0 CGPA.

COURSEWORK (TAUGHT COURSE)

In this mode, the candidate must complete a minimum of 45 credits and must obtain a final Cumulative Grade Point Average (CGPA) of at least 3.0 on a scale of 4.0. The minimum 45 credits of several courses including the faculty compulsory, faculty electives, a university elective and a Master's research project.

RESEARCH (R)

A Masters or Doctor of Philosophy candidate is supervised by one or more graduate faculty staff who holds a PhD or at least Associate Professor. The directed work introduces candidates to the processes by which new knowledge is generated and applied accordingly. In the case of panel supervision, co-supervisor(s) from the other universities / industry / research institutions related to the area of study may be appointed.

The academic progress of a candidate is assessed through a bi-annual research progress report. The degree is awarded based on a comprehensive examination (viva voce) of the master's or PhD thesis submitted at the completion of study.

FACULTY OF SCIENCE
POSTGRADUATE PROGRAMMES

The Faculty of Science currently offers 16 postgraduate programmes leading to the Master's of Science, Master of Philosophy or Doctor of Philosophy Degrees in areas of science and mathematics.

The normal duration of study is **2–8** semesters (1–4 years) for the Master's programmes and **6–16** semesters (3–8 years) for the Doctor of Philosophy programmes

For the Master's Degree, students may register either for the Masters by Research Programme, Masters by Mixed-Mode or Masters by Taught Course.

No.	Programme Name	Field of Research	Modes of Study
1	Master of Science (Chemistry)	-	Mixed-Mode
2	Master of Science in Mathematics	-	Mixed-Mode
3	Master of Science in Engineering Mathematics	-	Mixed-Mode
4	Master of Science Physics	-	Mixed-Mode
5	Master of Science (Biotechnology)	-	Mixed-Mode
6	Master of Forensic Science	-	Taught Course
7	Master of Philosophy	Chemistry	Research
8	Master of Philosophy	Mathematics	Research
9	Master of Philosophy	Physics	Research
10	Master of Philosophy	Bioscience	Research
11	Doctor of Philosophy	Chemistry	Research
12	Doctor of Philosophy	Mathematics	Research
13	Doctor of Philosophy	Physics	Research
14	Doctor of Philosophy	Bioscience	Research
15	Doctor of Philosophy	Generic	Research

Each programme requires the student to take at least one of the University compulsory courses from the following options:

No.	Course code	Faculty	Course name
1	UBSS 6013	AHIBS KL	Organization Behaviour and Development
2	UBSS 6023	AHIBS KL	Business Ethics, Responsibility and Sustainability
3	UHMS 6013	FSSH/SHARP	Seminar on Global Development, Economic and Social Issues
4	UHMZ 6023	FSSH/SHARP	Malaysian Society and Culture
5	UHIS 6013	FSSH/ATI	Philosophy of Science and Civilization
6	UHPS 6013	FSSH/SOE	Dynamics of Leadership
7	UHLM 6013	FSSH/LA	Malay Language for Post Graduates
8	URTS 6013	FTIR	Environmental Ethics
9	UECS 6013	FC	IT Project Management
10	URSP 6023	FTIR	ICT Ethics and Society
11	UANP 6013	FTIR	Informatics in Society
12	UMJJ 6013	MJIIT	Basic Japanese Language & Culture

Apart from the above requirements, research students must enrol in a research methodology course:

USCP 6013 : Research Methodology (HW)

MASTER OF PHILOSOPHY AND DOCTOR OF PHILOSOPHY

Programmes by Research (Full-time)

General Information

Faculty of Science offers **Master of Philosophy** and **Doctor of Philosophy** programmes by research in all fields of specialisation (Chemistry, Mathematics, Physics and Bioscience). A student will carry out research in any one of the areas of research. Each research work has to be supervised by a lecturer or a panel of lecturers from the Graduate Faculty. Co-supervisors may also be appointed from a local/international higher institutions or related industry.

In addition to the university compulsory courses, research students may be required to attend lectures related to their research fields. The subjects to be taken shall be determined by the respective supervisors. As part of their training, students are required to participate in seminars and conferences, write technical reports or papers for publications in refereed proceedings or indexed journals.

Assessment for research students is done by means of each semester progress reports, first assessment report and thesis examination (viva-voce). At the end of each semester, all research students will have to submit their progress report to their supervisors by Week 15. All **PhD** and **M.Phil** students must undergo the first assessment of their research proposal. The first assessment is scheduled according to the student's appropriate semester of study as described below:

PROGRAMME	SEMESTER
M.Phil	Semester 2
PhD	Semester 3

Students who wish to submit the final draft of their thesis must send in the **'Notice of Thesis Submission'** to the Faculty at least 3 months prior to the date of submitting their thesis.

M.PHIL BY RESEARCH COURSE CODES

SEMESTER / YEAR	CHEMISTRY	MATHEMATICS	PHYSICS	BIOSCIENCE	DESCRIPTION
1/1	MSCC 1100	MSCT 1100	MSCZ 1100	MSCS 1100	Research
2/1	MSCC 1200	MSCT 1200	MSCZ 1200	MSCS 1200	Research
3/2	MSCC 2100	MSCT 2100	MSCZ 2100	MSCS 2100	Research
4/2	MSCC 2200	MSCT 2200	MSCZ 2200	MSCS 2200	Research
5/3	MSCC 3100	MSCT 3100	MSCZ 3100	MSCS 3100	Research
6/3	MSCC 3200	MSCT 3200	MSCZ 3200	MSCS 3200	Research
7/4	MSCC 4100	MSCT 4100	MSCZ 4100	MSCS 4100	Research
8/4	MSCC 4200	MSCT 4200	MSCZ 4200	MSCS 4200	Research

For the **M.Phil** programmes in Chemistry, Mathematics, Physics and Bioscience, the course code for research is given as MSCC wxyz, MSCT wxyz, MSCZ wxyz and MSCS wxyz respectively.

w – Year of Study (PhD 1 – 8, MSc 1 – 4)
x – Semester (1 or 2)
y – 0 (Full time)
z – Number of Credits,

Ph.D BY RESEARCH COURSE CODES

SEMESTER / YEAR	CHEMISTRY	MATHEMATICS	PHYSICS	BIOSCIENCE	GENERIC	DESCRIPTION
1/1	PSCC 1100	PSCT 1100	PSCZ 1100	PSCS 1100	PSCG 1100	Research
2/1	PSCC 1200	PSCT 1200	PSCZ 1200	PSCS 1200	PSCG 1200	Research
3/2	PSCC 2100	PSCT 2100	PSCZ 2100	PSCS 2100	PSCG 2100	Research
4/2	PSCC 2200	PSCT 2200	PSCZ 2200	PSCS 2200	PSCG 2200	Research
5/3	PSCC 3100	PSCT 3100	PSCZ 3100	PSCS 3100	PSCG 3100	Research
6/3	PSCC 3200	PSCT 3200	PSCZ 3200	PSCS 3200	PSCG 3200	Research
7/4	PSCC 4100	PSCT 4100	PSCZ 4100	PSCS 4100	PSCG 4100	Research
8/4	PSCC 4200	PSCT 4200	PSCZ 4200	PSCS 4200	PSCG 4200	Research
9/5	PSCC 5100	PSCT 5100	PSCZ 5100	PSCS 5100	PSCG 5100	Research
10/5	PSCC 5200	PSCT 5200	PSCZ 5200	PSCS 5200	PSCG 5200	Research
11/6	PSCC 6100	PSCT 6100	PSCZ 6100	PSCS 6100	PSCG 6100	Research
12/6	PSCC 6200	PSCT 6200	PSCZ 6200	PSCS 6200	PSCG 6200	Research
13/7	PSCC 7100	PSCT 7100	PSCZ 7100	PSCS 7100	PSCG 7100	Research
14/7	PSCC 7200	PSCT 7200	PSCZ 7200	PSCS 7200	PSCG 7200	Research
15/8	PSCC 8100	PSCT 8100	PSCZ 8100	PSCS 8100	PSCG 8100	Research
16/8	PSCC 8200	PSCT 8200	PSCZ 8200	PSCS 8200	PSCG 8200	Research

For the **PhD** programmes in Chemistry, Mathematics, Physics and Bioscience, the course code for research is given as PSCC wxyz, PSCT wxyz, PSCZ wxyz, and PSCS wxyz, respectively.

w – Year of Study (PhD 1 – 8, MSc 1 – 4)

x – Semester (1 or 2)

y – 0 (Full time)

z – Number of Credits,

MASTER OF SCIENCE (M.Sc)

Programmes By Mixed-Mode

General Information

Students have to take at least 42 (for MSCC) and 45credits including one compulsory University courses and obtain a CPA of at least 3.0 to graduate. Students have to pass each course with at least a B- grade. The distribution of grade and GPA is given in the following table:

Marks	Grade	Evaluation Point	Level of Achievement
90 – 100	A+	4.00	Excellent Pass
80 – 89	A	4.00	
75 – 79	A-	3.67	
70 – 74	B+	3.33	Good Pass
65 – 69	B	3.00	
60 – 64	B-	2.67	Pass
55 – 59	C+	2.33	Fail
50 – 54	C	2.00	
45 – 49	C-	1.67	
40 – 44	D+	1.33	
35 – 39	D	1.00	
30 – 34	D-	0.67	
0 – 29	E	0.00	

MASTER OF FORENSIC SCIENCE

Programme By Taught Course

General Information

Students have to take at least 45 credits including one compulsory University courses and obtain a CPA of at least 3.0 to graduate. Students have to pass each course with at least a B- grade. The distribution of grade and GPA is given in the following table:

Marks	Grade	Evaluation Point	Level of Achievement
90 – 100	A+	4.00	Excellent Pass
80 – 89	A	4.00	
75 – 79	A-	3.67	
70 – 74	B+	3.33	Good Pass
65 – 69	B	3.00	
60 – 64	B-	2.67	Pass
55 – 59	C+	2.33	Fail
50 – 54	C	2.00	
45 – 49	C-	1.67	
40 – 44	D+	1.33	
35 – 39	D	1.00	
30 – 34	D-	0.67	
0 – 29	E	0.00	

BIOSCIENCES PROGRAMMES

MASTER OF SCIENCE (BIOTECHNOLOGY)

PROGRAMME SPECIFICATION

1. Awarding Institution	UTM
2. Teaching Institution	UTM
3. Programme Name	Master of Science (Biotechnology)
4. Final Award	Master of Science (Biotechnology
5. Programme Code	MSCB
6. Professional or Statutory Body of Accreditation	Malaysian Ministry of Higher Education Kementerian Pengajian Tinggi Malaysia
7. Language(s) of Instruction	English
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-govern
10. Study Scheme	Full Time
11. Study Duration	Minimum: 1½ years Maximum: 4 years
12. Entry Requirement	**University Entry Requirement** **i)** A bachelor's degree in the field or related fields with a minimum CGPA of 2.75 or equivalent, as accepted by the HEP Senate; or **ii)** A bachelor's degree in the field or related fields or equivalent with a minimum CGPA of 2.50 and not meeting CGPA of 2.75, can be accepted subject to rigorous internal assessment; or **iii)** A bachelor's degree in the field or related fields or equivalent with a minimum CGPA of 2.00 and not meeting CGPA 2.50, can be accepted subject to a minimum of 5 years working experience in the relevant field and rigorous internal assessment. **Faculty Entry Requirement** Bachelor of Science (Biology, Biochemistry, Biotechnology, Microbiology, Bioscience, Chemistry, Chemical Engineering, Bioprocess Engineering, Genetics of equivalent) with CPA ≥ 3.0 will be considered for this programme.

	English Language Requirement **i) Student with TOEFL score if 60 and above can enroll at faculty** **ii) Students with TOEFL score of 60 and below required to attend either:** ● **Intensive English Programme (IEP) conducted by Language Academy (LA), UTM** *and pass IELTS with a minimum of 6.0 or pass CEFR – aligned test with the required score* Or ● **Certified Intensive English Programme (CIEP)** conducted by ELS Language Center and pass level 108 **iii) Student with IELTS band 6.0 and above can enroll at faculty** **iv) Student with band 5.5 and below are required to attend either:** • **Intensive English Programme (IEP) conducted by Language Academy (LA), UTM** and pass IELTS with a minimum of 6.0 or pass CEFR-aligned test with the required score or • **Certified Intensive English Programme (CIEP)** conducted by ELS Language Center and pass level 108

13. Programme Educational Objectives (PEO)

Graduates of the programme should be :

1. PEO1: Competent in applying advanced knowledge towards solving Biotechnology problems to meet local and global needs.

2. PEO2: Adaptable to changing situations with initiatives for career advancement through life-long learning.

3. PEO3: Holistic leader who adhere to standards of ethical conduct within professional and societal setting.

14. Programme Learning Outcomes (PLO)

Intended Learning Outcomes			Teaching and Learning Methods	Assessment
TECHNICAL SKILLS	**PLO1**	Synthesize advanced knowledge, theories and concepts in biotechnology.	Lectures, seminars, directed reading, independent study	Examinations, tests, quizzes, written assignments
	PLO2	Produce innovative solutions to complex and current issues in biotechnology and related field.	Lectures, laboratory works, mini project	Examinations, tests, oral presentations, written assignments, Dissertation, quizzes
	PLO3	Use specific and advanced equipment in executing specialised Research Methodology to generate accurate and valid data.	Mini project, supervised project.	Dissertation, oral presentations, written assignments
	PLO7	Evaluate numerical and graphical data using relevant software as well as qualitative and quantitative methods for research.	Lecture, independent study.	tests, examinations, assignment, quizzes, Dissertation

INTENDED LEARNING OUTCOMES			TEACHING AND LEARNING METHODS	ASSESSMENT
GENERIC SKILLS	**PLO4**	Collaborate effectively with different groups in learning and working communities.	Group assignments, research project supervision, laboratory works	Oral presentations, written assignments, laboratory reports,
	PLO5	Communicate effectively using appropriate media in delivering knowledge and ideas to the relevant communities.	Research project supervision, group assignments, laboratory work, lecture	Oral presentations, written assignments, research project presentation, laboratory reports
	PLO6	Utilize a wide range of suitable digital technologies and appropriate software competently to enhance study and research.	Group assignments, laboratory works	Oral presentations, laboratory reports,

	PLO8	Demonstrate leadership skills, autonomy and responsibility in supervising and managing an organization.	Lectures, group assignments, Mini project	written assignments, laboratory reports, peer assessment
	PLO9	Demonstrate self-advancement through continuous academic and professional development.	Research project supervision, laboratory works	Dissertation, laboratory reports
	PLO10	Initiate entrepreneurial ventures in biotechnology and related field.	Research project, Group assignments,	written assignments, Oral presentations
	PLO11	Practice adherence to biosafety guidelines, professional ethics and legal norms.	Independent study, supervised project, laboratory works	Dissertation, assignment

15. Classification of Courses

No.	Classification	Credit Hours	Percentage	Standard (QA)
i.	University General Course	3	7	50%
ii.	Core Courses	12	29	
iii.	Elective Courses	6	14	
iv.	Dissertation	21	50	50%
	Total	42	100	100%

16. Total credit hours to graduate : 42 credit hours

17. Programme structures and features, curriculum, and award requirements

The course is offered in full-time mode and based on a 3 Semester Academic Year with several subjects being delivered and assessed in each semester. Assessment: Based on final examination, coursework and dissertation.

Award requirements:

To graduate, students should:

- achieve a total of minimum 42 credit hours with minimum CPA of 3.00
- complete and pass viva M.Sc Dissertation.

Course Category	Code	Course	Credit
University General Course (3 Credits)	**UXX 6XX3**	(Choose 1 courses from the list given by School of Graduate Studies)	3
Core Courses (12 Credits)	**MSCB 1403**	Research Methodology	3
	MSCB 1113	Biochemistry and Microbial Physiology	3
	MSCB 1813	Protein Engineering	3
	MSCB 1523	Industrial Technology & Bioreactor Design	3
Elective Courses (6 Credits)		(Select any 6 credits)	
	MSCB 1323	Tissue Culture Approaches in Industrial Biotechnology	3
	MSCB 1423	Halal Industry Regulations, Management and Practices	3
	MSCB 1503	Agricultural Practices	3
	MSCB 1203	Algae Biotechnology	3
	MSCB 1223	Environmental Bioengineering	3
	MSCB 1823	Bioinformatics	3
Research Course (21 Credits)	**MSCB 1280**	Research Proposal (pre-requisite Research Methodology)	3
	MSCB XX80	Dissertation (pre-requisite Research Proposal)	18
TOTAL CREDIT			**42**

18. Mapping of Program Learning Outcomes to Course

	COURSES OFFERED	Knowledge and understanding	Cognitive Skills	Practical Skills	Numeracy Skills	Interpersonal Skills	Communication Skills	Digital Skills	Leadership, Autonomy and Responsibility	Personal Skills	Entrepreneurial Skills	Ethics and Professional skills
Code	**Courses**	PLO1 KW	PLO2 CG	PLO3 PS	PLO7 NS	PLO4 IPS	PLO5 CS	PLO6 DS	PLO8 LAR	PLO9 PRS	PLO10 ENT	PLO11 ETS
University General Courses (Choose 1 from the list*)												
UXXX 6XX3	University Elective						✓					
Core Courses -Compulsory												
MSCB 1403	Research Methodology	✓	✓				✓	✓			✓	✓

MSCB 1113	Biochemistry and Microbial Physiology	✓		✓						✓		
MSCB 1813	Protein Engineering	✓	✓				✓	✓				
MSCB 1523	Industrial Technology & Bioreactor Design	✓			✓				✓	✓		
Elective Course (Choose only 6 credits)												
MSCB 1323	Tissue Culture Approaches in Industrial Biotechnology	✓	✓				✓					✓
MSCB 1423	Halal Industry Regulations, Management and Practices	✓					✓				✓	✓
MSCB 1503	Agricultural Practices	✓	✓			✓	✓			✓		
MSCB 1203	Algae Biotechnology	✓	✓			✓	✓					
MSCB 1223	Environmental Bioengineering	✓	✓				✓		✓			
MSCB 1823	Bioinformatics	✓	✓					✓				✓
Research Courses												
MSCB 1280	Research Proposal	✓	✓	✓			✓					✓
MSCB XX80	Dissertation	✓	✓	✓			✓					✓

Key:
1. Technical Skills: PLO1, 2, 3 and 7
2. Generic Skills: PLO 4, 5, 6, 8, 9, 10 and 11.

* List of University General Courses

1. UHMS 6013 - Seminar on Global Development
2. UHMZ 6023 - Malaysian Society and Culture
3. UHIS 6013 - Philosophy of Science and Civilization
4. UHPS 6013 – Dynamics of Leadership
5. UHLM 6013 – Malay Language for Post Graduates
6. URTS 6013 – Environmental Ethics
7. UECS 6013 – IT Project Management

19. Support for students and their learning

Students and their learning are supported by:

- Briefing of all new post-graduate students during registration week.
- Postgraduate Handbook for every academic session.
- Information services provided by the Graduate School (SPS) and through the university's web site.
- Student Support provided by counselors and psychologists at 'Unit Perkhidmatan Sokongan Pelajar' (UPSP), UTM Medical Centre, accommodation officers and University Library and others.
- Student Advisors Programme: Selected academic staff provides advice on academic progress and monitoring students' performance and achievements.
- Special programmes on career development conducted by the university to ensure students acquire necessary skills during their academic and future career.
- Staff student ratio for teaching of 1:12.
- Extensive library and other learning resources and facilities

20. Career Prospect

Graduate of the programme can work as:

- Research officer - Research Institute, university and industries
- Science Officer - Research Institute, university and industries
- Academician (teacher, tutor, lecturer)
- Sales executive for biotech product

or

They can further their education by doing a PhD programme in the related field of study.

21. Regulation of Assessment

Assessment rules and degree classification applies for every course with the minimum passing mark of 60%. To qualify for the degree award, students should complete all of the programme's requirements; achieve passing mark for every courses examination. Dissertation will be examined by a panel of internal examiners appointed by the Department's Post-graduate Committee; their roles include evaluating candidates' viva-voce and written project dissertation.

Summary of marks, grades, and their evaluation points

Marks	Grade	Evaluation Point	Level of Achievement
90-100	A+	4.00	Excellent Pass
80-89	A	4.00	
75-79	A-	3.67	
70.74	B+	3.33	Good Pass
65-69	B	3.00	
60-64	B-	2.67	Pass
55-59	C+	2.33	Fail
50-54	C	2.00	
45-49	C-	1.67	
40-44	D+	1.33	
35-39	D	1.00	
30-34	D-	0.67	
00-29	E	0.00	

For further information on academic regulations please refer to the graduate school website: http://www.sps.utm.my/

22. Facilities available :

Laboratories

- Animal Tissue Culture Laboratory
- Biodiagnostic Laboratory
- Bionanotechnology Laboratory
- Bioprocess Laboratory
- Biosensor Laboratory
- Biofilm Laboratory
- Computational Pharmacy and Molecular Modeling Laboratory
- Environmental Bioengineering Laboratory
- Enzyme Research Laboratory
- Genomics and Proteomics Laboratory
- Mesoporous and Nanoporous Material Laboratory
- Microbiology Research Laboratory
- Plant Molecular Biology and Tissue Culture Laboratory
- Postgraduate Research Laboratories
- Specific Research Laboratory
- Structural Biology Laboratory
- Tissue Engineering Laboratory
- Virology Laboratory
- Spectrometry and Chromatography Room that house analytical equipments such as High Performance Liquid Chromatography (HPLC), luminometer, top range UV-visible spectrophotometers, Gas Chromatography (GC), Total Organic Carbon (TOC) analyzer and Microscopy Room that houses CCTV- phase contrast and stereo microscopes, simple light and stereo microscopes.

23. Methods for Evaluating and Improving the Quality and Standards of Teaching and Learning

Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards

1. Students' performance in terms of:
- KB/KS/KG –Pass/conditional pass/fail
- CPA – Cumulative point average
- Graduating students' performance
- GOT – Graduate on time
- Completion Rate
- Analysis of course performance

2. Employability
- Exit survey
- Alumni survey
- Market survey

3. Lecturer's performance
- Teaching evaluation by students (e-PPP)
- Annual staff appraisal (e-LPPT)
- Teaching Evaluation System (TES)

4. Curriculum review
- Faculty academic committee
- External examiner reports
- CLO achievement survey by students

5. Delivery system
- Academic Quality Assurance Committee
- Malaysia Quality Assurance (MQA) standards

24. Regulation of Program Assessment

Role of Board of Study (BOS): Alumni, Industry and University professor:

and

Role of External Examiners (Visiting Examiners):

- review and evaluate program curriculum,
- review and evaluate methods of student's assessment,
- make necessary recommendations to the Academic Committee.

25. Program Assessment Tools

Measurement Tools	Programme Learning Outcomes (PLO)											Duration	Action by
	1	2	3	4	5	6	7	8	9	10	11		
Course Exit Survey	x	x	x	x	x	x	x	x	x	x	x	Per semester	Lecturer
Course Assessment Report (CAR)	x	x	x	x	x	x	x	x	x	x	x	Per semester	Lecturer
Annual Programme Assessment Report (APAR)	x	x	x	x	x	x	x	x	x	x	x	Per year	Faculty
Exit Survey	x	x	x	x	x	x	x	x	x	x	x	Final Semester	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/ 3 year	Director

CURRICULUM STRUCTURE

SEMESTER 1

CODE	COURSE	CREDIT
UXX 6XX3	(Choose 1 course from the list given by School of Graduate Studies)	3
MSCB 1403	Research Methodology	3
MSCB 1113	Biochemistry and Microbial Physiology	3
MSCB 1813	Protein Engineering	3
Total Credit Hours		***12***

SEMESTER 2

CODE	COURSE	CREDIT
MSCB 1523	Industrial Technology & Bioreactor Design	3
MSCB 1280	Research Proposal pre-requisite Research Methodology)	3
Select any TWO Courses (6 credits) - elective		
CODE	**COURSE**	**CREDIT**
MSCB 1323	Tissue Culture Approaches in Industrial Biotechnology	3
MSCB 1423	Halal Industry Regulations, Management and Practices	3
MSCB 1503	Agricultural Practices	3
MSCB 1203	Algae Biotechnology	3
MSCB 1223	Environmental Bioengineering	3
MSCB 1823	Bioinformatics	3
Total Credit Hours		***12***

SEMESTER 3

CODE	COURSE	CREDIT
MSCB XX80	Dissertation (pre-requisite Research Proposal)	18
Total Credit Hours		18
	TOTAL CREDIT	**42**

MASTER OF PHILOSOPHY AND DOCTOR OF PHILOSOPHY

Field of Research: Bioscience
- By Research (Full time)

Department of Biosciences offers full time research programmes leading to M.Phil. and Ph.D. degree for students interested in pursuing research careers. To ensure the suitability of the research for the given academic level, students are required to present their research proposal to be evaluated by experts in the related area. This usually takes place in the second semester for M.Phil. student and third semester for Ph.D. student. Students are expected to disseminate the output of their research through writing of research articles and presentations in conferences. On completion of the research project, students are required to submit their dissertation/thesis for evaluation by external and internal examiners appointed by the Faculty of Science. The programmes are MQA accredited.

Programme	NEC Code	MQA Reference Number (Certificate Number)
M.Phil.	421 (Biology and Biochemistry)/ 0510 (Biological and related science, National Education Code 2020)	MQA/SWA0353 (18889)
Ph.D.	421 (Biology and Biochemistry)/ 0510 (Biological and related science, National Education Code 2020)	MQA/SWA0455 (20672)

Programme Educational Objectives (PEO)

PEO	M.Phil.	Ph.D.
1	Knowledgeable and skilful in catering to knowledge-intensive industries in the field of Biology and Biochemistry through application of research and innovation skills	Knowledgeable and skillful in catering to knowledge-intensive industries in the field of Bioscience through application of research and innovation skills
2	Competent to advice and solve on contemporary issues and proposed new solutions and innovations for development and advancement in the field of Biology and Biochemistry.	Competent to advice and solve on contemporary issues, and proposed new solutions and innovations for development and advancement in the field of Bioscience.
3	Equipped with professional skills critical to excel within a multicultural, transnational work and learning environment.	Equipped with professional skills critical to excel within a multicultural, transnational work and learning environment.

Programme Learning Outcome (PLO)

PLO	M.Phil.	Ph.D.
1	Integrate and generate in-depth relevant knowledge independently using innovative techniques, tools and skills for decision-making to manage and resolve a complex problem in the field of Biology and Biochemistry as a basis for research.	Synthesize, critique, apply, and extend in-depth relevant knowledge independently using innovative techniques, tools, and skills in the field of Bioscience as a basis for research to produce new ideas and solution.
2	Construct a critical and innovative solution for complex problems or issues in the field of Biology and Biochemistry through research using the latest development techniques and skills.	Create new concept/theories/solutions/practice through independent research and originality that satisfies international standards within the field of Bioscience using the latest techniques, tools, and skills.
3	Devise standard research methodology that is based on the forefront knowledge and latest development in the field of Biology and Biochemistry to solve research problems with reasonable degree of originality.	Integrate highly advanced and specialized research methodologies based on the forefront knowledge and latest development in the field of Bioscience to solve complex research problems with reasonable degree of originality.
4	Demonstrate effective collaboration with peers, scholarly communities and society at large in the relevant field of expertise and research.	Demonstrate decent collaboration with peers, scholarly communities and society at large in the relevant field of expertise and research.
5	Communicate the knowledge, skills, ideas clearly using appropriate methods to peers, experts, and non-experts through various mediums.	Communicate effectively the knowledge, skills, ideas and research findings using appropriate methods to peers, scholarly communities, and societies through various medium.
6	Use a broad range of suitable digital technologies, media, and software to design, manage, analyse and report research studies.	Use, improve existing or develop new appropriate tools or methodologies using a broad range of digital technology, media and software to support and enhance research activities.

7	Demonstrate skills in designing, planning evaluation activities, and analysing numerical and graphical data using quantitative or qualitative tools in solving problems.	Demonstrate skills in designing, critical evaluation, and analysing numerical and graphical data using quantitative or qualitative tools to support and enhance research activities.
8	Demonstrate leadership, autonomy and responsibility in conducting and managing own research and resources.	Demonstrate leadership, professionalism and management skills, and take full responsibility for own work, and significantly for others in the research organization.
9	Demonstrate the ability to manage and enhance own self-advancement for academic development, professional development and research skills using lifelong learning strategies.	Demonstrate the ability to manage and enhance own self- and if necessary, can be accountable for overall management of one's research organization and professional development.
10	Develop potential commercialisation research output.	Develop potential commercialisation research output.
12	Demonstrate adherence to legal, ethical and professional codes of practice in the field of Biology and Biochemistry and research activities.	Demonstrate adherence to legal, professional and contribute to the development of ethical sound codes of practice.

Field of Research

The research project of the student may fall into one or more aspects of the following field:

- Biological Science
- Bioinformatics
- Environmental Biotechnology
- Genome Biology
- Industrial and Food Biotechnology
- Medical Biotechnology
- Nanobiotechnology
- Plant and Agriculture Biotechnology

Courses and duration of study

The normal duration of study is 2–8 semesters (1–4 years) for M.Phil. and 6–16 semesters (3–8 years) for the Ph.D. programme.

Students must register a Research Course with the following code in each semester.

Year/ Semester (Total Semester)	**M.Phil.**	**Ph.D.**
1/1 (Sem. 1)	MSCS 1100	PSCS 1100
1/2 (Sem. 2)	MSCS 1200	PSCS 1200
2/1 (Sem. 3)	MSCS 2100	PSCS 2100
2/2 (Sem. 4)	MSCS 2200	PSCS 2200
3/1 (Sem. 5)	MSCS 3100	PSCS 3100
3/2 (Sem. 6)	MSCS 3200	PSCS 3200
4/1 (Sem. 7)	MSCS 4100	PSCS 4100
4/2 (Sem. 8)	MSCS 4200 (**maximum semester**)	PSCS 4200
5/1 Sem. (9)	-	PSCS 5100
5/2 (Sem. 10)	-	PSCS 5200
6/1 (Sem. 11)	-	PSCS 6100
6/2 (Sem. 12)	-	PSCS 6200
7/1 (Sem. 13)	-	PSCS 7100
7/2 (Sem. 14)	-	PSCS 7200
8/1 (Sem. 15)	-	PSCS 8100
8/2 Sem. (16)	-	PSCS 8200 (**maximum semester**)

All research students must enrol in Research Methodology (USCP 6013) and at least one of the University's General Courses (subjected to courses offered in each semester listed in SPS website).

Examples of General Courses offered are:

No.	Course code	Faculty	Course name
1	UBSS 6013	AHIBS KL	Organization Behaviour and Development
2	UBSS 6023	AHIBS KL	Business Ethics, Responsibility and Sustainability
3	UHMS 6013	FSSH/SHARP	Seminar on Global Development, Economic and Social Issues
4	UHMZ 6023	FSSH/SHARP	Malaysian Society and Culture
5	UHIS 6013	FSSH/ATI	Philosophy of Science and Civilization
6	UHPS 6013	FSSH/SOE	Dynamics of Leadership
7	UHLM 6013	FSSH/LA	Malay Language for Post Graduates
8	URTS 6013	FTIR	Environmental Ethics
9	UECS 6013	FC	IT Project Management
10	URSP 6023	FTIR	ICT Ethics and Society
11	UANP 6013	FTIR	Informatics in Society
12	UMJJ 6013	MJIIT	Basic Japanese Language & Culture

Credit transfer of Research Methodology and the University's General Courses

Students can apply for credit transfer if the course(s) taken in another M.Phil. programme(s) prior to the current study with at least 80% identical learning outcomes.

Deferment of study

- Students may apply for deferment of the programme registration for not more than **TWO SUBSEQUENT** semesters subject to University's approval.
- Students who do not register for any courses in a semester must apply for deferment. The deferred semester will be counted as a part of the total study period.
- Students who withdraw (TD) from **ALL** courses in a semester will automatically be given a deferment. The deferred semester will be counted as a part of the total study period.
- Students may apply for deferment of study due to health reasons. The application has to be accompanied with a medical report certified by a Medical Officer recognised by the University. The deferred semester may not be counted as a part of the total study period.

Conversion from M.Phil. to Ph.D. programme

In the period between six and fifteen months after program registration, M. Phil. students may apply to convert to a Ph.D. program upon achieving the requirement listed in the table below.

Bachelor's Degree CGPA	Requirements
CGPA ≥ 3.33	Presented **TWO** conference articles in proceedings with ISBN. **OR** published **ONE** article in a SCOPUS/WOS/ERA indexed journal. **AND** The applicant must be the first student author of the publication.
3.00 ≤ CGPA ≤ 3.32	Published **ONE** article in a WOS indexed journal. The applicant must be the first student author of the publication.

Students will be requested to defend the research proposal to the evaluation panels. Passing the evaluation is necessary for successful conversion to Ph.D. programme.

Assessments and evaluation

(i) First Assessment

Students are required to present a research proposal (**with preliminary/expected results**) for evaluation purposes within the duration specified by the University, according to the following schedule:

Programme	Semester
M.Phil.	2nd semester
Ph.D.	3rd semester

If the students failed to present without any valid reasons, the student may be given a TM status by the Faculty.

(ii) Progress Report Assessment

All postgraduate research students are required to submit a progress report online (GSMS system) before the due date. The online system will usually be opened in week 10–13 of each semester, unless specified otherwise in the academic calendar.

The supervisor shall evaluate the progress report. A student whose progress is satisfactory (MM status) will be recommended for the continuation of his/her candidature.

A student may be given a TM or GG status if he/she does not submit his/her progress report.

The faculty shall terminate the candidature of a student whose progress is not satisfactory (TM status) for **TWO** consecutive semesters.

(iii) Qualifying Assessment (Fast Track Ph.D.)

Fast track students in the Ph.D. programme must undergo a qualifying assessment after 6 to 18 months of registration in the Ph.D. programme. The result of the assessment can be one of the following:

(a) **Pass -** The student will continue their Ph.D. programme and proceed with the First Assessment in the following semester.

(b) **Fail -** The student will be transferred to the M.Phil. programme and a new study period begins.

(iv) Viva Voce (Oral Examination)

A student should submit Notice for Thesis Submission (NHT) approved by the supervisor at least three months prior to submission of the dissertation/thesis for examination, or three months before expiry of the maximum study duration. Dissertation/Thesis report must follow the guidelines prescribed in the UTM Thesis Manual 2018 and the report must be written in English. Students shall apply for a permission if the dissertation/thesis is to be written in other languages, i.e. Bahasa Malaysia. The Turnitin score for each chapter shall not be more than 20%. The publication criteria for the M.Phil. and Ph.D. programme is listed below.

Program	Publication criteria
M. Phil.	Students may submit their dissertation after 12 months with at least one publication that has been accepted or published in either journal, conference, or book chapters for the purpose of the viva voce.
Ph.D.	**Submission of thesis for normal duration of study (within 6 - 16 semesters)** Students can submit their thesis for viva voce after having: ● at least **ONE** accepted or published article in a WOS indexed journal, or ● **TWO** accepted or published articles in Scopus/ERA/Malaysia Journal Management System indexed journals. **Early thesis submission (in the Semester 5)** Students can submit their thesis for viva voce after having: ● accepted or published **TWO** articles in WOS/Scopus/ERA indexed journals. **Submission of thesis using publication format** Students can submit their thesis for viva voce using publication format if the following condition is fulfilled: ● At 24 months after the student enrols; a minimum of **THREE** journal articles indexed in Scopus/WOS with at least **TWO** articles accepted or published in Q1/Q2 WOS indexed journals.

	● At least 30 months after the student enrols: a minimum **THREE** journal articles indexed in Scopus/WOS with at least **ONE** journal article accepted or published in Q1/Q2 WOS indexed journal.

Dissertation/Thesis examination for M.Phil. and Ph.D. programmes should be made according to the criteria set for the programme as approved by the Senate. For instance, oral defence cannot be held more than twice. The thesis examiner should consist of at least one internal and one external examiner, unless specified in 'Prosedur Penyelidikan Pascasiswazah (ProPS-06), 2022. Please refer to the Faculty on the fee imposed for viva voce.

Change of supervisor

During the study period, students may apply for a change of supervisor if necessary. The application is made by filling in the specific form available at the Faculty's Postgraduate Office. The application needs to be supported and approved by the Faculty's Academic Committee. However, students have to take note that the application for a change in supervisor can only be made with the following restrictions (except for special cases):

- Change of supervisor can only be made **ONCE** throughout the study period.
- Application can only be made **BEFORE** the First Assessment.

Abbreviations

ERA : Excellence in Research Australia
GG : *Gagal* (Fail)
GSMS : Graduate Studies Management System
MM : *Memuaskan* (Satisfactory)
M.Phil. : Master of Philosophy
MQA : Malaysian Qualifications Agency
NEC : National Education Code
NHT : Notis Hantar Thesis (Notice for Thesis Submission)
Ph.D. : Doctor of Philosophy
TD : *Tarik Diri* (Withdraw)
TM : *Tidak Memuaskan* (Unsatisfactory)
WOS : Web of Science

CHEMISTRY PROGRAMMES

MASTER OF SCIENCE (CHEMISTRY)

PROGRAMME SPECIFICATION

1. Awarding Institution	**UTM**
2. Teaching Institution	**UTM**
3. Programme Name	**Master of Science (Chemistry)**
4. Final Award	**Master of Science (Chemistry)**
5. Programme Code	**MSCC2**
6.Professional or Statutory Body of Accreditation	Malaysian Ministry of Higher Education Kementerian Pengajian Tinggi Malaysia
7. Language(s) of Instruction	**English**
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-govern
10. Study Scheme	**Full Time**
11. Study Duration	Minimum: 1½ years Maximum: 4 years
12. Entry Requirement	**General University Requirements:** Basic conditions of entry are referring to the Assessment Guidelines in 1998 Entry, Pind. 1/2013. **Faculty Requirements:** Bachelor of Science with a CGPA of ≥ 2.75 from Universiti Teknologi Malaysia in chemistry or any institutions of higher learning recognized by the Senate in the same field. **OR** equivalent to a Bachelor of Science degree with experience in the same field and recognized by the UTM Senate. **English Language Requirement (for international students):** All international students who apply for UTM must have a valid TOEFL to last two years or IELTS certificate. Students with a TOEFL score of 550 (or 79 IBT) or IELTS Band 6 will be enrolled in the faculty program without undergoing UTM English Courses.

13. Programme Educational Objectives (PEO)

Graduates of the programme should be :

1. PEO 1 : Knowledgeable in advanced areas of chemistry for teaching, research and applications, in alignment with industrial demands
2. PEO 2 : Competent in frontier technologies applicable in the field of chemistry towards sustainable community and in meeting global needs
3. PEO 3 : Professional with high sense of responsibility and compliance to standards of ethical conduct

14. Programme Learning Outcomes (PLO)

INTENDED LEARNING OUTCOMES			TEACHING AND LEARNING METHODS	ASSESSMENT
TECHNICAL SKILLS	**PLO1**	Synthesize comprehensive knowledge in theory, methodology and practice independently in advanced Chemistry.	Active lecture, assigned reading, group discussion, assignment and research work.	Examinations, tests, quizzes, project reports and assignments
	PLO2	Construct critical solutions to related complex issues in the field of frontier Chemistry.	Active lectures, research works, assigned reading, group discussion and problem-based assignments, hands-on instrumentations, chemistry related software.	Examination, test, assignment report, dissertation, oral presentation, group project, and computer simulation.
	PLO3	Design experimental set up based on a research topic.	Active lectures, research works, assigned reading, group discussion and problem-based assignments, hands-on instrumentations, chemistry related software skills, experimental work, research presentation and report.	Research proposal, project presentation, dissertation and viva-voce.
	PLO7	Evaluate the numerical and graphical data for studies and research purposes using qualitative, quantitative, mathematical and statistical methods.	Laboratory works, individual / group assignments	Progress report, logbooks and group assignment report.

INTENDED LEARNING OUTCOMES			TEACHING AND LEARNING METHODS	ASSESSMENT
GENERIC SKILLS	**PLO4**	Collaborate effectively with different people in learning and working communities.	Group projects, laboratory work, independent research.	Written assignment, and research proposal, dissertation, research project report.
	PLO5	Communicate effectively through variety of media and technology to a diverse audience.	Assignment, research proposal, dissertation.	Project report and group presentation, dissertation, viva-voce
	PLO6	Competent in utilizing a wide range of appropriate digital technologies and software to enhance studies and research.	Assignment, individual research project, hands-on instrumentations, chemistry related software skills, experimental work, research presentation and report	Report and seminar presentation, proposal and dissertation.
	PLO8	Demonstrate significant autonomy, independence, leadership, and substantial responsibility in studies and research	Group assignment, laboratory work.	Group assignment report and dissertation thesis.
	PLO9	Build self-advancement through continuous development of new ideas, solutions and systems.	Active lecture, individual assignment, laboratory work, dissertation.	Laboratory report, individual assignment report, seminar presentation and dissertation thesis.
	PLO10	Propose entrepreneurial opportunities in the field of Chemistry	Active lecture, laboratory works and research work.	Written assignment, dissertation thesis and progress report.
	PLO11	Comply to ethical and professional codes of practice on complex issues in the area of Chemistry.	Active lecture, laboratory works, research proposal, and research work.	Individual and group assignment reports and dissertation thesis.

15. Classification of Courses

	Classification	Credit Hours	Percentage	Standard (QA)
i.	University General Course	3	7	50%
ii.	Core Courses	15	36	
iii.	Elective Courses	3	7	
iv.	Research	21	50	50%
	Total	**42**	**10**	**100%**

16. Total credit hours to graduate : 42 credit hours

17. Programme structures and features, curriculum, and award requirements

The course is offered in full-time mode and based on a 3 Semester Academic Year with several subjects being delivered and assessed in each semester. Assessment: Based on final examination, coursework and dissertation.

Award requirements :

To graduate, students should:

- achieve a total of minimum 42 credit hours with minimum CPA of 3.00
- complete and pass viva M.Sc Dissertation.

Course Category	Code	Course	Credit
University General Course (3 credits)	**UXXX 6XX3**	(Choose 1 courses from the list given by School of Graduate Studies)	3
Core Courses (15 credits)	**Semester 1**		
	MSCK 1713	Advanced Inorganic Chemistry	3
	MSCK 1413	Advanced Physical Chemistry	3
	MSCK 1303	Research Methodology	3
	Semester 2		
	MSCK 1613	Advanced Organic Chemistry	3
	MSCK 1213	Advanced Analytical Chemistry	3
Elective Courses	**Choose 1 Only**		
	MSCK 1323	Advanced Biochemistry	3
	MSCK 1333	Advanced Biotechnology	
	MSCK 1463	Quantum Chemistry and Spectroscopy	
	MSCK 1473	Advanced Surface and Colloid Chemistry	
	MSCK 1443	Advanced Solid State Chemistry	
	MSCK 1653	Advanced Organic Spectroscopy	
	MSCK 1753	Inorganic Reaction Mechanism	
	MSCK 1763	Inorganic Structural Methods	
	MSCK 1263	Advanced Electroanalytical Chemistry	
	MSCK 1243	Advanced Separation Methods	
	MSCK 1273	Advanced Environmental Chemistry	
Research (21 credits	**Semester 2**		
	MSCK 1180	Research Proposal	3
	Semester 3		
	MSCK XX80	Dissertation	18
TOTAL CREDIT			**42**

18. Mapping of Program Learning Outcomes to Course

	COURSES OFFERED	Knowledge and Understanding	Cognitive Skills	Practical Skills	Numeracy Skills	Interpersonal Skills	Communication Skills	Digital Skills	Leadership, Autonomy and Responsibility	Personal Skills	Entrepreneurial Skills	Ethics and Professionalism Skills
Code	**Courses**	PLO1 KW	PLO2 CG	PLO3 PS	PLO7 NS	PLO4 IPS	PLO5 CS	PLO6 DS	PLO8 LAR	PLO9 PRS	PLO10 ENT	PLO11 ETS
University General Courses (Choose 1 from the list*)												
UHXX 6XX3	University Course						✓					
Core Courses												
MSCK 1713	Advanced Inorganic Chemistry	✓	✓			✓						
MSCK 1613	Advanced Organic Chemistry	✓	✓						✓			
MSCK 1413	Advanced Physical Chemistry	✓	✓		✓		✓					
MSCK 1213	Advanced Analytical Chemistry	✓	✓							✓	✓	
MSCK 1303	Research Methodology	✓	✓				✓	✓			✓	✓
Elective Courses (Choose 2)												
MSCK 1323	Advanced Biochemistry	✓	✓									✓
MSCK 1333	Advanced Biotechnology	✓	✓					✓				
MSCK 1463	Quantum Chemistry and Spectroscopy	✓	✓					✓				
MSCK 1473	Advanced Surface and Colloid Chemistry	✓	✓									✓
MSCK 1443	Advanced Solid State Chemistry	✓	✓									✓
MSCK 1653	Advanced Organic Spectroscopy	✓	✓					✓				
MSCK 1753	Inorganic Reaction Mechanism	✓	✓					✓				
MSCK 1763	Inorganic Structural Methods	✓	✓					✓				
MSCK 1263	Advanced Electroanalytical Chemistry	✓	✓					✓				
MSCK 1243	Advanced Separation Methods	✓	✓					✓				
MSCK 1273	Advanced Environmental Chemistry	✓	✓									✓
Research												
MSCK 1180	*Research Proposal*	✓	✓				✓					✓
MSCK 2180	Dissertation	✓	✓	✓			✓					✓

Key:
1. Technical Skills: PLO1, 2, 3 and 7
2. Generic Skills : PLO 4, 5, 6, 8, 9, 10 and 11.

* List of University General Courses

1. UHMS 6013 - Seminar on Global Development
2. UHMZ 6023 - Malaysian Society and Culture
3. UHIS 6013 - Philosophy of Science and Civilization
4. UHPS 6013 – Dynamics of Leadership
5. UHLM 6013 – Malay Language for Post Graduates
6. URTS 6013 – Environmental Ethics
7. UECS 6013 – IT Project Management
8. URSP 6023 – ICT Ethics and Society
9. UBSS 6013 – Organization Behaviour and Development
10. UBSS 6023 – Business Ethics, Responsibility and Sustainability
11. UMJJ 6013 – Basic Japanese Language & Culture

19. Support for students and their learning

Students and their learning are supported by:

- Briefing of all new post-graduate students during registration week.
- Postgraduate Handbook for every academic session.
- Information services provided by the Graduate School (SPS) and through the university's web site.
- Student Support provided by counsellors and psychologists at 'Unit Perkhidmatan Sokongan Pelajar' (UPSP), UTM Medical Centre, accommodation officers and University Library and others.
- Special programmes on career development conducted by the university to ensure students acquire necessary skills during their academic and future career.
- Staff student ratio for teaching of 1:12.
- Extensive library and other learning resources and facilities
- Each student is assigned an academic advisor (programme tutor) whose role is to assist and advice on programmed of study.

20. Career Prospects

Graduate of the programme can work as:

a) chemists or scientists in private and government research institutions such as MARDI, PORIM, RRI, PRSS, AMREC, SIRIM and MINT

b) lecturers or researchers in higher learning institutions, following further their degree qualifications at Masters of PhD levels;

c) officers in agencies or industries in which sound knowledge of chemistry and high levels of generic skills are required.

OR

They can further their education by doing a PhD programme in the related field of study.

21. Regulation of Assessment

Assessment rules and degree classification applies for every course with the minimum passing mark of 60%. To qualify for the degree award, students should complete all of the programme's requirements; achieve passing mark for every courses examination. Dissertation will be examined by a panel of internal examiners appointed by the Department's Post-graduate Committee; their roles include evaluating candidates' viva-voce and written project dissertation.

Summary of marks, grades and their evaluation points

Marks	Grade	Evaluation Point	Level of Achievement
90-100	A+	4.00	Excellent Pass
80-89	A	4.00	
75-79	A-	3.67	
70.74	B+	3.33	Good Pass
65-69	B	3.00	
60-64	B-	2.67	Pass
55-59	C+	2.33	Fail
50-54	C	2.00	
45-49	C-	1.67	
40-44	D+	1.33	
35-39	D+	1.00	
30-34	D-	0.67	
00-29	E	0.00	

For further information on academic regulations please refer to the graduate school website: http://www.sps.utm.my/

21. Facilities available

Laboratories

- Inorganic Chemistry Laboratory 1 & 2
- Physical Chemistry Laboratory 1 & 2
- Organic Chemistry Laboratory 1 & 2
- Analytical Laboratory 1, 2, & 3
- Project Laboratories
- Macromolecule Laboratory
- Biotechnology Laboratory
- Students Computer Room
- Resource Centre

Major Equipments

- Nuclear Magnetic Resonance Spectrometer
- Gas Chromatography-Mass Spectrometer System
- Fourier Transform Infrared Spectrometers
- Gel Permeation Chromatograph
- UV-Visible Spectrometers
- High Performance Liquid Chromatograph
- Gas Chromatograph
- Liquid Chromatograph
- Atomic Absorption Spectrometer
- Ion Chromatograph
- Capillary Electrophoresis Unit
- BET Surface Analyser
- Differential Scanning Calorimeter
- Voltammetric Systems
- Fluorescence Spectrometer
- Surface Adsorption/Desorption System
- Total Organic Carbon Analyser
- Flame Photometer
- Electron Spin Resonance Spectrometer
- X-Ray Diffraction Spectrometer
- Inductively Coupled Plasma

23. Methods for Evaluating and Improving the Quality and Standards of Teaching and Learning

Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards

1. Students' performance in terms of:
   - KB/KS/KG –Pass/conditional pass/fail
   - CPA – Cumulative point average
   - Graduating students' performance
   - GOT – Graduate on time
   - Completion Rate
   - Analysis of course performance

2. Employability
   - Exit survey
   - Alumni survey
   - Market survey

3. Lecturer's performance
   - Teaching evaluation by students (e-PPP)
   - Annual staff appraisal (e-LPPT)
   - Teaching Evaluation System (TES)

4. Curriculum review
   - Faculty academic committee
   - External examiner reports
   - CO achievement survey by students

5. Delivery system
   - Academic Quality Assurance Committee
   - Malaysia Quality Assurance (MQA) standards

24. Regulation of Program Assessment

Board of Study (external examiner, IAP and Alumni) are appointed by the Faculty Academic Committee to:

- review and evaluate program curriculum,
- review and evaluate methods of students assessment,
- make necessary recommendations to the Academic Committee.

25. Program Assessment Tools

Measurement Tools	Programme Learning Outcomes (PLO)											Duration	Action by
	1	2	3	4	5	6	7	8	9	10	11		
Course Exit Survey (SCO)	x	x	x	x	x	x	x	x	x	x	x	Per semester	Lecturer
Course assessment report (CAR)	x	x	x	x	x	x	x	x	x	x	x	Per semester	Lecturer
Annual Programme Assessment report (APAR)	x	x	x	x	x	x	x	x	x	x	x	Per Year	Faculty
Exit Survey	x	x	x	x	x	x	x	x	x	x	x	Final Semester	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/ 3 year	Director

CURRICULUM STRUCTURE

INTAKE SEMESTER I 2023/2024

Semester I 2023/2024

COURSE CODE	COURSE NAME	CREDIT
MSCK 1713	Advanced Inorganic Chemistry	3
MSCK 1413	Advanced Physical Chemistry	3
UHXX 6xx3	University Compulsory Course	3
MSCK 1303	Research Methodology	3
	Total	**12**

Semester II 2023/2024

COURSE CODE	COURSE NAME	CREDIT
MSCK 1613	Advanced Organic Chemistry	3
MSCK 1213	Advanced Analytical Chemistry	3
MSCK 1180	Research Proposal	3
MSCK 1xx3	*Elective Course	3
	Total	**12**

**Choose one*

Semester I 2024/2025

COURSE CODE	COURSE NAME	CREDIT
MSCK 2180	Dissertation	18
	Total	**18**

CURRICULUM STRUCTURE

INTAKE SEMESTER II 2023/2024

Semester II 2023/2024

COURSE CODE	COURSE NAME	CREDIT
MSCK 1613	Advanced Organic Chemistry	3
MSCK 1213	Advanced Analytical Chemistry	3
UHXX 6xx3	University Compulsory Course	3
MSCK 1303	Research Methodology	3
	Total	**12**

Semester I 2024/2025

COURSE CODE	COURSE NAME	CREDIT
MSCK 1713	Advanced Inorganic Chemistry	3
MSCK 1413	Advanced Physical Chemistry	3
MSCK 1180	Research Proposal	3
MSCK 1xx3	*Elective Course	3
	Total	**12**

**Choose one*

Semester II 2024/2025

COURSE CODE	COURSE NAME	CREDIT
MSCK 2180	Dissertation	18
	Total	**18**

List of Elective Courses

Course availability is subject to change

COURSE CODE	COURSE	CREDIT
MSCK 1323	Advanced Biochemistry	3
MSCK 1333	Advanced Biotechnology	3
MSCK 1463	Quantum Chemistry and Spectroscopy	3
MSCK 1473	Advanced Surface and Colloid Chemistry	3
MSCK 1443	Advanced Solid State Chemistry	3
MSCK 1653	Advanced Organic Spectroscopy	3
MSCK 1753	Inorganic Reaction Mechanism	3
MSCK 1763	Inorganic Structural Methods	3
MSCK 1263	Advanced Electroanalytical Chemistry	3
MSCK 1243	Advanced Separation Methods	3
MSCK 1273	Advanced Environmental Chemistry	3

MASTER OF FORENSIC SCIENCE

PROGRAMME SPECIFICATION

1. Awarding Institution	**UTM**
2. Teaching Institution	**UTM**
3. Programme Name	Master of Forensic Science
4. Final Award	Master of Forensic Science
5. Programme Code	**MSCQ1**
6. Professional or Statutory Body of Accreditation	Ministry of Higher Education Malaysia (Kementerian Pengajian Tinggi Malaysia)
7. Language(s) of Instruction	**English**
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-govern
10. Study Scheme	**Full Time**
11. Study Duration	Minimum: 1½ years Maximum: 4 years
12. Entry Requirement	**General University Requirements:** Basic conditions of entry are referring to the Assessment Guidelines in 1998 Entry Pind. 1/2013. **Faculty Requirement:** Bachelor of Science (Chemistry, Industrial Chemistry, Forensic Science, Applied Science, Health Science or related courses) CPA ≥ 3.0 from any institution of higher learning recognized by the Senate **OR** Bachelor of Science (Chemistry, Industrial Chemistry, Forensic Science, Applied Science, Health Science or related courses) or equivalent and recognized with CPA ≥ 2.7 and work experience for at least ONE year in related field **OR** Bachelor of Science (Chemistry, Industrial Chemistry, Forensic Science, Applied Science, Health Science or related courses) or equivalent and recognized with CPA ≥ 2.5 and work experience for at least TWO years in related field.

	English Language Requirement (for international students): All international students who apply for UTM must have a valid TOEFL for the last two years or IELTS certificate. Students with a TOEFL score of 550 (or 79 IBT) or IELTS Band 6 will be enrolled in the faculty program without undergoing UTM English Courses.

13. Programme Educational Objectives (PEO)

Graduates of the programme should be :

1. PEO 1 : Skilled, competent, ethical, creative and innovative for meeting the requirement of national development and advancement.
2. PEO 2 : Capable to continuously enhance forensic science knowledge and research skills for providing better services and products.
3. PEO 3 : Capable of developing new forensic technologies as well as facilitating technology transfer.
4. PEO 4 : Capable to collaborate with relevant governmental agencies and private entities for enhancing forensic practice and/or research activities.

14. Programme Learning Outcomes (PLO)

At the end of this programme, students will be able to:

Intended Learning Outcomes			Teaching and Learning Methods	Assessment
TECHNICAL SKILLS	**PLO1**	Ability to acquire and apply advanced knowledge as well as understanding of forensic principles and related research advances. (Advanced Knowledge)	Lectures, group laboratory works, group discussion and problem-based learning.	Examinations, tests, project reports and assignments
	PLO2	Ability to demonstrate thorough knowledge, understanding and research skills in applying scientific methodology for undertaking and reporting laboratory analyses and field investigation. (Research Skills)	Lectures, group laboratory practical, simulated crime case investigation, group discussion and problem based learning. Hands-on instrumentations, forensic skills and research project.	Examinations, tests, assignments, and project reports, Oral presentations and group crime scene investigation simulation.
	PLO3	Ability to think critically in formulating and solving problems related to crime scene and forensic science, as well as competent in initiating, developing, and pursuing a scientific research.	Lectures, simulated crime case investigation, group discussion, problem based learning and expert witness testimony	Examinations, tests, assignments, project reports, Moot court. Oral presentations, group projects, computer simulation.

		(Critical Thinking and Problem Solving)	Hands-on instrumentations, forensic skills and research project. Research proposal, experimental works, project presentation and report.	Proposal, presentation and project report
Intended Learning Outcomes			**Teaching and Learning Methods**	**Assessment**
GENERIC SKILLS	**PLO4**	Ability to act ethically and professionally with sensible humane values while undertaking their profession and societal obligations. (Ethics, Values and Professionalisms)	Research project, expert witness testimony.	Individual assignment, research project report, oral presentation and moot court.
	PLO5	Ability to communicate technical, scientific and forensic information as well as expert testimony effectively via oral and written presentations (Communication Skills-CS)	Group laboratory works, individual research, expert testimony in moot court session, simulated crime scene investigation.	Oral presentations (seminar and moot court), written assignments, and research project report.
	PLO6	Ability to independently and continuously seek relevant forensic knowledge and skills from various appropriate sources (Life-long Learning)	Research projects and problem-based learning.	Assignment and research project report.
	PLO8	Ability to demonstrate good interpersonal skills with ability to work collaboratively within a team in achieving a common goal. (Team Working)	Group laboratory works, simulated crime scene investigation, expert testimony.	Group reports (laboratory works, crime scene investigation and moot court) and presentations.

15. Classification of Courses

No.	Classification	Credit Hours	Percentage	Standard QA
i.	University General Course	3	6.7 %	
ii.	Research methodology course	3	6.7 %	
iii.	Core Courses	18	40 %	
iv.	Elective Courses	9	20 %	
v.	Research Project	12	26.7 %	
	Total	45	100 %	

16. Total credit hours to graduate : 45 credit hours

17. Programme structures and features, curriculum, and award requirements

The course is offered in full-time mode and based on a 3 Semester Academic Year with several subjects being delivered and assessed in each semester. Assessment: Based on final examination, coursework and research project.

Award requirements:

To graduate, students should:

- achieve a total of minimum 45 credit hours with minimum CPA of 3.00 complete and pass presentation Master of Forensic Science Research Project.

COURSE CATEGORY	CODE	COURSE	CREDIT
University general course (3 Credits)	UXXX 6XX3	(Choose 1 courses from the list given by School of Graduate Studies)	3
Core Courses (18 Credits)	MSCQ 1803	Forensic Evidence and the Aspects of Law	3
	MSCQ 1823	Forensic Chemistry	3
	MSCQ 1923	Biological Aspects of Forensic Sciences	3
	MSCQ 1853	Forensic Practical	3
	MSCQ 1913	Crime Scene Investigation	3
	MSCQ 1833	Expert Testimony and Moot Court	3
Elective Courses (9 Credits) (Choose 3 from the list)	MSCQ 1813	Forensic Analytical Instrumentation	3
	MSCQ 1963	Computer Forensics	3
	MSCQ 1933	Examination of Questioned Documents	3
	MSCQ 1973	Fire and Explosion Investigation	3
	MSCQ 1943	Quality Assurance in Forensic Science	3
	MSCQ 1953	Forensic Engineering	3
	MSCQ 1983	Firearms and Forensic Ballistics	3
	MSCQ 1993	Forensic Toxicology and Drugs of Abuse	3
Research Methodology Courses (3 Credits)	MSCQ 1303	Research Methodology	3
Research Project (12 Credits)	MSCQ 1180	Research Project 1	6
	MSCQ 2180	Research Project 2	6
TOTAL CREDIT			**45**

18. Mapping of Program Learning Outcomes to Course

	COURSES OFFERED	Advanced Knowledge	Research Skills	Critical Thinking & Problem Solving	Ethics, Values, Professionalism	Communication Skills	Lifelong Learning	Social Skills	Team Working	Leadership	Information Management	Managerial & Entrepreneurial
Code	**Courses**	**PLO1 AKW**	**PLO2 RS**	**PLO3 CTPS**	**PLO4 EM**	**PLO5 CS**	**PLO6 LL**	**PLO7 SS**	**PLO8 TS**	**PLO9 LS**	**PLO10 IM**	**PLO 11 ME**
University General Courses (Choose 1 from the list*)												
UXXX 6XX3	University General Course											
Core Courses												
MSCQ 1803	Forensic Evidence and the Aspects of Law	✓		✓		✓	✓					
MSCQ 1913	Crime Scene Investigation	✓	✓	✓	✓	✓			✓			
MSCQ 1833	Expert Testimony and Moot Court	✓		✓	✓	✓			✓			
MSCQ 1823	Forensic Chemistry	✓	✓	✓		✓	✓					
MSCQ 1923	Biological Aspects of Forensic Sciences	✓	✓	✓		✓	✓					
MSCQ 1853	Forensic Practical	✓	✓	✓		✓			✓			
Elective Courses (Choose 3)												
MSCQ 1813	Forensic Analytical Instrumentation	✓	✓	✓		✓	✓					
MSCQ 1963	Computer Forensics	✓	✓	✓		✓	✓					
MSCQ 1933	Examination of Questioned Documents	✓	✓	✓		✓	✓					
MSCQ 1973	Fire and explosion Investigation	✓	✓	✓		✓	✓					
MSCQ 1943	Quality Assurance in Forensic Science	✓	✓	✓		✓	✓					
MSCQ 1953	Forensic Engineering	✓	✓	✓		✓	✓					

MSCQ 1983	Firearms and Forensic Ballistics	✓	✓	✓		✓	✓					
MSCQ 1993	Forensic Toxicology and Drugs of Abuse	✓	✓	✓		✓	✓					
Research Methodology Course												
MSCQ 1303	Research Methodology	✓	✓	✓	✓		✓					
Research												
MSCQ 1180	Forensic Research Project 1	✓		✓	✓	✓	✓					
MSCQ 2180	Forensic Research Project 2	✓		✓	✓	✓	✓					

Key:
1. Technical Skills: PLO 1, 2, 3
2. Generic Skills : PLO 4, 5, 6, 7, 8, 9, 10 and 11.

* List of University General Courses

1. UHMS 6013 - Seminar on Global Development
2. UHMZ 6023 - Malaysian Society and Culture
3. UHIS 6013 - Philosophy of Science and Civilization
4. UHPS 6013 – Dynamics of Leadership
5. UHLM 6013 – Malay Language for Post Graduates
6. URTS 6013 – Environmental Ethics
7. UECS 6013 – IT Project Management
8. URSP 6023 – ICT Ethics and Society
9. UBSS 6013 – Organization Behaviour and Development
10. UBSS 6023 – Business Ethics, Responsibility and Sustainability
11. UMJJ 6013 – Basic Japanese Language & Culture

19. Support for students and their learning

Students and their learning are supported by:

- Briefing of all new post-graduate students during registration week.
- Postgraduate Handbook for every academic session.
- Information services provided by the Graduate School (SPS) and through the university's web site.
- Student Support provided by counselors and psychologists at 'Unit Perkhidmatan Sokongan Pelajar' (UPSP), UTM Medical Centre, accommodation officers and University Library and others.
- Student Advisors Programme: Selected academic staff provides advice on academic progress and monitoring students' performance and achievements.
- Special programmes on career development conducted by the university to ensure students acquire necessary skills during their academic and future career.
- Staff student ratio for teaching of 1:12.
- Extensive library and other learning resources and facilities

20. Career Prospects

Graduate of the programme can work as:

- Research officer – Research Institute, university and industries
- Science Officer -- Research Institute, university and industries
- Academician
- Mathematics practitioner
- Data analyst

OR

They can further their education by doing a PhD programme in the related field of study.

21. Regulation of Assessment

Assessment rules and degree classification applies for every course with the minimum passing mark of 60%. To qualify for the degree award, students should complete all of the programme's requirements; achieve passing mark for every courses examination. The research project will be examined by a panel of internal examiners appointed by the Forensic Science Programme Coordinator; their roles include evaluating candidates' presentation and written research project.

Summary of marks, grades and their evaluation points

Marks	Grade	Evaluation Point
90-100	A+	4.00
80-89	A	4.00
75-79	A-	3.67
70.74	B+	3.33
65-69	B	3.00
60-64	B-	2.67
55-59	C+	2.33
50-54	C	2.00
45-49	C-	1.67
40-44	D+	1.33
35-39	D+	1.00
30-34	D-	0.67
00-29	E	0.00

For further information on academic regulations please refer to the graduate school website: http://www.sps.utm.my/

22. Facilities available

List of laboratories:

1. Forensic Analytical Laboratory
2. Inorganic Chemistry Laboratory 1 & 2
3. Physical Chemistry Laboratory 1 & 2
4. Organic Chemistry Laboratory 1 & 2
5. Analytical Chemistry Laboratory 1, & 2
6. Project Laboratories
7. Macromolecule Laboratory
8. Biotechnology Laboratory
9. Students Computer Room
10. Resource Centre

List of Forensic & Capital Instruments :

1. Stereomicroscopes
2. Comparison microscope
3. Crime lite
4. Nuclear Magnetic Resonance Spectrometer
5. Gas Chromatography-Mass Spectrometer System
6. Fourier Transform Infrared Spectrometers
7. Gel Permeation Chromatograph
8. UV-Visible Spectrophotometers
9. High Performance Liquid Chromatographs
10. Gas Chromatographs
11. Atomic Absorption Spectrometer
12. Ion Chromatograph
13. Capillary Electrophoresis Unit
14. BET Surface Analyser
15. Differential Scanning Calorimeter
16. Voltammetric Systems
17. Fluorescence Spectrophotometer
18. Surface Adsorption/Desorption System
19. Total Organic Carbon Analyzer
20. Flame Photometer
21. Electron Spin Resonance Spectrometer
22. X-Ray Diffraction Spectrometer
23. Inductively Coupled Plasma-Mass Spectrometer

List of computer laboratories :

1. Computer Lab
2. Smart Classroom
3. Resource Centre

23. Methods for Evaluating and Improving the Quality and Standards of Teaching and Learning

Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards

1. Students' performance in terms of:
- KB/KS/KG –Pass/conditional pass/fail
- CPA – Cumulative point average
- Graduating students' performance
- GOT – Graduate on time
- Completion Rate
- Analysis of course performance

2. Employability
- Exit survey
- Alumni survey
- Market survey

3. Curriculum review
- Faculty academic committee
- External examiner reports
- CLO achievement survey by students

4. Delivery system
- Academic Quality Assurance Committee
- Customer Satisfaction Index (CSI)
- Employer Satisfaction Index (ESI)
- Malaysia Quality Assurance (MQA) standards

5. Lecturer's performance • Teaching evaluation by students (e-PPP) • Competency check-list for staff (CS). • Annual staff appraisal (e-LPPT) • ++ TES	

24. Regulation of Program Assessment

++BoS

Role of External Examiners (Visiting Examiners): Visiting Examiners are appointed by the Faculty Academic Committee to:

- review and evaluate program curriculum,
- review and evaluate methods of student's assessment,
- make necessary recommendations to the Academic Committee.

25. Program Assessment Tools

Measurement Tools	**Programme Learning Outcomes (PLO)**											**Duration**	**Action by**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**		
Course Exit Survey	x	x	x	x	x	x	x	x	x	x	x	Per semester	Lecturer
Course Assessment Report (CAR)	x	x	x	x	x	x	x	x	x	x	x	Per semester	Lecturer
Annual Programme Assessment Report (APAR)	x	x	x	x	x	x	x	x	x	x	x	Per year	Faculty
Exit Survey	x	x	x	x	x	x	x	x	x	x	x	Final Semester	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/ 3 year	Director

CURRICULUM STRUCTURE

MASTER OF FORENSIC SCIENCE

- by Taught Course

This is a 3-semester full-time programme comprising a total of 45 credits that include six core courses (18 credits), three elective course (9 credits), one research methodology course (3 credits), one University compulsory course (3 credits), Research Project 1 and Research Project 2 (12 credits). The following is a typical course distribution for the Master of Forensic Science by taught course:

SEMESTER 1

COURSE CODE	COURSE	CREDIT
MSCQ 1823	Forensic Chemistry *Kimia Forensik*	3
MSCQ 1803	Forensic Evidence and the Aspects of Law *Bukti Forensik dan Aspek Perundangan*	3
MSCQ 1XX3	Elective 1 *Elective 1*	3
MSCQ 1303	Research Methodology *Kaedah Penyelidikan*	3
UHAX 6XX3	University Compulsory Course *Kursus Wajib Universiti*	3
	Total	**15**

XX – year and semester of study

SEMESTER 2

COURSE CODE	COURSE	CREDIT
MSCQ 1853	Forensic Practical *Amali Forensik*	3
MSCQ 1923	Biological Aspects of Forensic Sciences *Aspek Biologi Sains Forensik*	3
MSCQ 1913	Siasatan Tempat Jenayah *Crime Scene Investigation*	3
MSCQ 1180	Forensic Research Project 1 *Projek Penyelidikan Forensik 1*	6
	Total	**15**

SEMESTER 3

COURSE CODE	COURSE	CREDIT
MSCQ 2180	Forensic Research Project 2 *Project Penyelidikan Forensik 2*	6
MSCQ 1833	Expert Testimony and Moot Court *Keterangan Pakar dalam Mahkamah*	3
MSCQ 1XX3	Elective 2 *Elective 2*	3
MSCQ 1XX3	Elective 3 *Elective 3*	3
	Total	15
Total credits		**45**

XX – year and semester of study

LIST OF ELECTIVE COURSES

COURSE CODE	COURSE	CREDITS
MSCQ 1813	Forensic Analytical Instrumentation *Analitikal Forensik Berinstrumen*	3
MSCQ 1933	Examination of Questioned Documents *Pemeriksaan Dokumen yang dipertikaikan*	3
MSCQ 1943	Quality Assurance in Forensic Science *Jaminan Kualiti dalam Sains Forensik*	3
MSCQ 1953	Forensic Engineering *Kejuruteraan Forensik*	3
MSCQ 1963	Computer Forensics *Komputer Forensik*	3
MSCQ 1973	Fire and Explosion Investigation *Siasatan Kebakaran dan Letupan*	3
MSCQ 1983	Firearms and Forensic Ballistics *Senjata dan Balistik Forensik*	3
MSCQ 1993	Forensic Toxicology and Drugs of Abuse Toksikologi Forensik dan Dadah yang Disalahgunakan	3

Elective course availability is subject to change

Please refer to **Synopsis of Courses** for the synopsis of each course.

MASTER OF PHILOSOPHY AND DOCTOR OF PHILOSOPHY

Field of Research: Chemistry
- By Research (Full time)

Department of Chemistry offers full time research programmes leading to M.Phil. and Ph.D. degree for students interested in pursuing research careers. To ensure the suitability of the research for the given academic level, students are required to present their research proposal to be evaluated by experts in the related area. This usually takes place in the second semester for M.Phil. student and third semester for Ph.D. student. Students are expected to disseminate the output of their research through writing of research articles and presentations in conferences. On completion of the research project, students are required to submit their dissertation/thesis for evaluation by external and internal examiners appointed by the Faculty of Science. The programmes are MQA accredited.

Programme	NEC Code	MQA Reference Number (Certificate Number)
M.Phil.	442 (Chemistry) / 0531 (Chemistry, National Education Code 2020)	MQA/SWA0310 (20677)
Ph.D.	442 (Chemistry) / 0531 (Chemistry, National Education Code 2020)	MQA/SWA0312 (12980)

Programme Educational Objectives (PEO)

PEO	M.Phil.	Ph.D.
1	Knowledgeable and skilful in catering to knowledge-intensive industries in the field of Chemistry through application of research and innovation skills	Knowledgeable and skillful in catering to knowledge-intensive industries in the field of Chemistry through application of research and innovation skills.
2	Competent to advice and solve on contemporary issues and proposed new solutions and innovations for development and advancement in the field of Chemistry.	Competent to advice and solve on contemporary issues, and proposed new solutions and innovations for development and advancement in the field of Chemistry.
3	Equipped with professional skills critical to excel within a multicultural, transnational work and learning environment.	Equipped with professional skills critical to excel within a multicultural, transnational work and learning environment.

Programme Learning Outcome (PLO)

PLO	M.Phil.	Ph.D.
1	Integrate and generate in-depth relevant knowledge independently using innovative techniques, tools and skills for decision-making to manage and resolve a complex problem in the field of Chemistry as a basis for research.	Synthesize, critique, apply, and extend in-depth relevant knowledge independently using innovative techniques, tools, and skills in the field of Chemistry as a basis for research to produce new ideas and solution.
2	Construct a critical and innovative solution for complex problems or issues in the field of Chemistry through research using the latest development techniques and skills.	Create new concept/theories/solutions/practice through independent research and originality that satisfies international standards within the field of Chemistry using the latest techniques, tools, and skills.
3	Devise standard research methodology that is based on the forefront knowledge and latest development in the field of Chemistry to solve research problems with reasonable degree of originality.	Integrate highly advanced and specialized research methodologies based on the forefront knowledge and latest development in the field of Chemistry to solve complex research problems with reasonable degree of originality.
4	Demonstrate effective collaboration with peers, scholarly communities and society at large in the relevant field of expertise and research.	Demonstrate decent collaboration with peers, scholarly communities and society at large in the relevant field of expertise and research.
5	Communicate the knowledge, skills, ideas clearly using appropriate methods to peers, experts, and non-experts through various mediums.	Communicate effectively the knowledge, skills, ideas and research findings using appropriate methods to peers, scholarly communities, and societies through various mediums.
6	Use a broad range of suitable digital technologies, media, and software to design, manage, analyse and report research studies.	Use, improve existing or develop new appropriate tools or methodologies using a broad range of digital technology, media and software to support and enhance research activities.
7	Demonstrate skills in designing, planning evaluation activities, and analysing numerical and graphical data using quantitative or qualitative tools in solving problems.	Demonstrate skills in designing, critical evaluation, and analysing numerical and graphical data using quantitative or qualitative tools to support and enhance research activities.

8	Demonstrate leadership, autonomy and responsibility in conducting and managing own research and resources.	Demonstrate leadership, professionalism and management skills, and take full responsibility for own work, and significantly for others in the research organization.
9	Demonstrate the ability to manage and enhance own self-advancement for academic development, professional development and research skills using lifelong learning strategies.	Demonstrate the ability to manage and enhance own self- and if necessary, can be accountable for overall management of one's research organization and professional development.
10	Develop potential commercialisation research output.	Develop potential commercialisation research output.
12	Demonstrate adherence to legal, ethical and professional codes of practice in the field of Chemistry and research activities.	Demonstrate adherence to legal, professional and contribute to the development of ethical sound codes of practice.

Field of Research

The research project of the student may fall into one or more aspects of the following field:

- biotechnology
- catalysis
- chemometrics
- computational chemistry
- environmental chemistry
- forensic science
- nanostructured materials
- natural products
- organic synthesis
- organometallics
- polymer electrolytes
- separation science
- solid state chemistry
- zeolites

Courses and duration of study

The normal duration of study is 2–8 semesters (1–4 years) for M.Phil. and 6–16 semesters (3–8 years) for the Ph.D. programme.

Students must register a Research Course with the following code in each semester.

Year/ Semester (Total Semester)	**M.Phil.**	**Ph.D.**
1/1 (Sem. 1)	MSCC 1100	PSCC 1100
1/2 (Sem. 2)	MSCC 1200	PSCC 1200
2/1 (Sem. 3)	MSCC 2100	PSCC 2100
2/2 (Sem. 4)	MSCC 2200	PSCC 2200
3/1 (Sem. 5)	MSCC 3100	PSCC 3100
3/2 (Sem. 6)	MSCC 3200	PSCC 3200
4/1 (Sem. 7)	MSCC 4100	PSCC 4100
4/2 (Sem. 8)	MSCC 4200 (**maximum semester**)	PSCC 4200
5/1 Sem. (9)	-	PSCC 5100
5/2 (Sem. 10)	-	PSCC 5200
6/1 (Sem. 11)	-	PSCC 6100
6/2 (Sem. 12)	-	PSCC 6200
7/1 (Sem. 13)	-	PSCC 7100
7/2 (Sem. 14)	-	PSCC 7200
8/1 (Sem. 15)	-	PSCC 8100
8/2 Sem. (16)	-	PSCC 8200 (**maximum semester**)

All research students must enrol in Research Methodology (USCP 6013) and at least one of the University's General Courses (subjected to courses offered in each semester listed in SPS website).

Examples of General Courses offered are:

No.	Course code	Faculty	Course name
1	UBSS 6013	AHIBS KL	Organization Behaviour and Development
2	UBSS 6023	AHIBS KL	Business Ethics, Responsibility and Sustainability
3	UHMS 6013	FSSH/SHARP	Seminar on Global Development, Economic and Social Issues
4	UHMZ 6023	FSSH/SHARP	Malaysian Society and Culture
5	UHIS 6013	FSSH/ATI	Philosophy of Science and Civilization
6	UHPS 6013	FSSH/SOE	Dynamics of Leadership
7	UHLM 6013	FSSH/LA	Malay Language for Post Graduates
8	URTS 6013	FTIR	Environmental Ethics
9	UECS 6013	FC	IT Project Management
10	URSP 6023	FTIR	ICT Ethics and Society
11	UANP 6013	FTIR	Informatics in Society
12	UMJJ 6013	MJIIT	Basic Japanese Language & Culture

Credit transfer of Research Methodology and the University's General Courses

Students can apply for credit transfer if the course(s) taken in another M.Phil. programme(s) prior to the current study with at least 80% identical learning outcomes.

Deferment of study

- Students may apply for deferment of the programme registration for not more than **TWO SUBSEQUENT** semesters subject to University's approval.
- Students who do not register for any courses in a semester must apply for deferment. The deferred semester will be counted as a part of the total study period.
- Students who withdraw (TD) from **ALL** courses in a semester will automatically be given a deferment. The deferred semester will be counted as a part of the total study period.
- Students may apply for deferment of study due to health reasons. The application has to be accompanied with a medical report certified by a Medical Officer recognised by the University. The deferred semester may not be counted as a part of the total study period.

Conversion from M.Phil. to Ph.D. programme

M. Phil. students can apply for conversion to a Ph.D. programme between SIX (6) to FIFTEEN (15) months from the registration date upon achieving the requirement listed in the table below.

Bachelor's Degree CGPA	Requirements
CGPA ≥ 3.33	Presented **TWO** conference articles in proceedings with ISBN. **OR** published **ONE** article in a SCOPUS/WOS/ERA indexed journal.
3.00 ≤ CGPA ≤ 3.32	Published **ONE** article in a WOS indexed journal.

Students will be requested to defend the research proposal to the evaluation panels. Passing the evaluation is necessary for successful conversion to Ph.D. programme.

Assessments and evaluation

(i) First Assessment

Students are required to present a research proposal (**with preliminary/expected results**) for evaluation purposes within the duration specified by the University, according to the following schedule:

Programme	Semester
M.Phil.	2nd semester
Ph.D.	3rd semester

If the students failed to present without any valid reasons, the student may be given a TM status by the faculty.

(ii) Progress Report Assessment

All postgraduate research students are required to submit a progress report online (GSMS system) before the due date. The online system will usually be opened in week 10–13 of each semester, unless specified otherwise in the academic calendar.

The supervisor shall evaluate the progress report. A student whose progress is satisfactory (MM status) will be recommended for the continuation of his/her candidature.

A student may be given a TM or GG status if he/she does not submit his/her progress report.

The faculty shall terminate the candidature of a student whose progress is not satisfactory (TM status) for **TWO** consecutive semesters.

(iii) Qualifying Assessment (Fast Track Ph.D.)

Fast track students in the Ph.D. programme must undergo a qualifying assessment after 6 to 18 months of registration in the Ph.D. programme. The result of the assessment can be one of the following:

(c) **Pass** - The student will continue their Ph.D. programme and proceed with the First Assessment in the following semester.
(d) **Fail** - The student will be transferred to the M.Phil. programme and a new study period begins.

(iv) Viva Voce (Oral Examination)

A student should submit Notice for Thesis Submission (NHT) approved by the supervisor at least three months prior to submission of the dissertation/thesis for examination, or three months before expiry of the maximum study duration. Dissertation/Thesis report must follow the guidelines prescribed in the UTM Thesis Manual 2018 and the report must be written in English. Students shall apply for a permission if the dissertation/thesis is to be written in other languages, i.e., Bahasa Malaysia. The Turnitin score for each chapter shall not be more than 20%. The publication criteria for the M.Phil. and Ph.D. programme are listed below. The article must contain the name of the supervisor (with UTM affiliation) and the student must be listed as the first student author.

Program	Publication criteria
M. Phil.	Students may submit their dissertation after 12 months with at least one publication that has been accepted or published in either journal, conference, or book chapters for the purpose of the viva voce.
Ph.D.	**Submission of thesis for normal duration of study (within 6 - 16 semesters)** Students can submit their thesis for viva voce after having: ● at least **ONE** accepted or published article in a WOS indexed journal, or ● **TWO** accepted or published articles in Scopus/ERA/Malaysia Journal Management System indexed journals. **Early thesis submission (in the Semester 5)** Students can submit their thesis for viva voce after having: ● accepted or published **TWO** articles in WOS/Scopus/ERA indexed journals. **Submission of thesis using publication format** Students can submit their thesis for viva voce using publication format if the following condition is fulfilled: ● At 24 months after the student enrols; a minimum of **THREE** journal articles indexed in Scopus/WOS with at least **TWO** articles accepted or published in Q1/Q2 WOS indexed journals. ● At least 30 months after the student enrols: a minimum **THREE** journal articles indexed in Scopus/WOS with at least **ONE** journal article accepted or published in Q1/Q2 WOS indexed journal.

Dissertation / Thesis examination for M.Phil. and Ph.D. programmes should be made according to the criteria set for the programme as approved by the Senate. For instance, oral defence cannot be held more than twice. The thesis examiner should consist of at least one internal and one external examiner, unless specified in *Prosedur Penyelidikan Pascasiswazah (ProPS-06), 2022*. Please refer to the faculty on the fee imposed for viva voce.

Change of supervisor

During the study period, students may apply for a change of supervisor if necessary. The application is made by filling in the specific form available at the Faculty's Postgraduate Office. The application needs to be supported and approved by the Faculty's Academic Committee. However, students have to take note that the application for a change in supervisor can only be made with the following restrictions (except for special cases):

- Change of supervisor can only be made **ONCE** throughout the study period.
- Application can only be made **BEFORE** the First Assessment.

Abbreviations

ERA	: Excellence in Research Australia
GG	: *Gagal* (Fail)
GSMS	: Graduate Studies Management System
MM	: *Memuaskan* (Satisfactory)
M.Phil.	: Master of Philosophy
MQA	: Malaysian Qualifications Agency
NEC	: National Education Code
NHT	: Notis Hantar Thesis (Notice for Thesis Submission)
Ph.D.	: Doctor of Philosophy
TD	: *Tarik Diri* (Withdraw)
TM	: *Tidak Memuaskan* (Unsatisfactory)
WOS	: Web of Science

MATHEMATICAL SCIENCES PROGRAMMES

MASTER OF SCIENCE IN MATHEMATICS

PROGRAMME SPECIFICATION

1. Awarding Institution	**UTM**
2. Teaching Institution	**UTM**
3. Programme Name	**Master of Science in Mathematics**
4. Final Award	**Master of Science in Mathematics**
5. Programme Code	**MSCH2**
6. Professional or Statutory Body of Accreditation	Ministry of Higher Education Malaysia (Kementerian Pengajian Tinggi Malaysia)
7. Language(s) of Instruction	**English**
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-govern
10. Study Scheme	**Full Time**
11. Study Duration	Minimum: 1½ years Maximum: 4 years
12. Entry Requirement	1. A Bachelor's Degree with good honours from Universiti Teknologi Malaysia or any other institution of higher learning recognised by the Senate; **Or** 2. A qualification equivalent to a Bachelor's Degree and working experience in the relevant field recognised by the Senate. **Special Admission Requirement** 1. Bachelor of Science or Bachelor of Education (Mathematics) with CPA ≥ 3.00 from Universiti Teknologi Malaysia or equivalent. 2. Bachelor of Science or Bachelor of Education (Mathematics) recognized with CPA ≥ 2.5 from Universiti Teknologi Malaysia or equivalent, and with at least two years of work experience in a related field.

13. Programme Educational Objectives (PEO)

Graduates of the programme should be:

1. PEO 1 : knowledgeable and competent in embedding advanced mathematical approaches in solving multidisciplinary science problems.

2. PEO 2 : professionally competent with initiative for career advancement through life-long learning.

3. PEO 3 : proficient in practicing ethical principles within organizational and societal context.

14. Programme Learning Outcomes (PLO)

At the end of this programme, students will be able to:

Intended Learning Outcomes			Teaching and Learning Methods	Assessment
	PLO1	synthesize advanced technical knowledge to generate new ideas in the field of mathematical sciences. (Knowledge and Understanding -KW)	Guided lectures, computer laboratory works, directed reading, group discussion, problem solving and intellectual discourse.	Examinations, tests, quizzes, project reports and assignments.
	PLO2	construct solutions for various problems related to the discipline of mathematical sciences. (Cognitive Skills - CG)	Lectures, mini research, computer laboratory works, article critique and group discussions. Hands-on mathematical software and simulation	Oral examination(viva), Test, assignments, project reports and dissertation.
	PLO3	use advanced mathematical and computer tools in conducting research methodologies for multidisciplinary science problems. (Practical Skills - PS)	Guided lectures, case studies, paper critique, group discussions and problem solving. Hands- on mathematical software and simulation.	Tests, assignments, research proposal, academic writing, project reports and oral presentations.
	PLO7	evaluate numerical and graphical data using advanced mathematical software. (Numeracy Skills – NS)	Case studies, Computer-based learning and directed reading	Assignments, programming and simulation reports

Intended Learning Outcomes			Teaching and Learning Methods	Assessment
GENERIC SKILLS	**PLO4**	collaborate effectively with different people in the learning and employment communities (Interpersonal Skills -IPS)	Case studies, projects and group discussions	Project reports, group presentation, reflection journal and peer assessment
	PLO5	communicate effectively through variety of media and technology in delivering ideas to a diverse audience. (Communication Skills-CS)	Group discussion and active learning,	Project reports, assignments and group presentation
	PLO6	competently utilize a wide range of digital technologies to enhance study and work. (Digital Skills-DS)	Case studies, computer-based learning and directed reading	Assignments, programming and simulation reports
	PLO8	demonstrate leadership, autonomy and responsibility in managing projects) (Leadership, Autonomy and Responsibility -LAR)	Lecture, Active Learning, Group projects and presentations	Project reports, assignments, and group presentation
	PLO9	demonstrate self-advancement through good character, enthusiasm for independent and continuous learning, and professional development. (Personal Skills -PRS)	Lectures, group works, case studies	Project reports, group presentations
	PLO10	initiate entrepreneurial project related to mathematical sciences (Entrepreneurial Skills-ENT)	Lecture, Group discussion	Project reports, assignments and group presentation
	PLO11	demonstrate adherence to legal and professional ethics in dealing with any relevant issue. (Ethics and Professional Skills -ETS)	Brainstorming, discussion and case studies.	Assignments and research project reports.

15. Classification of Courses

No.	Classification	Credit Hours	Percentage	Standard (QA)
i.	University General Course	3	7.1	50%
ii.	Core Courses	12	28.6	
iii.	Elective Courses	6	14.3	
iv.	Research and Dissertation	21	50	50%
Total		**42**	**100**	**100%**

16. Total credit hours to graduate : 42 credit hours

17. Programme structures and features, curriculum, and award requirements

The course is offered in full-time mode and based on a 3 Semester Academic Year with several subjects being delivered and assessed in each semester. Assessment: Based on final examination, coursework and dissertation.

Award requirements:

To graduate, students should:

- achieve a total of minimum 42 credit hours with minimum CPA of 3.00
  complete and pass viva M.Sc Dissertation

Course Category	Code	Course	Credit
University general course (3 Credits)	UXXX 6XX3	(Choose 1 courses from the list given by School of Graduate Studies)	3
Core Courses (12 Credits)	MSCM 1303	Research Methodology	3
	MSCM1023/ SSCM5053	Advanced Mathematical Methods 1	3
	MSCM1053/ SSCM5373	Computational Mathematics	3
	MSCM1233/ SSCM5693	Mathematical Analysis	3
Elective Courses (6 Credits) (Choose 3 from the list)	MSCM 1113	Advanced Engineering Mathematics	3
	MSCJ 1733	Theoretical Mechanics	3
	MSCM 1133	Soliton & Nonlinear Waves	3
	MSCM 1143	Fluid Mechanics and Heat Transfer	3
	MSCM 1153	Applied and Computational Complex Analysis	3
	MSCM 1183	Advanced Mathematical Methods 2	3
	MSCJ 1543/SSCM 5703	Advanced Partial Differential Equations	3
	MSCM 1213	Group Theory I	3
	MSCM 1223	Galois Theory	3
	MSCM 1253	Theory of Matrices	3
	MSCM 1263	Point Set Topology	3
	MSCM 1273	Group Theory II	3
	MSCM 1313	Numerical Ordinary Differential Equations	3
	MSCM 1323	Finite Difference Methods for Partial Differential Equations	3
	MSCM 1333	Finite Element Methods	3
	MSCM 1353	Parallel Computing	3
	MSCM 1363	Numerical Integral Equation	3
	MSCM 1393	Numerical Linear Algebra	3
	MSCM 1403	Advanced Mathematical Statistics	3
	MSCM 1423	Probability Theory	3
	MSCM 1433	Stochastic Processes	3
	MSCM 1453	Generalized Linear Models	3

	MSCM 1483 MSCM 1493 MSCM 1613 MSCM 1623 MSCM 1633 MSCM 1643 MSCM 1663	Time Series Analysis Advanced Multivariate Analysis Advanced Optimization Techniques Mathematics of Operations Research Game Theory Heuristic Optimization Methods Supply Chain Modelling	3 3 3 3 3 3 3
Research (21 Credits)	MSCM 1280 MSCM 2180	Research Proposal Dissertation	3 18
TOTAL CREDIT			**42**

18. Mapping of Program Learning Outcomes to Course

	COURSES OFFERED	Knowledge and Understanding	Cognitive Skills	Practical Skills	Numeracy Skills	Interpersonal Skills	Communication Skills	Digital Skills	Leadership, Autonomy and Responsibility	Personal Skills	Entrepreneurial Skills	Ethics and Professionalism Skills
Code	**Courses**	**PLO1 KW**	**PLO2 CG**	**PLO3 PS**	**PLO7 NS**	**PLO4 IPS**	**PLO5 CS**	**PLO6 DS**	**PLO8 LAR**	**PLO9 PRS**	**PLO10 ENT**	**PLO11 ETS**
University General Courses (Choose 1 from the list*)												
UXXX 6XX3	University General Course						✓					
Core Courses												
MSCM 1303	Research Methodology	✓	✓				✓	✓			✓	✓
MSCM 1023/ SSCM5053	Advanced Mathematical Methods 1	✓	✓				✓					
MSCM 1053/ SSCM5373	Computational Mathematics	✓	✓					✓	✓			
MSCM1233/ SSCM5693	Mathematical Analysis	✓	✓				✓					
Elective Courses (Choose 2)												
MSCM 1113	Advanced Engineering Mathematics	✓	✓				✓					
MSCM 1123	Theoretical Mechanics	✓	✓				✓					
MSCJ 1733	Soliton & Nonlinear Waves	✓	✓				✓					
MSCM 1143	Fluid Mechanics and Heat Transfer	✓	✓				✓					
MSCM 1153	Applied and Computational Complex Analysis	✓	✓				✓					
MSCM 1183	Advanced Mathematical Methods 2	✓	✓				✓					
MSCJ 1543/ SSCM5703	Advanced Partial Differential Equations	✓	✓				✓					
MSCM 1213	Group Theory I	✓	✓				✓					
MSCM 1223	Galois Theory	✓	✓				✓					
MSCM 1253	Theory of Matrices	✓	✓				✓					
MSCM 1263	Point Set Topology	✓	✓				✓					
MSCM 1273	Group Theory II	✓	✓				✓					
MSCM 1313	Numerical Ordinary Differential Equations	✓	✓					✓	✓			
MSCM 1323	Finite Difference Methods for Partial Differential Equations	✓	✓					✓	✓			

MSCM 1333	Finite Element Methods	✓	✓					✓	✓			
MSCM 1353	Parallel Computing	✓	✓					✓	✓			
MSCM 1363	Numerical Integral Equation	✓	✓					✓	✓			
MSCM 1393	Numerical Linear Algebra	✓	✓					✓	✓			
MSCM 1403	Advanced Mathematical Statistics	✓	✓		✓					✓		
MSCM 1423	Probability Theory	✓	✓		✓					✓		
MSCM 1433	Stochastic Processes	✓	✓		✓					✓		
MSCM 1453	Generalized Linear Models	✓	✓		✓					✓		
MSCM 1483	Time Series Analysis	✓	✓		✓					✓		
MSCM 1493	Advanced Multivariate Analysis	✓	✓		✓					✓		
MSCM 1613	Advanced Optimization Techniques	✓	✓		✓							
MSCM 1623	Mathematics of Operations Research	✓	✓		✓			✓				
MSCM 1633	Game Theory	✓	✓		✓			✓				
MSCM 1643	Heuristic Optimization Methods	✓	✓		✓			✓				
MSCM 1663	Supply Chain Modelling	✓	✓	✓				✓				
Research												
MSCM1280	Research Proposal	✓	✓				✓					✓
MSCM 2180	Dissertation	✓	✓	✓			✓					✓

Key:

1. Technical Skills: PLO1, 2, 3 and 7
2. Generic Skills : PLO 4, 5, 6, 8, 9, 10 and 11.

* List of University General Courses

1. UHMS 6013 - Seminar on Global Development
2. UHMZ 6023 - Malaysian Society and Culture
3. UHIS 6013 - Philosophy of Science and Civilization
4. UHPS 6013 – Dynamics of Leadership
5. UHLM 6013 – Malay Language for Post Graduates
6. URTS 6013 – Environmental Ethics
7. UECS 6013 – IT Project Management
8. URSP 6023 – ICT Ethics and Society
9. UBSS 6013 – Organization Behaviour and Development
10. UBSS 6023 – Business Ethics, Responsibility and Sustainability
11. UMJJ 6013 – Basic Japanese Language & Culture

19. Support for students and their learning

Students and their learning are supported by:

- Briefing of all new post-graduate students during registration week.
- Postgraduate Handbook for every academic session.
- Information services provided by the Graduate School (SPS) and through the university's web site.
- Student Support provided by counselors and psychologists at 'Unit Perkhidmatan Sokongan Pelajar' (UPSP), UTM Medical Centre, accommodation officers and University Library and others.
- Student Advisors Programme: Selected academic staff provides advice on academic progress and monitoring students' performance and achievements.
- Special programmes on career development conducted by the university to ensure students acquire necessary skills during their academic and future career.
- Staff student ratio for teaching of 1:12.
- Extensive library and other learning resources and facilities

20. Career Prospects

Graduate of the programme can work as:

- Research officer - Research Institute, university and industries
- Science Officer - Research Institute, university and industries
- Academician
- Mathematics practitioner
- Data analyst

OR

They can further their education by doing a PhD programme in the related field of study.

21. Regulation of Assessment

Assessment rules and degree classification applies for every course with the minimum passing mark of 60%. To qualify for the degree award, students should complete all of the programme's requirements; achieve passing mark for every courses examination. Dissertation will be examined by a panel of internal examiners appointed by the Department's Post-graduate Committee; their roles include evaluating candidates' viva-voce and written project dissertation.

Summary of marks, grades and their evaluation points

Marks	Grade	Evaluation Point
90-100	A+	4.00
80-89	A	4.00
75-79	A-	3.67
70.74	B+	3.33
65-69	B	3.00
60-64	B-	2.67
55-59	C+	2.33
50-54	C	2.00
45-49	C-	1.67
40-44	D+	1.33
35-39	D+	1.00
30-34	D-	0.67
00-29	E	0.00

For further information on academic regulations please refer to the graduate school website: http://www.sps.utm.my/

22. Facilities available

List of computer laboratories:

1. Computer Lab
2. Smart Classroom
3. Resource Centre

23. Methods for Evaluating and Improving the Quality and Standards of Teaching and Learning

Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards

1. Students' performance in terms of:

- KB/KS/KG –Pass/conditional pass/fail
- CPA – Cumulative point average
- Graduating students' performance
- GOT – Graduate on time
- Completion Rate
- Analysis of course performance

2. Employability

- Exit survey
- Alumni survey
- Market survey

3. Curriculum review

- Faculty academic committee
- External examiner reports
- CLO achievement survey by students

4. Delivery system

- Academic Quality Assurance Committee
- Customer Satisfaction Index (CSI)
- Employer Satisfaction Index (ESI)
- Malaysia Quality Assurance (MQA) standards

5. Lecturer's performance • Teaching evaluation by students (e-PPP) • Annual staff appraisal (e-LPPT) • Teaching Evaluation System (TES)	

24. Regulation of Program Assessment

Board of Study (BoS) Faculty of Science:

- External Examiners
- IAP
- Alumni

BoS panels are appointed by the Faculty Academic Committee to:

- review and evaluate program curriculum,
- review and evaluate methods of students assessment,
- make necessary recommendations to the Academic Committee.

25. Program Assessment Tools

Measurement Tools	**Programme Learning Outcomes (PLO)**											**Duration**	**Action by**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**		
Course Exit Survey (SCO)	x	x	x	x	x	x	x	x	x	x	x	Per semester	Lecturer
Course assessment report (CAR)	x	x	x	x	x	x	x	x	x	x	x	Per semester	Lecturer
Annual Programme Assessment report (APAR)	x	x	x	x	x	x	x	x	x	x	x	Per Year	Faculty
Exit Survey	x	x	x	x	x	x	x	x	x	x	x	Final Semester	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/ 3 year	Director

CURRICULUM STRUCTURE

MASTER OF SCIENCE IN MATHEMATICS
- by Mixed Mode

This is a 3-semester full-time course comprising a total of 42 credits that include 3 mathematics core subjects (9 credits), 2 elective mathematics subjects (6 credits), Research Methodology (3 credits), Research Proposal (3 credits), university subject (3 credits) and Dissertation (18 credits). Specialised topics for the dissertation can be selected from any of the five areas of research in the mathematical sciences, described in the M.Sc and Ph.D by Research programmes. Typical distribution of subjects beginning in Semester 1, are as follows:

CURRICULUM STRUCTURE : INTAKE SEM 1 2023/2024 (OCTOBER 2023)

Semester 1

COURSE CODE	COURSE NAME	CREDIT
MSCM1043/ MSCM1023/ SSCM5053	**Mathematical Methods I/** Advanced Mathematical Methods 1	3
MSCM1033/MSCM1303	Research Methodology	3
Uxxx 6XY3	**University Compulsory Subject	3
Electives (Choose 3 credit)		
MSCM1XY3	Elective Course 1	3
	TOTAL	**12**

Semester 2

COURSE CODE	COURSE NAME	CREDIT
MSCM1233/ SSCM5693	Mathematical Analysis	3
MSCM1053/ SSCM5373	Computational Mathematics	3
MSCM1280	Research Proposal	3
Electives (Choose 3 credit)		
MSCM1XY3	Elective Course 2	3
	TOTAL	**12**

Semester 3

COURSE CODE	COURSE NAME	CREDIT
MSCM2180	Dissertation	18
	TOTAL	**18**

CURRICULUM STRUCTURE
INTAKE SEM 2 2023/2024 (FEBRUARY 2024)

Semester 1

COURSE CODE	COURSE NAME	CREDIT
MSCM1233/ SSCM5693	Mathematical Analysis	3
MSCM1053/ SSCM5373	Computational Mathematics	3
MSCM1280	Research Methodology	3
Electives (Choose 3 credit)		
MSCM1XY3	Elective Course 1	3
	TOTAL	**12**

Semester 2

COURSE CODE	COURSE NAME	CREDIT
MSCM1043/ MSCM1023/ SSCM5053	**Mathematical Methods I**/ Advanced Mathematical Methods 1	3
MSCM1033/MSCM1303	Research Proposal	3
Uxxx 6XY3	**University Compulsory Subject	3
Electives (Choose 3 credit)		
MSCM1XY3	Elective Course 2	3
	TOTAL	**12**

Semester 3

COURSE CODE	COURSE NAME	CREDIT
MSCM2180	Dissertation	18
	TOTAL	**18**

X – year of study ;
Y – 1st or 2nd semester;

LIST OF COURSES
Core courses

COURSE CODE	COURSE	CREDITS
MSCM1303	Research Methodology	3
MSCM1023/SSCM5053 (PRISMS)	Advanced Mathematical Methods I	3
MSCM1053/SSCM5373 (PRISMS)	Computational Mathematics	3
MSCM1233/SSCM5693 (PRISMS)	Mathematical Analysis	3
MSCM 1280	Research Proposal	3
MSCM 2180	Dissertation	18

Elective courses (choose two)

COURSE CODE	COURSE	CREDITS
MSCM 1113	Advanced Engineering Mathematics	3
MSCM 1123	Theoretical Mechanics	3
MSCJ 1733	Soliton and Nonlinear Waves	3
MSCM 1143	Fluid Mechanics and Heat Transfer	3
MSCM 1153	Applied and Computational Complex Analysis	3
MSCM 1183	Advanced Mathematical Methods 2	3
MSCJ 1543/SSCM5703	Advanced Partial Differential Equations	3
MSCM 1213	Group Theory I	3
MSCM 1223	Galois Theory	3
MSCM 1253	Theory of Matrices	3
MSCM 1263	Point Set Topology	3
MSCM 1273	Group Theory II	3
MSCM 1313	Numerical Ordinary Differential Equations	3

COURSE CODE	COURSE	CREDITS
MSCM 1323	Finite Difference Methods for Partial Differential Equations	3
MSCM 1333	Finite Element Methods	3
MSCM 1353	Parallel Computing	3
MSCM 1363	Numerical Integral Equation	3
MSCM 1393	Numerical Linear Algebra	3
MSCM 1403	Advanced Mathematical Statistics	3
MSCM 1423	Probability Theory	3
MSCM 1433	Stochastic Processes	3
MSCM 1453	Generalized Linear Models	3
MSCM 1483	Time Series Analysis	3
MSCM 1493	Advanced Multivariate Analysis	3
MSCM 1613	Advanced Optimization Techniques	3
MSCM 1623	Mathematics of Operations Research	3
MSCM 1633	Game Theory	3
MSCM 1643	Heuristic Optimization Methods	3
MSCM 1663	Supply Chain Modelling	3

Please refer to **Synopsis of Courses** for the synopsis of each course.

MASTER OF SCIENCE IN ENGINEERING MATHEMATICS

PROGRAM SPECIFICATION

1. Awarding Institution	**UTM**
2. Teaching Institution	**UTM**
3. Programme Name	**Master of Science in Engineering Mathematics (Sarjana Sains Matematik Kejuruteraan)**
4. Final Award	**Master of Science in Engineering Mathematics (Sarjana Sains Matematik Kejuruteraan)**
5. Programme Code	**MSCE2**
6. Professional or Statutory Body of Accreditation	Malaysian Ministry of Higher Education Kementerian Pengajian Tinggi Malaysia
7. Language(s) of Instruction	**English**
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-govern
10. Study Scheme	**Full Time**
11. Study Duration	Minimum: 1½ years Maximum: 4 years
12.Entry Requirement	Bachelor of Science* or Bachelor of Engineering* with CPA ≥ 3.00 from Universiti Teknologi Malaysia or equivalent OR Bachelor of Science* or Bachelor of Engineering* recognized with CPA≥2.5 from Universiti Teknologi Malaysia or equivalent, and with at least two years of work experience in a related field. * Has taken and passed a basic mathematics course namely calculus and\or numerical methods or equivalent Persons with disabilities (PWDs) are accepted into this program (including color blind) Candidates with an APEL T-7 certificate can be considered for admission purposes (subject to faculty approval).

13. Programme Educational Objectives (PEO)

Graduates of the programme should be:

1. PEO 1: Knowledgeable and competent in embedding advanced mathematical approaches in solving engineering and industrial problems
2. PEO 2: Professionally competent with initiative for career advancement through life-long learning
3. PEO 3: Practice ethical principles within organizational and societal context

14. Programme Learning Outcomes (PLO)

At the end of this programme, students will be able to:

Intended Learning Outcomes			Teaching and Learning Methods	Assessment
	PLO1	synthesize advanced technical knowledge to generate new ideas in engineering mathematics. (Knowledge and Understanding -KW)	Guided lectures, computer laboratory works, directed reading, group discussion, problem solving and intellectual discourse	Examinations, tests, quizzes, project reports and assignments
	PLO2	construct solutions for various problems related to the discipline of engineering mathematics. (Cognitive Skills - CG)	Lectures, mini research, computer laboratory works, article critique and group discussions Hands-on mathematical software and simulation	Oral examination(viva), assignments, project reports and dissertation
	PLO3	use advanced mathematical and computer tools in selecting research methodologies for engineering problems (Practical Skills - PS)	Guided lectures, case studies, paper critique, group discussions and problem solving Hands- on mathematical software and simulation	Examinations, tests, assignments, research proposal, academic writing, project reports and oral presentations
	PLO7	evaluate numerical and graphical engineering data using advanced mathematical software (Numeracy Skills -NS)	Case studies, computer-based learning and directed reading	Assignments, programming and simulation reports

Intended Learning Outcomes			Teaching and Learning Methods	Assessment
GENERIC SKILLS	**PLO4**	collaborate effectively with different people in learning and working communities. (Interpersonal Skills - IPS)	Group discussion, active learning	Project reports, assignments and group presentation
	PLO5	communicate effectively through variety of media and technology in delivering ideas to a diverse audience (Communication Skills-CS)	Case studies, projects and group discussions	Project reports, group presentation
		competently utilize a wide range of digital technologies to enhance	Brainstorming, discussion and case studies	Assignments and research project reports.

	PLO6	study and research (Digital Skills-DS)		
	PLO8	demonstrate leadership, autonomy and responsibility in managing projects (Leadership, Autonomy and Responsibility -LAR)	Lecture, Active Learning and Group discussion	Project reports, assignments and group presentation
	PLO9	demonstrate self-advancement through good character, enthusiasm for independent and continuous learning, and professional development (Personal Skills -PRS)	Lecture, Active Learning, Group projects and presentations	Project reports, assignments and group presentation
	PLO10	initiate entrepreneurial projects related to engineering mathematics (Entrepreneurial Skills-ENT)	Lecture, Active Learning and Group discussion	Project reports, assignments and group presentation
	PLO11	demonstrate adherence to legal and professional ethics in dealing with any relevant issue (Ethics and Professional Skills - ETS)	Lecture, Active Learning, Group discussion and case study	Project reports, assignments and group presentation

15. Classification of Courses

No.	Classification	Credit Hours	Percentage	Standard (QA)
i.	University General Course	3	7.14	50%
ii.	Core Courses	12	28.57	
iii	Elective Courses	6	14.29	
iv.	Research Proposal Dissertation	3 18	50	50%
	Total	42	100	100%

16. Total credit hours to graduate : 42 credit hours

17. Programme structures and features, curricula and award requirements

The course is offered in full-time mode and based on a 3 Semester Academic Year with several subjects being delivered and assessed in each semester. Assessment: Based on final examination, coursework and dissertation. Co-supervisor in dissertation should involve staff academic from engineering or data science department/school.

Award requirements:
To graduate, students should:
- achieve a total of minimum 42 credit hours with minimum CPA of 3.00
- complete and pass viva M.Sc Dissertation.

Course Category	Code	Course	Credit
University general course **(3 credits)**	ULAJ 6013 UMJJ 6013 Uxxx 6xx3	Japanese Language Basic Japanese language and culture University General Courses	3
Core Courses (12 Credits)	MSCJ 1303	Research Methodology	3
	MSCJ 1523 / SSCM5713 (PRISMS)	Methods of Engineering Mathematics	3
	MSCJ 1533 / SSCM5423 (PRISMS)	Numerical Methods in Engineering	3
	MSCJ 1543 / SSCM5703 (PRISMS)	Advanced Partial Differential Equations	3
Elective Courses (6 Credits) (At least one Engineering/Data Science course)	**Semester 1 (Choose 1 Eng./Data Science/ Maths)** Mxxx xxx3	Engineering/Data Science courses	3
	MSCJ 1763 MSCM 1143 MSCJ 1733 MSCJ 1773	Modeling of Dynamical Systems Fluid Mechanics and Heat Transfer Soliton and Nonlinear Waves Generalized Linear Models with Engineering Applications	
	Semester 2 (Choose 1 Eng./Data Science/ Maths) Mxxx xxx3	Engineering/Data Science courses	3
	MSCJ 1763 MSCM 1143 MSCJ 1733 MSCJ 1773	Modeling of Dynamical Systems Fluid Mechanics and Heat Transfer Soliton and Nonlinear Waves Generalized Linear Models with Engineering Applications	

Research (21 Credits)	**Semester 2** MSCJ 1280 **Semester 3** MSCJ xx80	Research Proposal Dissertation	3 18
TOTAL CREDIT			**42**

18. Mapping of Program Learning Outcomes to Course

	COURSES OFFERED	Knowledge and Understanding	Cognitive Skills	Practical Skills	Numeracy Skills	Interpersonal Skills	Communication Skills	Digital Skills	Leadership, Autonomy and Responsibility	Personal Skills	Entrepreneurial Skills	Ethics and Professionalism Skills
Code	**Courses**	**PLO1 KW**	**PLO2 CG**	**PLO3 PS**	**PLO7 NS**	**PLO4 IPS**	**PLO5 CS**	**PLO6 DS**	**PLO8 LAR**	**PLO9 PRS**	**PLO10 ENT**	**PLO11 ETS**
University General Courses (Choose 1)												
ULAJ 6013	Japanese Language						✓					
UMJJ 6013	Basic Japanese language and culture						✓					
Uxxx 6xx3	University General Courses						✓					
Core Courses												
MSCJ 1523 / SSCM5713 (PRISMS)	Methods of Engineering Mathematics	✓	✓				✓					
MSCJ 1533 / SSCM5423 (PRISMS)	Numerical Methods in Engineering	✓	✓			✓		✓	✓			
MSCJ 1543 / SSCM5703 (PRISMS)	Advanced Partial Differential Equations	✓	✓				✓					
MSCJ 1303	Research Methodology	✓	✓				✓	✓			✓	
MSCJ1280	Research Proposal	✓	✓	✓			✓					✓
MSCJ 2180	Dissertation	✓	✓	✓			✓					✓
Choose two courses, at least one engineering or data science course												
Elective Courses (Mathematics)												
MSCJ 1763	Modeling of Dynamical Systems	✓	✓				✓					
MSCM 1143	Fluid Mechanics and Heat Transfer	✓	✓				✓					
MSCJ 1733	Soliton and Nonlinear Waves	✓	✓				✓					
MSCJ1773	Generalized Linear Models with Engineering Applications	✓	✓		✓					✓		
Elective Courses (Engineering / Data Science courses)												
Mxxx xxx3												

Research												
MSCJ xx80	Dissertation	✓	✓	✓			✓					✓

Key:

1. Technical Skills: PLO1, 2, 3 and 7
2. Generic Skills : PLO 4, 5, 6, 8, 9, 10 and 11.

* List of University General Courses (preferred ULAJ 6013 or UMJJ 6013)

1. UHMS 6013 - Seminar on Global Development
2. UHMZ 6023 - Malaysian Society and Culture
3. UHIS 6013 - Philosophy of Science and Civilization
4. UHPS 6013 – Dynamics of Leadership
5. UHLM 6013 – Malay Language for Post Graduates
6. URTS 6013 – Environmental Ethics
7. UECS 6013 – IT Project Management
8. URSP 6023 – ICT Ethics and Society
9. UBSS 6013 – Organization Behaviour and Development
10. UBSS 6023 – Business Ethics, Responsibility and Sustainability
11. UMJJ 6013 – Basic Japanese Language & Culture

19. Support for students and their learning

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- Student Support provided by counselors and psychologists at 'Unit Perkhidmatan Sokongan Pelajar' (UPSP), UTM Medical Centre, accommodation officers and University Library and others.
- Student Advisors Programme: Selected academic staff provides advice on academic progress and monitoring students' performance and achievements.
- Special programmes on career development conducted by the university to ensure students acquire necessary skills during their academic and future career.
- Staff student ratio for teaching of 1:12.
- Extensive library and other learning resources and facilities

20. Career Prospects

Graduate of the programme can work as:

- Research officer – Research Institute, university and industries
- Science Officer -- Research Institute, university and industries
- Academician
- Mathematics practitioner
- Data analyst
- Engineers in various institutions/industries

OR

They can further their education by doing a PhD programme in the related field of study.

21. Regulation of Assessment

Assessment rules and degree classification applies for every course with the minimum passing mark of 60%. To qualify for the degree award, students should complete all of the programme's requirements; achieve passing mark for every course's examination. Dissertation will be examined by a panel of internal examiners appointed by the Department's Post-graduate Committee; their roles include evaluating candidates' viva-voce and written project dissertation.

Summary of marks, grades and their evaluation points

Marks	Grade	Evaluation Point
90-100	A+	4.00
80-89	A	4.00
75-79	A-	3.67
70.74	B+	3.33
65-69	B	3.00
60-64	B-	2.67
55-59	C+	2.33
50-54	C	2.00
45-49	C-	1.67
40-44	D+	1.33
35-39	D+	1.00
30-34	D-	0.67
00-29	E	0.00

For further information on academic regulations please refer to the graduate school website: http://www.sps.utm.my/

22. Facilities available List of laboratories:

List of computer laboratories:

- Computer Lab
- Smart Classroom
- Resource Centre

23. Methods for Evaluating and Improving the Quality and Standards of Teaching and Learning

Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards

1. **Students' performance in terms of:**
   - KB/KS/KG –Pass/conditional pass/fail
   - CPA – Cumulative point average
   - Graduating students' performance
   - GOT – Graduate on time
   - Completion Rate
   - Analysis of course performance

2 **.Employability**
   - Exit survey
   - Alumni survey
   - Market survey

3. Lecturer's performance
   - Teaching evaluation by students (e-PPP)
   - Annual staff appraisal (e-LPPT)
   - Teaching Evaluation System (TES)

4. Curriculum review
   - Faculty academic committee
   - External examiner reports
   - CO achievement survey by students

5. Delivery system
   - Academic Quality Assurance Committee
   - Customer Satisfaction Index (CSI)
   - Employer Satisfaction Index (ESI)
   - Malaysia Quality Assurance (MQA) standards

24. Regulation of Program Assessment

Board of Study (BoS) Faculty of Science:

- External Examiners
- IAP
- Alumni

BoS panels are appointed by the Faculty Academic Committee to:

- review and evaluate program curriculum,
- review and evaluate methods of students assessment,
- make necessary recommendations to the Academic Committee.

25. Program Assessment Tools

Measurement Tools	Programme Learning Outcomes (PLO)											Duration	Action by
	1	2	3	4	5	6	7	8	9	10	11		
Course Exit Survey (SCO)	x	x	x	x	x	x	x	x	x	x	x	Per semester	Lecturer
Course assessment report (CAR)	x	x	x	x	x	x	x	x	x	x	x	Per semester	Lecturer
Annual Programme Assessment report (APAR)	x	x	x	x	x	x	x	x	x	x	x	Per Year	Faculty
Exit Survey	x	x	x	x	x	x	x	x	x	x	x	Final Semester	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/ 3 year	Director

CURRICULUM STRUCTURE

MASTER OF SCIENCE IN ENGINEERING MATHEMATICS
- by Mixed Mode

This is a 3-semester full-time course comprising a total of 42 credits that include 3 mathematics core subjects (9 credits), 2 elective courses from Engineering/Data Science/Mathematics (where at least one elective course from Engineering/Data Science (total 6 credits), Research Methodology (3 credits), university subject (including Japanese Language, 3 credits), Research Proposal (3 credits) and Dissertation (18 credits). Specialised topics for the dissertation can be selected from any of the Engineering/Data Science/Mathematics research areas. Typical distribution of subjects beginning in Semester 1 or 2, are as follows:

CURRICULUM STRUCTURE FOR INTAKE SEM 1 2023/2024 (OCTOBER 2023)

Semester 1

COURSE CODE	COURSE NAME	CREDIT
MSCJ 1523 /SSCM5713 (PRISMS)	Methods of Engineering Mathematics	3
MSCJ 1303	Research Methodology	3
Uxxx 6xx3	University general course (preferred Japanese Language ULAJ6013, UMJJ6013)	3
Electives (Choose 3 credit)		
MSCJ 1xx3	Elective 1* (Mathematics / Engineering/ Data Science)	3
	TOTAL	**12**

Semester 2

COURSE CODE	COURSE NAME	CREDIT
MSCJ 1533 /SSCM5423 (PRISMS)	Numerical Methods in Engineering	3
MSCJ 1543 /SSCM5703 (PRISMS)	Advanced Partial Differential Equations	3
MSCJ 1280	Research Proposal	3
Electives (Choose 3 credit)		
Mxxx xxx3	Elective 2* (Mathematics / Engineering/ Data Science)	3
	TOTAL	**12**

Semester 3

COURSE CODE	COURSE NAME	CREDIT
MSCJ 2180	Dissertation	18
	TOTAL	**18**

CURRICULUM STRUCTURE FOR INTAKE SEM 2 2023/2024 (FEBRUARY 2024)

Semester 1

COURSE CODE	COURSE NAME	CREDIT
MSCJ 1533 / SSCM5423 (PRISMS)	Numerical Methods in Engineering	3
MSCJ 1543 /SSCM5703 (PRISMS)	Advanced Partial Differential Equations	3
MSCJ 1303	Research Methodology	3
Electives (Choose 3 credit)		
Mxxx xxx3	Elective 1* (Mathematics / Engineering/ Data Science)	3
	TOTAL	**12**

Semester 2

COURSE CODE	COURSE NAME	CREDIT
MSCJ 1523 / SSCM5713 (PRISMS)	Methods of Engineering Mathematics	3
MSCJ 1280	Research Proposal	3
Uxxx 6xx3	University general course (preferred Japanese Language ULAJ6013, UMJJ6013)	3
Electives (Choose 3 credit)		
MSCJ 1xx3	Elective 2* (Mathematics / Engineering/ Data Science)	3
	TOTAL	**12**

Semester 3

COURSE CODE	COURSE NAME	CREDIT
MSCJ 2180	Dissertation	18
	TOTAL	**18**

*At least one Engineering/Data Science course in whole program

X – year of study ;
Y – 1st or 2nd semester;

LIST OF COURSES

Core courses

COURSE CODE	COURSE	CREDITS
MSCJ 1303	Research Methodology	3
MSCJ 1523 / SSCM5713 (PRISMS)	Methods of Engineering Mathematics	3
MSCJ 1533 / SSCM5423 (PRISMS)	Numerical Methods in Engineering	3
MSCJ 1543 /SSCM5703 (PRISMS)	Advanced Partial Differential Equations	3
MSCJ 1280	Research Proposal	3
MSCJ 2180 / MSCJ XY80	Dissertation	18

Elective Mathematics / Engineering / Data Science courses**

COURSE CODE	COURSE	CREDITS
MSCJ 1763	Modeling of Dynamical Systems	6 (Choose 2)
MSCM 1143	Fluid Mechanics and Heat Transfer	
MSCJ 1733	Soliton and Nonlinear Waves	
MSCJ1773	Generalized Linear Models with Engineering Applications	
Mxxx xxx3	Any mathematics heavy used engineering or data science course (as offered by Faculty of Engineering/Computing in respective semester)	

** At least one Engineering/Data Science course in whole program

Please refer to **Synopsis of Courses** for the synopsis of each course.

MASTER OF PHILOSOPHY AND DOCTOR OF PHILOSOPHY

Field of Research: Mathematics

- By Research (Full time)

Department of Mathematical Sciences offers full time research programmes leading to M.Phil. and Ph.D. degree for students interested in pursuing research careers. To ensure the suitability of the research for the given academic level, students are required to present their research proposal to be evaluated by experts in the related area. This usually takes place in the second semester for M.Phil. student and third semester for Ph.D. student. Students are expected to disseminate the output of their research through writing of research articles and presentations in conferences. On completion of the research project, students are required to submit their dissertation/thesis for evaluation by external and internal examiners appointed by the Faculty of Science. The programmes are MQA accredited.

Programme	NEC Code	MQA Reference Number (Certificate Number)
M.Phil.	461 (Mathematics) / 0520 (Mathematics and Statistics not further defined, National Education Code 2020)	MQA/SWA0311 (20678)
Ph.D.	461 (Mathematics) / 0520 (Mathematics and Statistics not further defined, National Education Code 2020)	MQA/SWA0303 (20720)

Programme Educational Objectives (PEO)

PEO	M.Phil.	Ph.D.
1	Knowledgeable and skilful in catering to knowledge-intensive industries in the field of Mathematics through application of research and innovation skills	Knowledgeable and skillful in catering to knowledge-intensive industries in the field of Mathematics through application of research and innovation skills
2	Competent to advice and solve on contemporary issues and proposed new solutions and innovations for development and advancement in the field of Mathematics.	Competent to advice and solve on contemporary issues, and proposed new solutions and innovations for development and advancement in the field of Science and Mathematics.
3	Equipped with professional skills critical to excel within a multicultural, transnational work and learning environment.	Equipped with professional skills critical to excel within a multicultural, transnational work and learning environment.

Programme Learning Outcome (PLO)

PLO	M.Phil.	Ph.D.
1	Integrate and generate in-depth relevant knowledge independently using innovative techniques, tools and skills for decision-making to manage and resolve a complex problem in the field of Mathematics as a basis for research.	Synthesize, critique, apply, and extend in-depth relevant knowledge independently using innovative techniques, tools, and skills in the field of Mathematics as a basis for research to produce new ideas and solution.
2	Construct a critical and innovative solution for complex problems or issues in the field of Mathematics through research using the latest development techniques and skills.	Create new concept/theories/solutions/practice through independent research and originality that satisfies international standards within the field of Mathematics using the latest techniques, tools, and skills.
3	Devise standard research methodology that is based on the forefront knowledge and latest development in the field of Mathematics to solve research problems with reasonable degree of originality.	Integrate highly advanced and specialized research methodologies based on the forefront knowledge and latest development in the field of Mathematics to solve complex research problems with reasonable degree of originality.
4	Demonstrate effective collaboration with peers, scholarly communities and society at large in the relevant field of expertise and research.	Demonstrate decent collaboration with peers, scholarly communities and society at large in the relevant field of expertise and research.
5	Communicate the knowledge, skills, ideas clearly using appropriate methods to peers, experts, and non-experts through various mediums.	Communicate effectively the knowledge, skills, ideas and research findings using appropriate methods to peers, scholarly communities, and societies through various medium.
6	Use a broad range of suitable digital technologies, media, and software to design, manage, analyse and report research studies.	Use, improve existing or develop new appropriate tools or methodologies using a broad range of digital technology, media and software to support and enhance research activities.
7	Demonstrate skills in designing, planning evaluation activities, and analysing numerical and graphical data using quantitative or qualitative tools in solving problems.	Demonstrate skills in designing, critical evaluation, and analysing numerical and graphical data using quantitative or qualitative tools to support and enhance research activities.
8	Demonstrate leadership, autonomy and responsibility in conducting and managing own research and resources.	Demonstrate leadership, professionalism and management skills, and take full responsibility for own work, and significantly for others in the research organization.

9	Demonstrate the ability to manage and enhance own self-advancement for academic development, professional development and research skills using lifelong learning strategies.	Demonstrate the ability to manage and enhance own self- and if necessary, can be accountable for overall management of one's research organization and professional development.
10	Develop potential commercialisation research output.	Develop potential commercialisation research output.
11	Demonstrate adherence to legal, ethical and professional codes of practice in the field of Mathematics and research activities.	Demonstrate adherence to legal, professional and contribute to the development of ethical sound codes of practice.

Field of Research

The research project of the student may fall into one or more aspects of the following field:

- Study of Algebra
- Functional Analysis
- Group Theory and Its Application
- Graph Theory and Its Application
- Formal Language Theory and Splicing Systems
- Mathematical Modelling of Fluids Flow
- Non-linear Waves and Soliton
- Conceptual and Mathematical Model of Behavioural Changes
- Mathematical and Fuzzy Modelling
- Numerical Analysis
- Numerical Computational Methods (Algorithms)
- Numerical Simulation and Visualization
- Development, Analysis and Implementation of Operational Research
- Optimization Models and Algorithms, Decision Making Gools
- Statistical Modelling and Analysis (Theory and Practise)
- Time Series and Forecasting
- Geo-statistical Modelling
- Functional Data Analysis
- Financial Mathematics
- Survival and Failure Time Modelling
- Robust Statistics

Courses and duration of study

The normal duration of study is 2–8 semesters (1–4 years) for M.Phil. and 6–16 semesters (3–8 years) for the Ph.D. programme.

Students must register a Research Course with the following code in each semester.

Year/ Semester (Total Semester)	M.Phil.	Ph.D.
1/1 (Sem. 1)	MSCT 1100	PSCT 1100
1/2 (Sem. 2)	MSCT 1200	PSCT 1200
2/1 (Sem. 3)	MSCT 2100	PSCT 2100
2/2 (Sem. 4)	MSCT 2200	PSCT 2200
3/1 (Sem. 5)	MSCT 3100	PSCT 3100
3/2 (Sem. 6)	MSCT 3200	PSCT 3200
4/1 (Sem. 7)	MSCT 4100	PSCT 4100
4/2 (Sem. 8)	MSCT 4200 (**maximum semester**)	PSCT 4200
5/1 Sem. (9)	-	PSCT 5100
5/2 (Sem. 10)	-	PSCT 5200
6/1 (Sem. 11)	-	PSCT 6100
6/2 (Sem. 12)	-	PSCT 6200
7/1 (Sem. 13)	-	PSCT 7100
7/2 (Sem. 14)	-	PSCT 7200
8/1 (Sem. 15)	-	PSCT 8100
8/2 Sem. (16)	-	PSCT 8200 (**maximum semester**)

All research students must enrol in Research Methodology (USCP 6013) and at least one of the University's General Courses (subjected to courses offered in each semester listed in SPS website).

Examples of General Courses offered are:

No.	Course code	Faculty	Course name
1	UBSS 6013	AHIBS KL	Organization Behaviour and Development
2	UBSS 6023	AHIBS KL	Business Ethics, Responsibility and Sustainability
3	UHMS 6013	FSSH/SHARP	Seminar on Global Development, Economic and Social Issues
4	UHMZ 6023	FSSH/SHARP	Malaysian Society and Culture
5	UHIS 6013	FSSH/ATI	Philosophy of Science and Civilization
6	UHPS 6013	FSSH/SOE	Dynamics of Leadership
7	UHLM 6013	FSSH/LA	Malay Language for Post Graduates
8	URTS 6013	FTIR	Environmental Ethics
9	UECS 6013	FC	IT Project Management
10	URSP 6023	FTIR	ICT Ethics and Society
11	UANP 6013	FTIR	Informatics in Society
12	UMJJ 6013	MJIIT	Basic Japanese Language & Culture

Credit transfer of Research Methodology and the University's General Courses

Students can apply for credit transfer if the course(s) taken in another M.Phil. programme(s) prior to the current study with at least 80% identical learning outcomes.

Deferment of study

- Students may apply for deferment of the programme registration for not more than **TWO SUBSEQUENT** semesters subject to University's approval.
- Students who do not register for any courses in a semester must apply for deferment. The deferred semester will be counted as a part of the total study period.
- Students who withdraw (TD) from **ALL** courses in a semester will automatically be given a deferment. The deferred semester will be counted as a part of the total study period.
- Students may apply for deferment of study due to health reasons. The application has to be accompanied with a medical report certified by a Medical Officer recognised by the University. The deferred semester may not be counted as a part of the total study period.

Conversion from M.Phil. to Ph.D. programme

In the period between six and fifteen months after program registration, M. Phil. students may apply to convert to a Ph.D. program upon achieving the requirement listed in the table below.

Bachelor's Degree CGPA	Requirements
CGPA ≥ 3.33	Presented **TWO** conference articles in proceedings with ISBN. **OR** published **ONE** article in a SCOPUS/WOS/ERA indexed journal. **AND** The applicant must be the first student author of the publication.
3.00 ≤ CGPA ≤ 3.32	Published **ONE** article in a WOS indexed journal. The applicant must be the first student author of the publication.

Students will be requested to defend the research proposal to the evaluation panels. Passing the evaluation is necessary for successful conversion to Ph.D. programme.

Assessments and evaluation

(i) First Assessment

Students are required to present a research proposal (**with preliminary/expected results**) for evaluation purposes within the duration specified by the University, according to the following schedule:

Programme	Semester
M.Phil.	2nd semester
Ph.D.	3rd semester

If the students failed to present without any valid reasons, the student may be given a TM status by the Faculty.

(ii) Progress Report Assessment

All postgraduate research students are required to submit a progress report online (GSMS system) before the due date. The online system will usually be opened in week 10–13 of each semester, unless specified otherwise in the academic calendar.

The supervisor shall evaluate the progress report. A student whose progress is satisfactory (MM status) will be recommended for the continuation of his/her candidature.

A student may be given a TM or GG status if he/she does not submit his/her progress report.

The Faculty shall terminate the candidature of a student whose progress is not satisfactory (TM status) for **TWO** consecutive semesters.

(iii) Qualifying Assessment (Fast Track Ph.D.)

Fast track students in the Ph.D. programme must undergo a qualifying assessment after 6 to 18 months of registration in the Ph.D. programme. The result of the assessment can be one of the following:

(e) **Pass** - The student will continue their Ph.D. programme and proceed with the First Assessment in the following semester.
(f) **Fail** - The student will be transferred to the M.Phil. programme and a new study period begins.

(iv) Viva Voce (Oral Examination)

A student should submit Notice for Thesis Submission (NHT) approved by the supervisor at least three months prior to submission of the dissertation/thesis for examination, or three months before expiry of the maximum study duration. Dissertation/Thesis report must follow the guidelines prescribed in the UTM Thesis Manual 2018 and the report must be written in English. Students shall apply for a permission if the dissertation/thesis is to be written in other languages, i.e. Bahasa Malaysia. The Turnitin score for each chapter shall not be more than 20%. The article must contain the name of the supervisor (with UTM affiliation) and the student must be listed as the first student author. The publication criteria for the M.Phil. and Ph.D. programme are listed below.

Program	Publication criteria
M. Phil.	Students may submit their dissertation after 12 months with at least one publication that has been accepted or published in either journal, conference, or book chapters for the purpose of the viva voce.
Ph.D.	**Submission of thesis for normal duration of study (within 6 - 16 semesters)** Students can submit their thesis for viva voce after having: ● at least **ONE** accepted or published article in a WOS indexed journal, or ● **TWO** accepted or published articles in Scopus/ERA/Malaysia Journal Management System indexed journals. **Early thesis submission (in the Semester 5)** Students can submit their thesis for viva voce after having: ● accepted or published **TWO** articles in WOS/Scopus/ERA indexed journals. **Submission of thesis using publication format** Students can submit their thesis for viva voce using publication format if the following condition is fulfilled: ● At 24 months after the student enrols; a minimum of **THREE** journal articles indexed in Scopus/WOS with at least **TWO** articles accepted or published in Q1/Q2 WOS indexed journals. ● At least 30 months after the student enrols:

	a minimum **THREE** journal articles indexed in Scopus/WOS with at least **ONE** journal article accepted or published in Q1/Q2 WOS indexed journal.

Dissertation/Thesis examination for M.Phil. and Ph.D. programmes should be made according to the criteria set for the programme as approved by the Senate. For instance, oral defence cannot be held more than twice. The thesis examiner should consist of at least one internal and one external examiner, unless specified in 'Prosedur Penyelidikan Pascasiswazah (ProPS-06), 2022'. Please refer to the faculty on the fee imposed for viva voce.

Change of supervisor

During the study period, students may apply for a change of supervisor if necessary. The application is made by filling in the specific form available at the Faculty's Postgraduate Office. The application needs to be supported and approved by the Faculty's Academic Committee. However, students have to take note that the application for a change in supervisor can only be made with the following restrictions (except for special cases):

- Change of supervisor can only be made **ONCE** throughout the study period.
- Application can only be made **BEFORE** the First Assessment.

Abbreviations

ERA : Excellence in Research Australia
GG : *Gagal* (Fail)
GSMS : Graduate Studies Management System
MM : *Memuaskan* (Satisfactory)
M.Phil. : Master of Philosophy
MQA : Malaysian Qualifications Agency
NEC : National Education Code
NHT : Notis Hantar Thesis (Notice for Thesis Submission)
Ph.D. : Doctor of Philosophy
TD : *Tarik Diri* (Withdraw)
TM : *Tidak Memuaskan* (Unsatisfactory)
WOS : Web of Science

PHYSICS PROGRAMMES

MASTER OF SCIENCE IN PHYSICS

PROGRAMME SPECIFICATION

1. Awarding Institution	**UTM**
2. Teaching Institution	**UTM**
3. Programme Name	**Master of Science in Physics**
4. Final Award	**Master of Science in Physics**
5. Programme Code	**MSCP2**
6. Professional or Statutory Body of Accreditation	Malaysian Ministry of Higher Education Kementerian Pengajian Tinggi Malaysia
7. Language(s) of Instruction	**English**
8. Mode of Study (Conventional, distance learning, etc)	Conventional
9. Mode of operation (Franchise, self-govern, etc)	Self-govern
10. Study Scheme	**Full Time**
11. Study Duration	Minimum: 1 year Maximum: 4 years
12. Entry Requirement	**1.** A bachelor's degree in physics from UTM or other Institutes of Higher Education. OR A bachelor's degree in engineering, Education Physics, and other fields related to Physics may be considered subject to the Department panel's approval. OR Equivalent qualifications recognized by the Senate are subject to work experience in the field of Physics and related areas.

Bachelor's Degree CGPA	Working Experience
≥ 3.00	N/A
2.70 – 3.00	2 years
2.50 – 2.70	4 years
2.30 – 2.50	6 years

The candidate must have completed a minimum of six (6) core Physics courses, with a minimum of 3 credit hours for each course and achieved a minimum grade of C+ or higher for each of these core Physics courses.

OR

The candidate undergoes a one-semester pre-master's program that requires the candidate to take 2 to 4 (according to the candidate's needs) undergraduate courses such as Quantum Mechanics, Solid State Physics, Electromagnetism and Mathematical Physics (subject to the Department Panel's recommendation).

2. International candidates must meet one of the following English language proficiency requirements:

i. Test of English as a Foreign Language, TOEFL (iBT) score of 60 and above; or

ii. International English Language Testing System (IELTS) band score of 6.0 and above; or

iii. ELS Certified Intensive English Program (CIEP) with Level 108; or

iv. Any examination aligned with The Common European Framework of Reference (CEFR) as follows:

- **a.** Cambridge English Qualification (CEQ) with a score of B2 First (FCE), C1 Advanced (CAE), C2 Proficiency (CPE); or
- **b.** PTE Academic with a score of 59 and above; or
- **c.** Malaysian University Entrance Test (MUET) Band 4 and above.

OR

Exemptions from the English language requirement may be granted to international students who have completed their secondary education or graduated from countries listed by the Student Recruitment and Admission Division (SRAD).

OR

	The international candidates must attend one of the following programs: **i.** Intensive English Program (IEP) conducted by the Language Academy, UTM and achieve an IELTS band score of 6.0 and above or pass an examination aligned with CEFR with the specified score; or **ii.** ELS Certified Intensive English Program (CIEP) with Level 108. **3.** Person with disabilities (OKU) are not accepted into this program (including color blindness). **4.** Candidates with APEL T-7 (Accreditation of Prior Experiential Learning) certificates may be considered for admission (subject to Faculty approval).

13. Programme Educational Objectives (PEO)

Graduates of the programme should be:

1. PEO 1: Competent and skilful in advanced areas of physics relevant to academic and industrial demands.
2. PEO 2: Equipped with ethics and professional skills to excel within a multicultural working environment.
3. PEO 3: Contribute to organization or society by engaging with contemporary issues.

14. Programme Learning Outcomes (PLO)

Intended Learning Outcomes			Teaching and Learning Methods	Assessment
COGNITIVE SKILLS	**PLO1**	Integrate scientific concepts related to advanced theoretical and contemporary knowledge comprehensively in the field of physics.	Lectures, directed reading, group discussions and problem-solving assignments	Tests, Final Exam, Assignments.
	PLO2	Formulate solutions using different approaches in solving complex physics problems independently.	Lectures, laboratory works, assigned reading, group discussions and relevant research document searching. Hands-on instrumentations and software; and writing research project	Tests, Final Exam, Assignments.

	PLO3	Use advanced/contemporary tools in the field of physics constructively in conducting scientific research or activities.	Lectures, assigned reading, group discussions and formulating problem and solving them Hands-on instrumentations and software; and writing research project Developing research proposal by identifying the research gap and defending it; presenting research findings in various settings.	Group Projects, Problem-based Projects, Assignments.
	PLO7	Evaluate available tools or approaches to analyze and solve Physics issues efficiently.	Collaborative research project design, implementation and evaluation.	Research presentations (writing and oral), article writing, viva-voce, group projects and assignments.

15. Classification of Courses

No.	Classification	Credit Hours	Percentage	Standard (QA)
i.	University General Course	3	7	50%
ii.	Core Courses	12	29	
iii.	Elective Courses	6	14	
iv.	Research	21	50	50%
	Total	**42**	**100**	**100%**

16. Total credit hours to graduate: 42 credit hours

17. Programme structures and features, curriculum, and award requirements

The course is offered in full-time mode and based on a 3 Semester Academic Year with several subjects being delivered and assessed in each semester. Assessment: Based on final examination, coursework, and dissertation.

Award requirements:
To graduate, students should:

- achieve a total of minimum 42 credit hours with minimum CGPA of 3.00
- complete and pass viva Master Science Dissertation.

Course Category	Code	Course	Credit
University General Course (3 Credits)	**UHXX 6XX3**	(Choose 1 courses from the list given by School of Graduate Studies)	3
Core Courses (12 Credits)	**Semester 1** **MSCP 1303** **MSCP 1203** **Semester 2** **MSCP 1403** **MSCP 1503** **MSCP 1180**	 Research Methodology Advanced Quantum Mechanics Electrodynamics Advanced Solid-State Physics Research Proposal	 3 3 3 3 3
Elective Courses (6 Credits)	**Semester 1 (Choose 1)** **MSCP 1113** **MSCP 1223** **MSCP 1133** **MSCP 1333** **MSCP 1143** **MSCP 1103** **Semester 2 (Choose 1)** **MSCP 1213** **MSCP 1313** **MSCP 1123** **MSCP 1233** **MSCP 1243**	 Materials Characterization and Analysis I Nuclear Techniques and Analysis Computation Space Physics Semiconductor Devices Fabrication Laser-Matter Interaction Mathematical Methods for Physics Materials Characterization and Analysis II Advanced Condensed Matter Physics Elementary Particles Scientific Computing Advanced Fibre Optics	 3 3 3 3 3 3 3 3 3 3 3
Research (21 Credits)	**Semester 3** **MSCP 2180**	Dissertation	18
TOTAL CREDIT			**42**

18. Mapping of Program Learning Outcomes to Course

	COURSES OFFERED	Knowledge and Understanding	Cognitive Skills	Practical Skills	Numeracy Skills	Interpersonal Skills	Communication Skills	Digital Skills	Leadership, Autonomy and Responsibility	Personal Skills	Entrepreneurial Skills	Ethics and Professionalism
Code	**Courses**	**PLO1 KW**	**PLO2 CG**	**PLO3 PS**	**PLO7 NS**	**PLO4 IPS**	**PLO5 CS**	**PLO6 DS**	**PLO8 LAR**	**PLO9 PRS**	**PLO10 ENT**	**PLO11 ETS**
University General Courses (Choose 1 from the list*)												
UHXX 6XX3							✓					
Core Courses												
MSCP 1303	Research Methodology	✓	✓				✓	✓			✓	✓
MSCP 1203	Advanced Quantum Mechanics	✓	✓						✓			
MSCP 1403	Electrodynamics	✓	✓		✓					✓		
MSCP 1503	Advanced Solid-State Physics	✓	✓			✓				✓		
Elective Courses (Choose 2)												
MSCP 1113	Materials Characterization and Analysis I	✓	✓	✓		✓						
MSCP 1213	Materials Characterization and Analysis II	✓	✓	✓		✓						
MSCP 1313	Advanced Condensed Matter Physics	✓	✓			✓						
MSCP 1123	Elementary Particles	✓	✓							✓		
MSCP 1223	Nuclear Technique and Analysis	✓	✓	✓		✓				✓		
MSCP 1133	Computational Space Physics	✓	✓					✓				
MSCP 1233	Scientific Computing	✓	✓		✓							
MSCP 1333	Semiconductor Devices Fabrication	✓	✓	✓			✓					
MSCP 1143	Laser-Matter Interaction	✓	✓									
MSCP 1243	Advanced Fibre Optics	✓	✓									

18. Mapping of Program Learning Outcomes to Course

MSCP 1103	Mathematical Methods for Physics	✓	✓		✓							
Research												
MSCP 1180	Research Proposal (HW)	✓	✓				✓					✓
MSCP XY80	Dissertation	✓	✓	✓			✓					✓

Key:
1. Technical Skills: PLO1, 2, 3 and 7
2. Generic Skills: PLO 4, 5, 6, 8, 9, 10 and 11.
3. X – year of study; Y – 1st or 2nd semester;

* List of University General Courses

1. UBSS 6013 : Organization Behaviour and Development
2. UBSS 6023: Business Ethics, Responsibility and Sustainability
3. UHMS 6013: Seminar on Global Development, Economic and Social Issues
4. UHMZ 6023: Malaysian Society and Culture
5. UHIS 6013: Philosophy of Science and Civilization
6. UHPS 6013: Dynamics of Leadership
7. UHLM 6013: Malay Language for Post Graduates
8. URTS 6013: Environmental Ethics
9. UECS 6013: IT Project Management
10. UECS 6023: Introduction to Technopreneurship
11. UMJJ 6013: Basic Japanese Language & Culture

19. Support for students and their learning

Students and their learning are supported by:

- Briefing of all new post-graduate students during registration week.
- Student Prospectus Book for every academic session.
- Information services provided by the Graduate School (SPS) and through the university's web site.
- Student Support provided by counselors and psychologists at 'Unit Perkhidmatan Sokongan Pelajar' (UPSP), UTM Medical Centre, accommodation officers and University Library and others.
- Student Advisors Programme: Selected academic staff provides advice on academic progress and monitoring students' performance and achievements.
- Special programs on career development conducted by the university to ensure students acquire necessary skills during their academic and future career.
- Staff student ratio for teaching of 1:12.
- Extensive library and other learning resources and facilities
- Each student is assigned an academic advisor (programme tutor) whose role is to assist and advice on programme of study.

20. Career Prospects

Graduate of the programme can work as:

- Research officer – Research Institute, university, and industries
- Science Officer – Research Institute, university, and industries
- Physics Teacher – Schools and colleges
- Quality control officer – Industries
- Industrial materials scientist
- Material testing and analysis expert

OR

They can further their education by doing a PhD programme in the related field of study.

21. Regulation of Assessment

Assessment rules and degree classification applies for every course with the minimum passing mark of 60%. To qualify for the degree award, students should complete all of the programme's requirements; achieve passing mark for every course's examination. Dissertation will be examined by a panel of internal examiners appointed by the Department's Post-graduate Committee; their roles include evaluating candidates' viva-voce and written project dissertation.

Summary of marks, grades and their evaluation points

Marks	Grade	Evaluation Point
90-100	A+	4.00
80-89	A	4.00
75-79	A-	3.67
70.74	B+	3.33
65-69	B	3.00
60-64	B-	2.67
55-59	C+	2.33
50-54	C	2.00
45-49	C-	1.67
40-44	D+	1.33
35-39	D+	1.00
30-34	D-	0.67
00-29	E	0.00

For further information on academic regulations please refer to the graduate school website: http://www.sps.utm.my/

22. Facilities available List of laboratories:

Laboratories

- Modern Physics Laboratory
- Optics Laboratory
- Basic & Advanced Electronic Laboratories
- Optoelectronics Devices Laboratory
- Nuclear Physics Laboratory
- Radiation Dosimetry Laboratory
- Laser Technology & Research Laboratories
- Fiber Optics Technology Laboratory
- Thin Film & Low Temperature Laboratory
- Vacuum Laboratory
- Material Science & Material Analysis Laboratories
- Computer & Microcomputer Laboratory
- Photonics Training & Research Laboratories
- Optical Crystal Research Laboratory
- Electronic & Mechanical Workshops

Major Equipment

- X-ray diffractometer (XRD)
- Automated Control Crystal growth CZ machine
- Infrared Spectrophotometer
- UV-VIS Spectrometer
- CNC Machine Equipment
- Photoluminescence Spectrometer
- High Precision Grinding and Polishing Machine
- Ellipsometer
- High Temperature Furnaces
- Differential Thermal Analyzers (DTA)
- Vickers Hardness Equipment
- General Mechanical Testing Machine
- Hyperpure Germanium Detector
- Atomic Force Microscope (AFM)
- Rapid Thermal Process (RTP)
- Tensile Machine
- Corrosion Machine

23. Methods for Evaluating and Improving the Quality and Standards of Teaching and Learning

Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum, and outcome standards

1. Students' performance in terms of:
- KB/KS/KG –Pass/conditional pass/fail
- CGPA – Cumulative grade point average
- Graduating students' performance
- GOT – Graduate on time
- Completion Rate
- Analysis of course performance

2. Employability
- Exit survey
- Alumni survey
- Market survey

3. Lecturer's performance
- Teaching evaluation by students (e-PPPK)
- Annual staff appraisal (e-LPPT)
- Teaching Evaluation System (TES)

4. Curriculum review
- Faculty academic committee
- External examiner reports
- CO achievement survey by students

5. Delivery system
- Academic Quality Assurance Committee
- Malaysia Quality Assurance (MQA) standards

24. Regulation of Program Assessment

Board of Study (BoS) Faculty of Science:
- External Examiners
- IAP
- Alumni

BoS panels are appointed by the Faculty Academic Committee to:
- review and evaluate program curriculum,
- review and evaluate methods of student's assessment,
- make necessary recommendations to the Academic Committee.

25. Program Assessment Tools

Measurement Tools	Programme Learning Outcomes (PLO)											Duration	Action by
	1	2	3	4	5	6	7	8	9	10	11		
Course Exit Survey (SCO)	x	x	x	x	x	x	x	x	x	x	x	Per semester	Lecturer
Course Assessment Report (CAR)	x	x	x	x	x	x	x	x	x	x	x	Per semester	Lecturer
Annual Programme Assessment Report (APAR)	x	x	x	x	x	x	x	x	x	x	x	Yearly	Faculty
Exit Survey	x	x	x	x	x	x	x	x	x	x	x	Final Semester	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/ 3 year	Director

MASTER OF SCIENCE IN PHYSICS
- by Mixed Mode

This is a 3-semester full-time course comprising a total of 42 credits that combines taught courses and research components. The taught courses include 4 core courses (12 credits), 2 elective Physics courses (6 credits), 1 university compulsory course (3 credits). As the research components are Research Proposal (3 credits) and Dissertation (18 credits). Specialized topics for the dissertation can be selected from any of the four areas of research in the physics department which are material physics, optics physics, nuclear and radiation physics, and instrumentation and computational physics. Typical distribution of subjects are as follows:

CURRICULUM STRUCTURE

INTAKE SEMESTER 1 2023/2024 (OCTOBER 2023)

Semester 1

COURSE CODE	COURSE	CREDIT
UHXX 6XX3	University general course	3
MSCP 1303	Research Methodology	3
MSCP 1203	Advanced Quantum Mechanics	3
Elective Course (Choose 1 Course – 3 credits)		
MSCP 1113	Materials Characterization and Analysis I	3
MSCP 1213	Materials Characterization and Analysis II	3
MSCP 1313	Advanced Condensed Matter Physics	3
MSCP 1123	Elementary Particles	3
MSCP 1223	Nuclear Techniques and Analysis	3
MSCP 1133	Computational Space Physics	3
MSCP 1233	Scientific Computing	3
MSCP 1333	Semiconductor Devices Fabrication	3
MSCP 1143	Laser-Matter Interaction	3
MSCP 1243	Advanced Fibre Optics	3
MSCP 1103	Mathematical Method for Physics	3
Total		**12**

Semester 2

COURSE CODE	COURSE	CREDIT
MSCP 1403	Electrodynamics	3
MSCP 1503	Advanced Solid-State Physics	3
MSCP 1180	Research Proposal	3
Elective Course (Choose 1 Course – 3 credits)		
MSCP 1113	Materials Characterization and Analysis I	3
MSCP 1213	Materials Characterization and Analysis II	3
MSCP 1313	Advanced Condensed Matter Physics	3
MSCP 1123	Elementary Particles	3
MSCP 1223	Nuclear Techniques and Analysis	3
MSCP 1133	Computational Space Physics	3
MSCP 1233	Scientific Computing	3
MSCP 1333	Semiconductor Devices Fabrication	3
MSCP 1143	Laser-Matter Interaction	3
MSCP 1243	Advanced Fibre Optics	3
MSCP 1103	Mathematical Method for Physics	3
Total		**12**

Semester 3

COURSE CODE	COURSE	CREDIT
MSCP 2180	Dissertation	18
Total		**18**

CURRICULUM STRUCTURE

INTAKE SEMESTER 2 2023/2024 (FEBRUARY 2024)

Semester 1

COURSE CODE	COURSE	CREDIT
MSCP 1403	Electrodynamics	3
MSCP 1503	Advanced Solid-State Physics	3
MSCP 1303	Research Methodology	3
Elective Course (Choose 1 Course – 3 credits)		
MSCP 1113	Materials Characterization and Analysis I	3
MSCP 1213	Materials Characterization and Analysis II	3
MSCP 1313	Advanced Condensed Matter Physics	3
MSCP 1123	Elementary Particles	3
MSCP 1223	Nuclear Techniques and Analysis	3
MSCP 1133	Computational Space Physics	3
MSCP 1233	Scientific Computing	3
MSCP 1333	Semiconductor Devices Fabrication	3
MSCP 1143	Laser-Matter Interaction	3
MSCP 1243	Advanced Fibre Optics	3
MSCP 1103	Mathematical Method for Physics	3
Total		**12**

Semester 2

COURSE CODE	COURSE	CREDIT
UHXX 6XX3	University general course	3
MSCP 1203	Advanced Quantum Mechanics	3
MSCP 1180	Research Proposal	3
Elective Course (Choose 1 Course – 3 credits)		
MSCP 1113	Materials Characterization and Analysis I	3
MSCP 1213	Materials Characterization and Analysis II	3
MSCP 1313	Advanced Condensed Matter Physics	3
MSCP 1123	Elementary Particles	3
MSCP 1223	Nuclear Techniques and Analysis	3
MSCP 1133	Computational Space Physics	3
MSCP 1233	Scientific Computing	3
MSCP 1333	Semiconductor Devices Fabrication	3
MSCP 1143	Laser-Matter Interaction	3
MSCP 1243	Advanced Fibre Optics	3
MSCP 1103	Mathematical Method for Physics	3
Total		**12**

Semester 3

COURSE CODE	COURSE	CREDIT
MSCP 2180	Dissertation	18
Total		**18**

Note : Dissertation can only be taken after completion of all courses

LIST OF COURSES
Core courses

COURSE CODE	COURSE	CREDITS
MSCP 1303	Research Methodology	3
MSCP 1203	Advanced Quantum Mechanics	3
MSCP 1403	Electrodynamics	3
MSCP 1503	Advanced Solid-State Physics	3

Elective courses

COURSE CODE	COURSE	CREDIT
MSCP 1113	Materials Characterization and Analysis I	3
MSCP 1213	Materials Characterization and Analysis II	3
MSCP 1313	Advanced Condensed Matter Physics	3
MSCP 1123	Elementary Particles	3
MSCP 1223	Nuclear Techniques and Analysis	3
MSCP 1133	Computational Space Physics	3
MSCP 1233	Scientific Computing	3
MSCP 1333	Semiconductor Devices	3
MSCP 1143	Laser-Matter Interaction	3
MSCP 1243	Advanced Fibre Optics	3
MSCP 1103	Mathematical Method for Physics	3

Research Courses

COURSE CODE	COURSE	CREDITS
MSCP 1180	Research Proposal	3
MSCP 2180	Dissertation	18

Please refer to **Synopsis of Courses** for the synopsis of each course.

MASTER OF PHILOSOPHY AND DOCTOR OF PHILOSOPHY

Field of Research: Physics
- By Research (Full time)

Department of Physics offers full time research programmes leading to M.Phil. and Ph.D. degree for students interested in pursuing research careers. To ensure the suitability of the research for the given academic level, students are required to present their proposal to be evaluated by experts in the related area. This usually takes place in the second semester for M.Phil. student and third semester for Ph.D. student. Students are expected to disseminate the output of their research through writing of research articles and presentations in conferences. On completion of the research project, students are required to submit their dissertation/thesis for evaluation by external and internal examiners appointed by the Faculty of Science. The programmes are MQA accredited.

Programme	NEC Code	MQA Reference Number (Certificate Number)
M.Phil.	441 (Physics) / 0533 (Physics, National Education Code 2020)	MQA/SWA0305 (20721)
Ph.D.	441 (Physics) / 0533 (Physics, National Education Code 2020)	MQA/SWA0501 (20673)

Programme Educational Outcomes (PEO)

PEO	M.Phil.	Ph.D
PEO1	Knowledgeable and skilful in catering to knowledge-intensive industries in the field of Physics through application of research and innovation skills	Knowledgeable and skillful in catering to knowledge-intensive industries in the field of Physics through application of research and innovation skills.
PEO2	Competent to advice and solve on contemporary issues and proposed new solutions and innovations for development and advancement in the field of Physics.	Competent to advice and solve on contemporary issues, and proposed new solutions and innovations for development and advancement in the field of Physics.
PEO3	Equipped with professional skills critical to excel within a multicultural, transnational work and learning environment.	Equipped with professional skills critical to excel within a multicultural, transnational work and learning environment.

Programme Learning Outcomes (PLO)

PEO	M.Phil.	Ph.D
PLO1	Integrate and generate in-depth relevant knowledge independently using innovative techniques, tools and skills for decision-making to manage and resolve a complex problem in the field of Physics as a basis for research.	Synthesize, critique, apply, and extend in-depth relevant knowledge independently using innovative techniques, tools, and skills in the field of Physics as a basis for research to produce new ideas and solutions.
PLO2	Construct a critical and innovative solution for complex problems or issues in the field of Physics through research using the latest development techniques and skills.	Create new concepts / theories / solutions / practice through independent research and originality that satisfies international standards within the field of Physics using the latest techniques, tools, and skills.
PLO3	Devise standard research methodology that is based on the forefront knowledge and latest development in the field of Physics to solve research problems with reasonable degree of originality.	Integrate highly advanced and specialised research methodologies based on the forefront knowledge and latest development in the field of Physics to solve complex research problems with reasonable degree of originality.
PLO4	Demonstrate effective collaboration with peers, scholarly communities and society at large in the relevant field of expertise and research.	Demonstrate decent collaboration with peers, scholarly communities and society at large in the relevant field of expertise and research.
PLO5	Communicate the knowledge, skills, ideas clearly using appropriate methods to peers, experts, and non-experts through various mediums.	Communicate effectively the knowledge, skills, ideas and research findings using appropriate methods to peers, scholarly communities, and societies through various mediums.
PLO6	Use a broad range of suitable digital technologies, media, and software to design, manage, analyse and report research studies.	Use, improve existing or develop new appropriate tools or methodologies using a broad range of digital technology, media and software to support and enhance research activities.
PLO7	Demonstrate skills in designing, planning evaluation activities, and analysing numerical and graphical data using quantitative or qualitative tools in solving problems.	Demonstrate skills in designing, critical evaluation, and analysing numerical and graphical data using quantitative or qualitative tools to support and enhance research activities.
PLO8	Demonstrate leadership, autonomy and responsibility in conducting and managing own research and resources.	Demonstrate leadership, professionalism and management skills, and take full responsibility for own work, and significantly for others in the research organisation.

PLO9	Demonstrate the ability to manage and enhance own self-advancement for academic development, professional development and research skills using lifelong learning strategies.	Demonstrate the ability to manage and enhance own self- and if necessary, can be accountable for overall management of one's research organisation and professional development.
PLO10	Develop potential commercialisation research output.	Develop potential commercialisation research output.
PLO11	Demonstrate adherence to legal, ethical and professional codes of practice in the field of Physics and research activities.	Demonstrate adherence to legal, professional and contribute to the development of ethical sound codes of practice.

Field of Research

The research project of the student may fall into one or more aspects of the following field:

Applied Optics Research Group (AORG)

- Applied optics: laser–matter interaction, optical fibre sensors, Fibre lasers and optical spectroscopy analysis for solid, liquid and gas (FTIR, OES, laser)
- Plasma physics: non-thermal plasma technology and applications
- All-optical fibre sensors for liquid & gas sensing, temperature and pressure monitoring.
- Development of medical monitoring devices based on optical techniques using near infrared laser diodes and LED as light sources.
- Gases and volatile organic compounds (VOCs) analysis using high resolution FTIR coupled with long optical path length gas cell
- Non-thermal plasma technology in agriculture, food treatment and wire cleaning.
- Laser induced breakdown spectroscopy technique in food and environmental analysis.
- Fibre laser development based on novel saturable absorber material.

Scientific Computing and Instrumentation (SCNI)

- Computational Condensed Matter and Nuclear Physics
- Scientific Instrumentation
- ESR Quantum Computing
- Nanostructured Materials
- Applied Optics Materials
- Thin Film Physics
- Vacuum Science
- Plasma Physics
- Space Weather

Nuclear & Radiation Physics Research Group

- Environmental Radioactivity monitoring and Nuclear Siting
- Medical Physics/Imaging by gamma and X-rays
- Nuclear Safety/Security Assessment
- Nuclear Structure and Reaction
- Nuclear Waste Materials
- Muon Physics
- Radiation Dosimetry (TLD/OSLD)
- Sensor / Biosensor

Advanced Optical Materials Research Group (AOMRG)

- Glass synthesis and characterizations
- Crystal growth and characterizations
- Nanomaterials analyses using analytical techniques
- Semiconductor nanostructures
- Noncrystalline solids and ceramics
- Thin film and Nanotechnology
- Thin film solar cell
- Proton batteries and wastewater treatment
- Biopolymer membrane
- Computational Methods in Amorphous and Polymeric Materials
- Metamaterials
- Perovskite-based Thin Film Solar Cell

Courses and duration of study

The normal duration of study is 2–8 semesters (1–4 years) for M.Phil. and 6–16 semesters (3–8 years) for the Ph.D. programme.

Students must register a Research Course with the following code in each semester.

Year/ Semester (Total Semester)	**M.Phil.**	**Ph.D.**
1/1 (Sem. 1)	MSCZ 1100	PSCZ 1100
1/2 (Sem. 2)	MSCZ 1200	PSCZ 1200
2/1 (Sem. 3)	MSCZ 2100	PSCZ 2100
2/2 (Sem. 4)	MSCZ 2200	PSCZ 2200
3/1 (Sem. 5)	MSCZ 3100	PSCZ 3100
3/2 (Sem. 6)	MSCZ 3200	PSCZ 3200
4/1 (Sem. 7)	MSCZ 4100	PSCZ 4100
4/2 (Sem. 8)	MSCZ 4200 (**maximum semester**)	PSCZ 4200
5/1 Sem. (9)	-	PSCZ 5100
5/2 (Sem. 10)	-	PSCZ 5200
6/1 (Sem. 11)	-	PSCZ 6100
6/2 (Sem. 12)	-	PSCZ 6200
7/1 (Sem. 13)	-	PSCZ 7100
7/2 (Sem. 14)	-	PSCZ 7200
8/1 (Sem. 15)	-	PSCZ 8100
8/2 Sem. (16)	-	PSCZ 8200 (**maximum semester**)

All research students must enrol in Research Methodology (USCP 0010) and at least one of the University's General Courses (subjected to courses offered in each semester listed in SPS website). Examples of General Courses offered are:

No.	Course code	Faculty	Course name
1	UBSS 6013	AHIBS KL	Organization Behaviour and Development
2	UBSS 6023	AHIBS KL	Business Ethics, Responsibility and Sustainability
3	UHMS 6013	FSSH/SHARP	Seminar on Global Development, Economic and Social Issues
4	UHMZ 6023	FSSH/SHARP	Malaysian Society and Culture
5	UHIS 6013	FSSH/ATI	Philosophy of Science and Civilization
6	UHPS 6013	FSSH/SOE	Dynamics of Leadership
7	UHLM 6013	FSSH/LA	Malay Language for Post Graduates
8	URTS 6013	FTIR	Environmental Ethics
9	UECS 6013	FC	IT Project Management
10	URSP 6023	FTIR	ICT Ethics and Society
11	UANP 6013	FTIR	Informatics in Society
12	UMJJ 6013	MJIIT	Basic Japanese Language & Culture

In addition to the above, PhD students in the Department of Physics need to sit for one of the following department courses before the **second** semester:

No.	Course code	Course name
1	MSCF1133	Advanced Numerical Method and Modelling
2	MSCF1473	Advanced Spectroscopic Technique
3	MSCF1483	Advanced Condensed Matter

Credit transfer of Research Methodology and the University's General Courses
Students can apply for credit transfer if the course(s) taken in another M.Phil. programme(s) prior to the current study with at least 80% identical learning outcomes.

Deferment of study

- Students may apply for deferment of the programme registration for not more than **TWO SUBSEQUENT** semesters subject to University's approval.
- Students who do not register for any courses in a semester must apply for deferment. The deferred semester will be counted as a part of the total study period.
- Students who withdraw (TD) from **ALL** courses in a semester will automatically be given a deferment. The deferred semester will be counted as a part of the total study period.
- Students may apply for deferment of study due to health reasons. The application has to be accompanied with a medical report certified by a Medical Officer recognised by the University. The deferred semester may not be counted as a part of the total study period.

Conversion from M.Phil. to Ph.D. programme

M. Phil. students can apply for conversion to a Ph.D. programme between SIX (6) to FIFTEEN (15) months from the registration date upon achieving the requirement listed in the table below.

Bachelor's Degree CGPA	Requirements
CGPA ≥ 3.33	Presented **TWO** conference articles in proceedings with ISBN. **OR** published **ONE** article in a SCOPUS/WOS/ERA indexed journal.
3.00 ≤ CGPA ≤ 3.32	Published **ONE** article in a WOS indexed journal.

Students will be requested to defend the research proposal to the evaluation panels. Passing the evaluation is necessary for successful conversion to Ph.D. programme.

Assessments and evaluation

(i) First Assessment

Students are required to present a research proposal (with preliminary/expected results) for evaluation purposes within the duration specified by the University, according to the following schedule:

Programme	Semester
M.Phil.	2nd semester
Ph.D.	3rd semester

If the students failed to present without any valid reasons, the student may be given a TM status by the faculty.

(ii) Progress Report Assessment

All postgraduate research students are required to submit a progress report online (GSMS system) before the due date. The online system will usually be opened in week 10–13 of each semester, unless specified otherwise in the academic calendar.

The supervisor shall evaluate the progress report. A student whose progress is satisfactory (MM status) will be recommended for the continuation of his/her candidature.

A student may be given a TM or GG status if he/she does not submit his/her progress report.

The faculty shall terminate the candidature of a student whose progress is not satisfactory (TM status) for **TWO** consecutive semesters.

(iii) Qualifying Assessment (Fast Track Ph.D.)

Fast track students in the Ph.D. programme must undergo a qualifying assessment after 6 to 18 months of registration in the Ph.D. programme. The result of the assessment can be one of the following:

(a) **Pass** - The student will continue their Ph.D. programme and proceed with the First Assessment in the following semester.
(b) **Fail** - The student will be transferred to the M.Phil. programme and a new study period begins.

(iv) Viva Voce (Oral Examination)

A student should submit Notice for Thesis Submission (NHT) approved by the supervisor at least three months prior to submission of the dissertation/thesis for examination, or three months before expiry of the maximum study duration. Dissertation/Thesis report must follow the guidelines prescribed in the UTM Thesis Manual 2018 and the report must be written in English. Students shall apply for a permission if the dissertation/thesis is to be written in other languages, i.e. Bahasa Malaysia. The Turnitin score for each chapter shall not be more than 20%. The publication criteria for the M.Phil. and Ph.D. programme is listed below. The article must contain the name of the supervisor (with UTM affiliation) and the student must be listed as the first student author.

Program	Publication criteria
M. Phil.	Students may submit their dissertation after 12 months with at least one publication that has been accepted or published in either journal, conference, or book chapters for the purpose of the viva voce.
Ph.D.	**Submission of thesis for normal duration of study (within 6 - 16 semesters)** Students can submit their thesis for viva voce after having: ● at least **ONE** accepted or published article in a WOS indexed journal, or ● **TWO** accepted or published articles in Scopus/ERA/Malaysia Journal Management System indexed journals. **Early thesis submission (in the Semester 5)** Students can submit their thesis for viva voce after having: ● accepted or published **TWO** articles in WOS/Scopus/ERA indexed journals. **Submission of thesis using publication format** Students can submit their thesis for viva voce using publication format if the following condition is fulfilled: ● At 24 months after the student enrols; a minimum of **THREE** journal articles indexed in Scopus/WOS with at least **TWO** articles accepted or published in Q1/Q2 WOS indexed journals. ● At least 30 months after the student enrols: ● a minimum **THREE** journal articles indexed in Scopus/WOS with at least **ONE** journal article accepted or published in Q1/Q2 WOS indexed journal.

Dissertation/Thesis examination for M.Phil. and Ph.D. programmes should be made according to the criteria set for the programme as approved by the Senate. For instance, oral defence cannot be held more than twice. The thesis examiner should consist of at least one internal and one external examiner, unless specified in *Prosedur Penyelidikan Pascasiswazah (ProPS-06), 2022*. Please refer to the Faculty on the fee imposed for viva voce.

Change of supervisor

During the study period, students may apply for a change of supervisor if necessary. The application is made by filling in the specific form available at the Faculty's Postgraduate Office. The application needs to be supported and approved by the Faculty's Academic Committee. However, students have to take note that the application for a change in supervisor can only be made with the following restrictions (except for special cases):

- Change of supervisor can only be made **ONCE** throughout the study period.
- Application can only be made **BEFORE** the First Assessment.

Abbreviations

ERA	: Excellence in Research Australia
GG	: *Gagal* (Fail)
GSMS	: Graduate Studies Management System
MM	: *Memuaskan* (Satisfactory)
M.Phil.	: Master of Philosophy
MQA	: Malaysian Qualifications Agency
NEC	: National Education Code
NHT	: Notis Hantar Thesis (Notice for Thesis Submission)
Ph.D.	: Doctor of Philosophy
TD	: *Tarik Diri* (Withdraw)
TM	: *Tidak Memuaskan* (Unsatisfactory)
WOS	: Web of Science

GENERIC PROGRAMMES

DOCTOR OF PHILOSOPHY

Field of Research: Generic

- By Research (Full time)

Faculty of Science offers full time research programmes leading to M.Phil. and Ph.D. degree for students interested in pursuing research careers. To ensure the suitability of the research for the given academic level, students are required to present their research proposal to be evaluated by experts in the related area. This usually takes place in the second semester for M.Phil. student and third semester for Ph.D. student. Students are expected to disseminate the output of their research through writing of research articles and presentations in conferences. On completion of the research project, students are required to submit their dissertation/thesis for evaluation by external and internal examiners appointed by the Faculty of Science.

Programme	NEC Code	MQA Reference Number (Certificate Number)
Ph.D.	440 (Physical Science (broad programmes)) / 0588 (Inter-disciplinary programmes and qualifications involving natural sciences, mathematics and statistics, National Education Code 2020)	

Field of Research

The research project of the student may fall into more than one aspects of the following field :

- Biotechnology
- Catalysis
- Chemometrics
- Computational Chemistry
- Environmental Chemistry
- Forensic Science
- Nanostructured Materials
- Natural Products
- Organic Synthesis
- Organometallics
- Polymer Electrolytes
- Separation Science
- Solid State Chemistry
- Zeolites
- Applied Optics: Laser–Matter Interaction, Optical Fibre Sensors, Fibre Lasers and Optical Spectroscopy Analysis for Solid, Liquid and Gas (Ftir, Oes, Laser)
- Plasma Physics: Non-Thermal Plasma Technology and Applications
- All-Optical Fibre Sensors for Liquid & Gas Sensing, Temperature and Pressure Monitoring.
- Development Of Medical Monitoring Devices Based on Optical Techniques Using Near Infrared Laser Diodes And Led As Light Sources.
- Gases And Volatile Organic Compounds (Vocs) Analysis Using High Resolution Ftir Coupled with Long Optical Path Length Gas Cell

- Non-Thermal Plasma Technology in Agriculture, Food Treatment and Wire Cleaning.
- Laser Induced Breakdown Spectroscopy Technique in Food and Environmental Analysis.
- Fibre Laser Development Based on Novel Saturable Absorber Material.
- Computational Condensed Matter and Nuclear Physics
- Scientific Instrumentation
- Esr Quantum Computing
- Nanostructured Materials
- Applied Optics Materials
- Thin Film Physics
- Vacuum Science
- Plasma Physics
- Space Weather
- Environmental Radioactivity Monitoring and Nuclear Siting
- Medical Physics/Imaging by Gamma and X-Rays
- Nuclear Safety/Security Assessment
- Nuclear Structure and Reaction
- Nuclear Waste Materials
- Muon Physics
- Radiation Dosimetry (Tld/Osld)
- Sensor / Biosensor
- Glass Synthesis and Characterizations
- Crystal Growth and Characterizations
- Nanomaterials Analyses Using Analytical Techniques
- Semiconductor Nanostructures
- Noncrystalline Solids and Ceramics
- Thin Film and Nanotechnology
- Thin Film Solar Cell
- Proton Batteries and Wastewater Treatment
- Biopolymer Membrane
- Computational Methods in Amorphous and Polymeric Materials
- Metamaterials
- Perovskite-Based Thin Film Solar Cell
- Study Of Algebra
- Functional Analysis
- Group Theory and Its Application
- Graph Theory and Its Application
- Formal Language Theory and Splicing Systems
- Mathematical Modelling of Fluids Flow
- Non-Linear Waves and Soliton
- Conceptual And Mathematical Model of Behavioural Changes
- Mathematical And Fuzzy Modelling
- Numerical Analysis
- Numerical Computational Methods (Algorithms)
- Numerical Simulation and Visualization
- Development, Analysis, and Implementation of Operational Research
- Optimization Models and Algorithms, Decision Making Gools
- Statistical Modelling and Analysis (Theory and Practise)
- Time Series and Forecasting
- Geo-Statistical Modelling
- Functional Data Analysis
- Financial Mathematics
- Survival And Failure Time Modelling
- Robust Statistics

Courses and duration of study

The normal duration of study is 2–8 semesters (1–4 years) for M.Phil. and 6–16 semesters (3–8 years) for the Ph.D. programme.

Students must register a Research Course with the following code in each semester.

Year/ Semester (Total Semester)	Research Code
1/1 (Sem. 1)	PSCG 1100
1/2 (Sem. 2)	PSCG 1200
2/1 (Sem. 3)	PSCG 2100
2/2 (Sem. 4)	PSCG 2200
3/1 (Sem. 5)	PSCG 3100
3/2 (Sem. 6)	PSCG 3200
4/1 (Sem. 7)	PSCG 4100
4/2 (Sem. 8)	PSCG 4200
5/1 Sem. (9)	PSCG 5100
5/2 (Sem. 10)	PSCG 5200
6/1 (Sem. 11)	PSCG 6100
6/2 (Sem. 12)	PSCG 6200
7/1 (Sem. 13)	PSCG 7100
7/2 (Sem. 14)	PSCG 7200
8/1 (Sem. 15)	PSCG 8100
8/2 Sem. (16)	PSCG 8200 (**maximum semester**)

All research students must enrol in Research Methodology (USCP 0010) and at least one of the University's General Courses (subjected to courses offered in each semester listed in SPS website).

Examples of General Courses offered are:

No.	Course code	Faculty	Course name
1	UBSS 6013	AHIBS KL	Organization Behaviour and Development
2	UBSS 6023	AHIBS KL	Business Ethics, Responsibility and Sustainability
3	UHMS 6013	FSSH/SHARP	Seminar on Global Development, Economic and Social Issues
4	UHMZ 6023	FSSH/SHARP	Malaysian Society and Culture
5	UHIS 6013	FSSH/ATI	Philosophy of Science and Civilization
6	UHPS 6013	FSSH/SOE	Dynamics of Leadership
7	UHLM 6013	FSSH/LA	Malay Language for Post Graduates
8	URTS 6013	FTIR	Environmental Ethics
9	UECS 6013	FC	IT Project Management
10	URSP 6023	FTIR	ICT Ethics and Society
11	UANP 6013	FTIR	Informatics in Society
12	UMJJ 6013	MJIIT	Basic Japanese Language & Culture

Credit transfer of Research Methodology and the University's General Courses

Students can apply for credit transfer if the course(s) taken in another M.Phil. programme(s) prior to the current study with at least 80% identical learning outcomes.

Deferment of study

- Students may apply for deferment of the programme registration for not more than **TWO SUBSEQUENT** semesters subject to University's approval.
- Students who do not register for any courses in a semester must apply for deferment. The deferred semester will be counted as a part of the total study period.
- Students who withdraw (TD) from **ALL** courses in a semester will automatically be given a deferment. The deferred semester will be counted as a part of the total study period.
- Students may apply for deferment of study due to health reasons. The application has to be accompanied with a medical report certified by a Medical Officer recognised by the University. The deferred semester may not be counted as a part of the total study period.

Conversion from M.Phil. to Ph.D. programme

M. Phil. students can apply for conversion to a Ph.D. programme between SIX (6) to FIFTEEN (15) months from the registration date upon achieving the requirement listed in the table below.

Bachelor's Degree CGPA	Requirements
CGPA ≥ 3.33	Presented **TWO** conference articles in proceedings with ISBN. **OR** published **ONE** article in a SCOPUS/WOS/ERA indexed journal. The applicant must be the first student author of the publication.
3.00 ≤ CGPA ≤ 3.32	Published **ONE** article in a WOS indexed journal. The applicant must be the first student author of the publication.

Students will be requested to defend the research proposal to the evaluation panels. Passing the evaluation is necessary for successful conversion to Ph.D. programme.

Assessments and evaluation

(i) First Assessment

Students are required to present a research proposal **(**with preliminary/expected results**)** for evaluation purposes within the duration specified by the University, according to the following schedule:

Programme	Semester
M.Phil.	2nd semester
Ph.D.	3rd semester

If the students failed to present without any valid reasons, the student may be given a TM status by the Faculty.

(ii) Progress Report Assessment

All postgraduate research students are required to submit a progress report online (GSMS system) before the due date. The online system will usually be opened in week 10–13 of each semester, unless specified otherwise in the academic calendar.

The supervisor shall evaluate the progress report. A student whose progress is satisfactory (MM status) will be recommended for the continuation of his/her candidature.

A student may be given a TM or GG status if he/she does not submit his/her progress report.

The faculty shall terminate the candidature of a student whose progress is not satisfactory (TM status) for **TWO** consecutive semesters.

(iii) Qualifying Assessment (Fast Track Ph.D.)

Fast track students in the Ph.D. programme must undergo a qualifying assessment after 6 to 18 months of registration in the Ph.D. programme. The result of the assessment can be one of the following:

(a) **Pass** - The student will continue their Ph.D. programme and proceed with the First Assessment in the following semester.
(b) **Fail** - The student will be transferred to the M.Phil. programme and a new study period begins.

(iv) Viva Voce (Oral Examination)

A student should submit Notice for Thesis Submission (NHT) approved by the supervisor at least three months prior to submission of the dissertation/thesis for examination, or three months before expiry of the maximum study duration. Dissertation/Thesis report must follow the guidelines prescribed in the UTM Thesis Manual 2018 and the report must be written in English. Students shall apply for a permission if the dissertation/thesis is to be written in other languages, i.e. Bahasa Malaysia. The Turnitin score for each chapter shall not be more than 20%. The publication criteria for the M.Phil. and Ph.D. programme are listed below. The publication criteria for the M.Phil. and Ph.D. programme is listed below. The article must contain the name of the supervisor (with UTM affiliation) and the student must be listed as the first student author.

Program	Publication criteria
M. Phil.	Students may submit their dissertation after 12 months with at least one publication that has been accepted or published in either journal, conference, or book chapters for the purpose of the viva voce.
Ph.D.	**Submission of thesis for normal duration of study (within 6 - 16 semesters)** Students can submit their thesis for viva voce after having: ● at least **ONE** accepted or published article in a WOS indexed journal, or ● **TWO** accepted or published articles in Scopus/ERA/Malaysia Journal Management System indexed journals. **Early thesis submission (in the Semester 5)** Students can submit their thesis for viva voce after having: ● accepted or published **TWO** articles in WOS/Scopus/ERA indexed journals. **Submission of thesis using publication format** Students can submit their thesis for viva voce using publication format if the following condition is fulfilled: ● At 24 months after the student enrols; a minimum of **THREE** journal articles indexed in Scopus/WOS with at least **TWO** articles accepted or published in Q1/Q2 WOS indexed journals. ● At least 30 months after the student enrols: a minimum **THREE** journal articles indexed in Scopus/WOS with at least **ONE** journal article accepted or published in Q1/Q2 WOS indexed journal.

Dissertation/Thesis examination for M.Phil. and Ph.D. programmes should be made according to the criteria set for the programme as approved by the Senate. For instance, oral defence cannot be held more than twice. The thesis examiner should consist of at least one internal and one external examiner, unless specified in '*Prosedur Penyelidikan Pascasiswazah* (ProPS-06), 2022'. Please refer to the Faculty on the fee imposed for viva voce.

Change of supervisor

During the study period, students may apply for a change of supervisor if necessary. The application is made by filling in the specific form available at the Faculty's Postgraduate Office. The application needs to be supported and approved by the Faculty's Academic Committee. However, students have to take note that the application for a change in supervisor can only be made with the following restrictions (except for special cases):

- Change of supervisor can only be made **ONCE** throughout the study period.
- Application can only be made **BEFORE** the First Assessment.

Abbreviations

ERA	: Excellence in Research Australia
GG	: *Gagal* (Fail)
GSMS	: Graduate Studies Management System
MM	: *Memuaskan* (Satisfactory)
M.Phil.	: Master of Philosophy
MQA	: Malaysian Qualifications Agency
NEC	: National Education Code
NHT	: Notis Hantar Thesis (Notice for Thesis Submission)
Ph.D.	: Doctor of Philosophy
TD	: *Tarik Diri* (Withdraw)
TM	: *Tidak Memuaskan* (Unsatisfactory)
WOS	: Web of Science

SYNOPSIS OF COURSES

BIOTECHNOLOGY

MSCB 1403 RESEARCH METHODOLOGY

This course is to provide a platform for furtherance to knowledge with regards to research skills. It consists of introduction (problem statement, objective and scope), literature review, methodology and expected results. Students are required to attend lectures on research methodology and information retrieval. At the end of the course, students are required to submit a research proposal of not more than 50 pages and defend their research proposal orally. Students must take this subject before they are allowed to proceed to register for the Dissertation Course.

MSCB 1113: BIOCHEMISTRY AND MICROBIAL PHYSIOLOGY

The course is designed to apply knowledge in basic cellular organisation of microorganisms, growth and central metabolic process to their existence in diverse environment. Knowledge on genetics coupled with regulation will be described. Growth and metabolism of microorganisms will be integrated to explain cellular growth and metabolism in diverse environment.

MSCB 1813: PROTEIN ENGINEERING

This course will start with an introduction to proteins structure and function. This will follow by allowing students to explore different databases and software relates to protein structures. Various protein engineering approaches, both site-directed and evolutional mutagenesis are then introduced. Besides, several successfully case studies on protein engineering will also be discussed. Students are required to carry out a guided mini project where they will be introduced to protein *in silico* homology modelling and mutagenesis.

MSCB 1523 INDUSTRIAL TECHNOLOGY & BIOREACTOR DESIGN

This course will emphasize on the industrial technology and bioreactor design for bioprocess industries. Different types of bioreactor and configurations, mode of operation of ideal bioreactors and the sustainability bioprocessing in industry will be introduced in this course. Students also will be exposed on the scaling-up process of the bioreactor for industrial application.

MSCB 1280 RESEARCH PROPOSAL

This research project allows students to be involved in research under the supervision of knowledgeable and widely experienced lecturers in specialized fields of biotechnology. Students must prepare a written research proposal and be approved by the panel of examiners in the second semester prior to executing the research. This enriching research experience enables students to utilize library or internet facilities for updating literature search, to plan and conduct research independently.

MSCB 1323 TISSUE CULTURE APPROACHES IN INDUSTRIAL BIOTECHNOLOGY
This course comprises the application of animal and plant Tissue Culture approaches in biotechnology-related industries. Part 1 covers the fundamental of animal culture technology for Industrial Biotechnology focusing on local and global issues (GMP, cGMP etc). Part II elaborates various strategies of plant tissue techniques adopted for secondary metabolite production at industrial level. Genetic improvement of crops using genetic engineering tools such as plant transformation and risks of genetically modified crops are also discussed.

MSCB 1423 HALAL INDUSTRY REGULATIONS, MANAGEMENT AND PRACTICES
This elective course is design for professional Halal executive. The fundamentals concept of Halal will be introduced for product and services certification based on Malaysia References and Standards. Both Certified Halal Trainers and industry player will facilitate the candidate with step by-step guide involving discussion and practical on Halal Assurance system. Regulation and Practices alongside with the ethics based on Malaysia Halal Standard will be acquainted. Upon completion the successful candidate may be awarded with professional certificate in Halal Executive.

MSCB 1503 AGRICULTURAL PRACTICES
The agricultural practice course is a specifically design for advanced learners in solving various issues in conventional agricultural practice using biotechnological approach. The course covers various issues in conventional agriculture such as application of pesticides that can create environmental pollution, usage of high plantation area etc and then, the sustainable agriculture approach especially using biotechnological approach will be covered. Other topics includes understanding and applying the concept of Good Agricultural Practices (GAP) and Good Handling Practices (GHP). Finally, students will be exposed to bioeconomy as well as innovation in agricultural business. This course addresses issues related to SDG 2: zero hunger.

MSCB 1203 ALGAE BIOTECHNOLOGY
This course introduces students to the diversity of aquatic microalgae, including classification, identification, growth, and reproduction. The application of microalgae are not only important as major primary producers in all aquatic systems and, at times because of the detrimental effects of algal blooms, but also in aquaculture and industry as sources of nutrition, high value chemicals, in wastewater treatment and potentially as sources of renewable fuels and in CO2 bioremediation. Recent technologies of upstream processes (microalgae cultivation) and downstream processes (algal harvesting and lipid extraction) will be explained and discussed in detail. The evaluation of this course will be based on the assignments, project, presentation and final exam.

MSCB 1223 ENVIRONMENTAL BIOENGINEERING
This course highlights global environmental issues stemming from rapid economic activities mainly from industrial manufacturing processes, oil and gas industry, agro industry, deforestation, logistic and many others. These subsequently generate abundant and possibly unmanageable amount of wastes of different forms mainly wastewater, gases and solid biomass. Sustainability in the processes, products generated towards environment, human and other life forms will be the main issue discussed in this course. Application of technologies for solving the environmental issues will be discussed and evaluated towards sustainable environment, living and economy. Selected industrial cases will be observed and evaluated from local industry by conducting pre and post site visit reporting. This course addresses issues related to SDG 11: sustainable cities and communities.

MSCB 1823 BIOINFORMATICS

This course covers the principles and methodology for Bioinformatics. It focuses on the application of computational methods and tools to study biological problems. This course will introduce the principle, scope, application and limitations of computational tools in bioinformatics. Additional application for molecular interaction using docking.

MSCB XX80 DISSERTATION

This research project allows students to be involved in research under the supervision of knowledgeable and widely experienced lecturers in specialized field of biotechnology. Students must prepare a written research proposal and approved by the panel of examiners during a Research Methodology course in second semester before executing the research. This enriching research experience enable students to utilize library or internet facilities for updating literature search, to plan and conduct research independently. Research data are collected and analysed before finalizing the research dissertation. Student must complete a written dissertation of research project and will be examined by a panel of internal examiners appointed by the Faculty's Post-graduate Committee via *viva-voce*.

CHEMISTRY

MSCK 1713 : ADVANCED INORGANIC CHEMISTRY

The course will cover the theoretical aspects of chemical bonding, molecular structure and symmetry. Emphasis is given on the chemistry of transition metals, including coordination and organometallic compounds. Primary reactions of organometallic compounds will be highlighted. Examples of important catalytic reactions involving organometallics as catalyst will be discussed. The students will be given a group assignment related to the topics discussed during lectures and an oral presentation will be executed.

MSCK 1613: ADVANCED ORGANIC CHEMISTRY

This course focuses on advanced knowledge and application of organic chemistry. The stereochemistry analysis including conformation, followed by asymmetric synthesis will be addressed. Organic reaction types and mechanisms will be discussed, including oxidation-reduction, substitution, elimination, rearrangements and pericyclic reactions with an emphasis on specific reactive intermediates as well as the special topic on transition-metal catalysed reactions.

MSCK 1413: ADVANCED PHYSICAL CHEMISTRY

Advanced physical chemistry provides insight into the fundamental reason that chemical systems and materials behave the way they do. This course gives students an advanced understanding of the properties and characteristics of solids, liquids and gases from a fundamental level right through to methodology for materials preparation and characterization. It emphasises on the key preparation processes, which include sol gel process, coprecipitation method, thin film techniques and solid state process. The course features essential characterization tools including X-ray techniques, electron microscopy and photo electron spectroscopy. Illustrations of the preparation and characterization techniques will be discussed in detail based on real researched materials through individual project works.

MSCK 1213 : ADVANCED ANALYTICAL CHEMISTRY

This course covers modern instrumental techniques in analytical separation and spectroscopy. The analytical separation methods include sample preparation in analytical chemistry, gas chromatography (GC), high performance liquid chromatography (HPLC), and capillary electrophoresis (CE). The spectroscopic methods include mass spectrometry, atomic absorption spectroscopy (AAS), atomic emission spectroscopy (AES), inductively coupled plasma-atomic emission spectroscopy (ICP-AES), inductively-coupled plasma mass spectrometry (ICP-MS).

MSCK 1303/USCP 0010 : RESEARCH METHODOLOGY

This course is to provide a platform for furtherance to knowledge with regards to research skills. It consists of introduction (problem statement, objective and scope), literature review, methodology and expected results. Students are required to attend lectures on research methodology and information retrieval. At the end of the course, students are required to submit a research proposal of not more than 1,500 words (50 pages) and defend their research proposal orally. Students must take this subject before they are allowed to proceed to register Dissertation Course.

MSCK 1323 : ADVANCED BIOCHEMISTRY

This course focuses on the integration of the major metabolic processes in mammals. It begins with an overview of metabolic processes and a description of the major metabolic contributions of several major organs. This is followed by a discussion of the feeding fasting cycle, which illustrates several important control mechanisms. It ends with a brief review of the major mammalian hormones and their mechanisms of action.

MSCK 1333 : ADVANCED BIOTECHNOLOGY

This course discusses the importance of industrial enzymes in biotechnology. Some of the enzymes that have importance in industrial biotechnology include lipases, proteases and amylases. As enzymes are proteins, an introduction to protein chemistry will first be discussed. This is followed by methods of protein extraction, separation and purification. Some important features of enzymes including nomenclature, kinetics and factors affecting enzyme activity will be elaborated. Lastly, a discussion on preparation and application of enzymes used in the industry will be discussed.

MSCK 1463 : QUANTUM CHEMISTRY AND SPECTROSCOPY

This course is designed as an introduction to quantum mechanics and its application in the molecular spectroscopy. It begins with an examination of the historical development of quantum theory, properties of particles and waves, wave mechanics and applications on simple systems, including the particle in a box, the harmonic oscillator, the rigid rotor and the hydrogen atom. The lectures continue with a discussion of the different types of spectroscopy and covers atomic, vibration, rotation and electronic spectroscopy for diatomic and polyatomic molecules. Besides, the final lectures cover the nuclear and electron magnetic resonance. This course is essential course for the theoretical and experimental chemists.

MSCK 1473 : ADVANCED SURFACE AND COLLOID CHEMISTRY

This course is offered as an elective for students who are interested in expanding their basic knowledge in surface and colloid chemistry. The course will discuss on the fundamentals of surface and colloid chemistry, adsorption isotherms and their application in related technologies such as environmental remediation, detergency, biological system, food, and agriculture. Attempting to better understand these technologies gives the impetus to investigate the underlying theories, principles and methods of surface and colloid chemistry. Upon completion, students should be able to develop and apply knowledge in describing processes related to interfacial phenomena and colloidal system.

MSCK 1443 : ADVANCED SOLID STATE CHEMISTRY

The emphasis of this course is to expose students to the application of classical solid state chemistry topics into contemporary, advanced materials ranging from solid state chemistry and advanced materials with novel properties topics. Solid state chemistry topics include crystal chemistry of the major inorganic structural families, bonding in solids and electronic properties, preparative methods, crystal defects, and solid state phase diagram. Advanced materials with novel properties topics include solid electrolytes, nanomaterials, heterogeneous catalysts and photocatalysts

MSCK 1653 : ADVANCED ORGANIC SPECTROSCOPY

This course revises the concepts and applications of infrared (IR), mass spectrometry (MS) and one dimensional nuclear magnetic resonance (1D NMR) together with elemental analysis for structural determination of organic compounds. Advanced theory and application of two dimensional nuclear magnetic resonance (2D NMR: HMQC, HMBC and NOESY) as well as mass spectrometry (MS) technique including EIMS, CIMS and FABMS will also be discussed.

MSCK 1753 : INORGANIC REACTIONS MECHANISM

The course review and discuss inorganic and organometallic reactions, their mechanisms and kinetic characteristics. Basic chemical kinetics including rate laws, integrated rate expression is discussed. Reaction energetics and determination of rate laws are also discussed. **Ligand substitution reactions**: dissociative, associative and interchange mechanisms. Substitution reactions in square planar complexes: factors influencing reactivity – *trans* influence, *cis* effect, leaving and entering group effects. Stereochemistry of products. Substitution reactions in octahedral complexes: rate law and Eigen-Wilkins mechanism. Ligand steric and electronic effect. Stereochemistry of products. pH effects on substitution in aqueous media. Organometallic reactions: oxidative-additions, reactions of metal carbonyls, insertion reactions. **Redox reactions**: Inner and outer sphere mechanisms. Rate law, Marcus theory. Reaction mechanisms in selected bioinorganic and catalytic processes will be reviewed.

MSCK 1763 : INORGANIC STRUCTURAL METHODS

This course discusses the various structural elucidation techniques commonly used to characterize inorganic compounds. It is designed to provide students with all the necessary knowledge and tools for the interpretation of theoretical and experimental results from simulation and measurement. This course aims to help the students to make decisions about which techniques will be most useful in solving structural problems

MSCK 1243 : ADVANCED SEPARATION METHOD

This course provides platform to deepen the knowledge to develop various powerful chromatographic and sample preparation methods adapted to various types of samples such as environmental waters and soils, biological fluids and foodstuff. The course is aimed at students who target industrial or academic careers in the field of separation sciences. Typical topics are advances in Microextraction techniques, Multi-dimensional Gas Chromatography (GC x GC), Ultra Performance Liquid Chromatography (UPLC), Tandem mass spectrometry (MS/MS), advances in Capillary Electrophoresis (CE), as well as Microfluidic and lab-on-a-chip. Application areas include food, pharmaceuticals, proteomics, metabolomics, forensics and environmental.

MSCK 1263 : ADVANCED ELECTROANAYLTICAL CHEMISTRY

This course is designed to enhance students with an understanding of the principles of analytical electrochemistry. Major electroanalytical techniques will be discussed including potentiometry, amperometry, polarography, cyclic voltammetry, pulse and differential pulse voltammetry, square wave voltammetry, and stripping analysis. Applications of electroanalytical principles in developing new modified electrode, corrosion controlling techniques, chemical and biochemical sensors are also included

MSCK 1273 : ADVANCED ENVIRONMENTAL CHEMISTRY

This course introduces the students to the environmental consequences of human activities and methods of minimizing their impacts through understanding of processes and technology. Ecological concepts and ecosystem process. Water chemistry in natural water system; water pollution prevention and water quality requirement. Water treatment: Water sources and their quality. Conventional water treatment unit operations: Sedimentation, coagulation, flocculation, filtration, disinfection. Advanced water treatment processes. Wastewater characteristic and treatment: Primary treatment and Secondary Treatment system. Sedimentation and sludge treatment..

MSCK 1180 : RESEARCH PROPOSAL

Students are required to execute a thorough literature review under an identified supervisor in an agreeable field of chemistry and produce a written proposal on their findings. Students will gather information on chosen topics through literature survey/review activities, construct research methodology, anticipate expected results, write current findings, and references. Finally, students are required to submit a research proposal and a draft project/research report comprising of Title, Introduction, Statement of Problem, Research Objectives, Literature Survey/Review, Research Methodology, Expected Findings, Conclusion and References.

MSCK XY80 : DISSERTATION

Dissertation is the final stage of the Masters degree. Students are required to execute a research project under an identified supervisor/supervisors in an agreeable field of chemistry and submit a research dissertation report. It should demonstrate the skill in identifying an area suitable for research: setting research objectives; locating, organising and critically analysing relevant data and authoritative literature; devising an appropriate research methodology; presenting the results and findings; drawing conclusions; and making relevant recommendations and indications of areas for further research. Students must have a main supervisor from Department of Chemistry and/or a co-supervisor from other related faculty or school. The student will need to defend his/her dissertation in a viva voce.

DISSERTATION CODES

CODE	NAME	STUDENT'S SEMESTER
MSCK 2180	DISSERTATION	3
MSCK 2280	DISSERTATION	4
MSCK 3180	DISSERTATION	5
MSCK 3280	DISSERTATION	6
MSCK 4180	`DISSERTATION	7
MSCK 4280	DISSERTATION	8

Guidelines for Dissertation codes:

MSCK XY80
X – year of study ;
Y – 1st or 2nd semester;

FORENSIC SCIENCE (Taught Course)

MSCQ 1033 : RESEARCH METHODOLOGY

This course is to provide a platform for furtherance to knowledge with regards to research skills. It consists of introduction (problem statement, objective and scope), literature review, methodology and expected results. Students are required to attend lectures on research methodology and information retrieval. At the end of the course, students are required to submit a research proposal of not more than 1,500 words (50 pages) and defend their research proposal orally. Students must take this subject before they are allowed to proceed to register Dissertation Course.

MSCQ 1803 : FORENSIC EVIDENCE AND THE ASPECTS OF LAW

This course introduces forensic science in the law aspects. The course covers the legal aspects of forensic science including the admissibility of scientific evidence, laboratory reports and expert testimony. This course also focuses on recognizing, protecting and preserving all physical evidence at a crime scene.

MSCQ 1813 : FORENSIC ANALYTICAL INSTRUMENTATION

This course provides the basic principles and application of various instrumental methods for examination of physical evidence, including microscopy, spectrophotometric and chromatographic techniques, electrophoresis and mass spectrometry.

MSCQ 1823 : FORENSIC CHEMISTRY

This course covers the principal areas of forensic chemistry, whereby physico-chemical properties of important evidences such as colorant, polymers and blood alcohol will be explored. Student will be introduced to qualitative and quantitative chemical analysis. This subject introduces to principles of forensic chemistry, basic analytical chemistry procedures, sampling, sample preparation, data analysis, immunoassay, analysis of color and colorants, analysis of polymers, analysis of blood alcohol concentration and statistical analysis. Case examples will also be presented and discussed.

MSCQ 1833 : FORENSIC TESTIMONY AND MOOT COURT

This course enables students to provide expert testimony, presenting evidence in a moot court, and to be examined by trial attorneys. This will provide them with the necessary skills for testifying forensic evidence as forensic experts.

MSCQ 1853 : FORENSIC PRACTICAL

This course covers the practical areas of forensic science related to the theory discussed in class – examinations of glass, paints, plastics, soil, hairs, drugs, fibres, accidents and alcohol analysis, as well as body fluid analysis (blood, saliva and semen). Upon analyses of exhibits in a simulated case, students are required to prepare a scientific and court report for preparation as an expert witness in a moot court.

MSCQ 1913 : CRIME SCENE INVESTIGATION
This course deals with advanced topics relating to the role physical evidence in the criminal justice system. Topics include philosophical aspects of crime scene investigation and reconstruction, as well as the practical crime scene searching techniques, evidence collection, handling and management, and the legal framework as it relates to physical evidence. Real case studies will also be discussed.

MSCQ 1923 : BIOLOGICAL ASPECTS OF FORENSIC SCIENCE
This course discusses the principles of forensic serology, DNA, pathology, anthropology, odontology, toxicology as well as special topics in entomology. The role of the forensic laboratory in the identification of human remains; determination of the time, cause, and manner of death; individualization of biological materials.

MSCQ 1933 : EXAMINATION OF QUESTIONED DOCUMENTS
This course introduces the fundamental concepts and principles of examining questioned documents. It focuses on the detection of handwriting, forgery and its execution, typewriting identification, document alteration, and counterfeiting, as well as the significance or role of a questioned document expert in the administration of justice, as well as the care and preservation of related evidence for court litigation.

MSCQ 1943 : QUALITY ASSURANCE IN FORENSIC SCIENCES
This course provides a preparation for the forensic scientists to develop and implement quality assurance and quality control procedures to ensure the excellence of a laboratory. Covers preparation of laboratory procedures and policies, use of appropriate standards and controls, and validation methods for establishing an effective quality assurance program in their laboratory.

MSCQ 1953 : FORENSIC ENGINEERING
This course introduces the students to problems that can arise from product failure caused by inadequate materials, poor manufacturing or assembly methods, or poor design. This course also provides guidance for good product design before development. Case studies on historical catastrophes and failures will be presented.

MSCQ 1963 : COMPUTER FORENSICS
This course introduces the students to computer evidence issues, computer incident responses and security risk assessments. Expert witness testimony is touched upon during the course. This course also stresses on computer evidence preservation, cross validation of forensic tools and the documentation of computer evidence findings. Solid computer evidence processing methodologies are also taught to help overcome legal "junk science" attacks against the admissibility of computer-related evidence.

MSCQ 1973 : FIRE AND EXPLOSION INVESTIGATION
This course covers the investigation of the causes of fires, whether accidental or deliberate. This involves the study of the dynamics of fires and explosions as a basis for interpretation of fire / explosion scenes in order to ascertain their cause (accidental or malicious) and who if anyone is to blame. The module will also explore the health and safety implications of such scenes and the identification and recovery of evidential materials. The investigation of accidental or illegal explosions are also dealt with in this course.

MSCQ 1983 : FIREARMS AND FORENSIC BALLISTICS

Firearms and Forensic Ballistics involves the examination of evidence from firearms that may have been used in a crime. This course will cover the basic overview of firearms and forensic ballistic, the mechanism and design aspect of firearm, evidence characteristic, types of examination, presentation of evidence in court and related case studies. The students are expected to identify the types and mechanics of firearms, indicate suitable analytical techniques and evaluate the forensic evidential value of firearms and forensic ballistic.

MSCQ 1993 : FORENSIC TOXICOLOGY AND DRUGS OF ABUSE

This course introduces the student to the general practices of Forensic Toxicology. It also includes a study of the qualitative and quantitative principles and procedures used in the detection of drugs commonly abused or as toxins in body fluids and human organs.

MSCQ 1180 : FORENSIC RESEARCH PROJECT 1

Each student is expected to prepare the forensic research proposal under the guidance of at least one supervisor and produce a proposal relevance to forensic science. The student will need to present his/her proposal in a writing or presentation. The areas of research may include (but not limited to) Forensic Chemistry, (analytical method development and validation for various analytes etc.), Forensic Biology (e.g. Entomology, Diatomology, DNA, etc), Physics (e.g. LIBS etc.), Chemometrics (forensic provenance), Crime Scene Reconstruction, Criminalistics (impression evidence, glass, paints, soil, gunshot residues, questioned documents, terminal ballistics etc.). Specific area of research can also be explored, subject to availability of supervisors.

MSCQ 2180 : FORENSIC RESEARCH PROJECT 2

This course enables the student to carry out a research project in any areas of forensic relevance. Each student is expected to perform the forensic research under the guidance of at least one supervisor and produce a project report. The research can also be supervised by officers from industries/stakeholders like the Royal Malaysia Police. The student will need to defend his/her research project in a presentation session. The areas of research may include (but not limited to) Forensic Chemistry, (analytical method development and validation for various analytes etc.), Forensic Biology (e.g. Entomology, Diatomology, DNA, etc), Physics (e.g. LIBS etc.), Chemometrics (forensic provenance), Crime Scene Reconstruction, Criminalistics (impression evidence, glass, paints, soil, gunshot residues, questioned documents, terminal ballistics etc.). Specific area of research can also be explored, subject to availability of supervisors.

MATHEMATICS

MSCM 1303 : RESEARCH METHODOLOGY

This course is to provide a platform for furtherance to knowledge with regards to research skills. It consists of introduction (problem statement, objective and scope), literature review, methodology and expected results. Students are required to attend lectures on research methodology and information retrieval. At the end of the course, students are required to submit a research proposal of not more than 1,500 words (50 pages) and defend their research proposal orally. Students must take this subject before they are allowed to proceed to register Dissertation Course.

MSCM 1023 (PRISMS) : ADVANCED MATHEMATICAL METHODS I

This subject provides selected advanced mathematical methods that can be used to construct solutions for differential equations of applied mathematics. The contents deal with the representation of solutions by hypergeometric series expansions, with the method of integral transforms, and with conformal mapping method. This course also integrates the use of standard mathematics software (e.g. Mathematica) to study special functions, integral transforms and conformal mapping.

MSCM 1053 (PRISMS) : COMPUTATIONAL MATHEMATICS

This course provides the fundamentals of programming, program design, verification and visualization using C++ and Matlab language. The goal is to provide the students with the skills in scientific computing, tools, and techniques that can be used to assist them in the dissertation later. In this course, students will learn to implement algorithms, construct codes, and perform the debugging using C++ and Matlab programming. The programming skills acquired in this course will allow students to go beyond what is available in ready-built-in analysis tools, and code their own custom data processing, analysis and visualization for any science and engineering problem.

MSCM 1233 (PRISMS) : MATHEMATICAL ANALYSIS

This course begins with introducing the metric spaces which include open set, closed set, convergence, Cauchy sequences and completeness. These are followed by the normed spaces which cover vector space, normed space, Banach space, finite dimensional normed space and subspaces, compactness and finite dimension, linear operators, bounded and continuous linear operators, linear functionals, linear operators and functionals on finite dimensional spaces, Hahn-Banach theorem, open mapping theorem and closed graph theorem. The course ends with Banach Fixed Point Theorem which include contraction mapping and error bound in iterations. The course also emphasizes on the applications of Banach Fixed Point Theorem to system of linear equations (Jacobi and Gauss-Seidel iterations), differential equations (Picard's existence and uniqueness theorem) and integral equations (Fredholm integral equation and Volterra integral equation).

MSCM 1280 : RESEARCH PROPOSAL

Students are required to execute a thorough literature review under an identified supervisor in an agreeable field of chemistry and produce a written proposal on their findings. Students will gather information on chosen topics through literature survey/review activities, construct research methodology, anticipate expected results, write current findings, and references. Finally, students are required to submit a research proposal and a draft project/research report comprising of Title, Introduction, Statement of Problem, Research Objectives, Literature Survey/Review, Research Methodology, Expected Findings, Conclusion and References.

MSCM 2180 : DISSERTATION

Dissertation is the final stage of the Master's degree. Students are required to execute a research project under an identified supervisor/supervisors in an agreeable field of engineering mathematics and submit a research dissertation report. It should demonstrate the skill in identifying an area suitable for research: setting research objectives; locating, organising and critically analysing relevant data and authoritative literature; devising an appropriate research methodology; presenting the results and findings; drawing conclusions; and making relevant recommendations and indications of areas for further research. Students must have a main supervisor from the Department of Mathematical Sciences and a co-supervisor from engineering-related faculty or school. The student will need to defend his/her dissertation in a viva voce.

MSCM 1113 : ADVANCED ENGINEERING MATHEMATICS

The course begins with the perturbation methods consisting of ordering, asymptotic sequences and expansions, together with Landau order symbols and Gauge functions. Solution of algebraic equations will be discussed such as the regular perturbation problems and singular perturbation problems. The course will also touch on the solutions of transcendental equations and the solutions of initial value problems. In addition regular perturbation will be discussed specifically on the projectile oscillators and pendulum problems. Further, linear damped oscillator and non-linear Duffing equations are handled by methods of multiple scales while the singular perturbation in boundary- value problems namely equations with constant coefficients are solved by the method of matched asymptotic expansion, where as equations with variable coefficients are treated by boundary layer theory. Finally the application of the above methods to partial differential equations will be shown.

MSCM 1123 : THEORETICAL MECHANICS

This course introduces students to the mechanics of particles and rigid bodies, oscillations and wave motions and analytical mechanics of material systems whose behaviours are governed by Newton’s Law of Motion. It emphasises the ideas of conservation of linear and angular momentum, energy, and to the relationship between these conservation laws and Newton’s Laws. This further touches on simple harmonic motion which is later generalised to include frictional damping, forcing terms and nonlinear effects. Finally attention is given to the advanced mathematical developments of the subject that are due, especially to Lagrange and Hamilton. The course is intended to facilitate students attaining knowledge and understanding on principles and techniques of classical mechanics.

MSCJ 1733 : SOLITONS AND NONLINEAR WAVES

The course introduces students to the basic theories and principles of soliton and nonlinear wave. It will examine some underlying general concepts related to solitons and nonlinear wave equations. These include topics in linear waves, certain nonlinear equations of evolutions, methods of solutions, soliton interaction, general equation of evolution, group velocity and nonlinear waves. The course is designed to facilitate students acquiring knowledge and understanding on principles and techniques of solving nonlinear wave equations and interpreting physically the resulting solutions.

MSCM 1143 : FLUID MECHANICS AND HEAT TRANSFER

This course aims to equip students with the required skills to develop mathematical models for incompressible fluid flow and heat transfer problems. Emphasis is on the derivation of the governing equations of motion for fluid flows and heat transfer in forced, free and mixed convection. The approximate and exact solutions obtained using an appropriate analytical method are discussed. These include the Oseen and Stokes flows and the boundary layer flows in various situations.

MSCM 1153 : APPLIED AND COMPUTATIONAL COMPLEX ANALYSIS

This course is a continuation of a typical undergraduate Complex Variables course. This course introduces more advanced topics on residue theory, conformal mapping and their applications. Topics include residue theory (with applications to Fourier integral transforms, improper integrals and summing of series), numerical complex integration, conformal mapping (Schwarz-Christoffel transformation, Riemann map) with applications in solving boundary value problems of science and engineering. This course also integrates the use of standard mathematics software to study numerical complex integration, numerical conformal mapping and boundary value problems.

MSCM 1183 ADVANCED MATHEMATICAL METHODS II

This course introduces students to techniques in advanced mathematical methods that will be useful in their research. It emphasises on two main topics related to complex variables – Bromide which integral & residues on branch cuts and on various asymptotic methods – integration by parts, Watson Lemma, Laplace methods and steepest descent method. The course is intended to facilitate students attaining knowledge and understanding on principles and techniques of advanced mathematical methods.

MSCJ 1543 : ADVANCED PARTIAL DIFFERENTIAL EQUATIONS

This course introduces the basic elements of the various solutions techniques for solving the partial differential equations. The solution methods include the method of characteristics, separation of variables, Laplace and Fourier transforms, perturbation and asymptotic methods. Topics include Laplace's equations, Green's functions and theorem. Each student will be required to do small project so that they gain experience in the implementation of the method for specific applications.

MSCM 1213 : GROUP THEORY I

This course is an advanced theory of algebra. It consists of two parts. The first part includes introduction to groups, types of groups, isomorphisms between groups, automorphisms; composition of groups to form a direct product, and types of subgroups including normal subgroups and factor groups. Furthermore, some advanced topics in group theory are included including autocommutators subgroups; rings and integral domains.The second part is a selected topic of Sylow Theorems and their applications, topics on generators and relations, and some applications of group theory including its application in Probability Theory.

MSCM 1223 : GALOIS THEORY

This course provides a connection between field theory and group theory. The course begins by reviewing the general properties of rings, integral domains and fields. Euclidean domain, test for irreducibility, and the field of quotients of an integral domain are next in line. The ultimate aim is to grasp the underlying ideas behind Galois Theory which include theorems on primitive elements, splitting fields, normal and separable extensions and the Galois group. Finally, The Galois correspondence which covers the topics on the Fundamental Theorem of Galois Theory, Galois extension, Galois closure and normal closure, finite separable extension, normal subgroups and normal extensions, the cyclotomic extensions and the Galois groups of cyclotomic extensions will be explored.

MSCM 1253 : THEORY OF MATRICES

This course discusses mainly theory of matrices and vectors from a point of view (theoretical) which will help the student gain insight into the theory. Beginning with a review matrices, determinants, polynomials, functions, equivalence relations, Zorns's lemma, cardinality Topics include Linear algebra on complex numbers and finite fields, eigen vectors and values, quadratic and normal forms, similarity and selected topics. Modules. Spectral Theorem.

MSCM 1263 : POINT SET TOPOLOGY

This course is an advancement of the foundation in analysis that students have studied in their undergraduate course. The students will be introduced the theory of topological space and to show them the interlink between branches in mathematics with aim to solve some problems in physics, engineering, etc. This course starts with discussions on basic concepts, definitions and theorems pertaining to metric space, normed vector spaces, subspace metrics, open subsets and continuous maps, metrics on products as the foundation for further discussion with the foundation in hand, the discussions proceed to Topological space which includes continuous maps, bases, the axiom of countability and product topologies. Also discussed is compact spaces which involves The Hausdorff separation axiom, compactness, products of compact spaces, the one-point compactification and properness. Next, the quotient topology, gluing surfaces out of charts and compatibility of quotient topology with products are also discussed. The discussion will end with introducing Toplogical group likes $GL_n(R)$ and quotient groups.

MSCM 1273 : GROUP THEORY II

This course is an advanced group theory. Firstly, simple groups, series of groups, group action on a set, isomorphism theorems, free abelian groups, free groups, group presentations are exposed. Properties of rings and field, integral domains, rings of polynomials, factor rings and ideals, Grobner bases for ideals are next in line. The final part of the course exposes the students to the underlying theory of extension fields, vector spaces and algebraic extensions.

MSCM 1313 : NUMERICAL ORDINARY DIFFERENTIAL EQUATIONS

Basic theory of the general linear multi-step method, explicit/implicit method, order and the convergence of method to solve initial value problem for first order ordinary differential equation. Address issues that arise when applying a multi-step method, local and global truncation error, and weak stability theory of the method. Implicit method, predictor-corrector method and step-control policy. The derivation of the classical Runge-Kutta method, order and convergence, error estimates, explicit/implicit. Polynomial extrapolation method and existence of asymptotic expansion, rational extrapolation. Higher order ordinary differential equation. First order system and the problem of stiffness. Shooting method and finite difference method for solving two-point boundary value problems.

MSCM 1323 : FINITE DIFFERENCE METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS

Discusses finite difference method (FDM) for solving partial differential equations (PDE). The models used for equations of the parabolic, hyperbolic, and elliptic used are the heat conduction, wave, and Poisson's equations, respectively. The PDE is dealing with a big data analytics generated by the grid generation of FDM discretization of PDE model. A big data analytic increases sample size, improves data accuracy, decrease the error estimation, enabling data scientific for decision making and predictive modelling and other analysis.

Parallelization of FDM for solving PDE is an answer to the challenges set by discussing the structure of data, the generate a set of domain, the decomposition of the domain into subdomain and analyse the numerical method and its performance.

For each of these equations, the corresponding large sparse finite difference methods are developed. The discussion begins with small and large scale of one-dimensional problems of the parabolic and hyperbolic equations. Next, discuss on two-dimensional of elliptic equations. Extensions to two- and three-dimensional problems are analysed in terms of small and large scale discretization. Nonlinear parabolic equations are also discussed. Two-dimensional problems FDM based on polar coordinates are also covered. For one-dimensional hyperbolic equations, finite-difference schemes based on characteristic curves are given preference over rectangular coordinates.

Some numerical methods for Parabolic PDEs involving explicit methods, Crank-Nicolson implicit method, alternating directions implicit method, direct and iterative methods, multigrid method and higher level schemes. Numerical Methods for Elliptic PDEs dealing with analytical methods, Jacobi's method, Gauss-Seidel method, successive over-relaxation method, rates of convergence, alternating directions implicit method, conjugate gradient method and Galerkin method. Numerical methods for hyperbolic PDEs discussing the explicit methods, the exact solution, method of characteristics, higher dimensions and computer implementations.

Discussion includes convergence, stability, and consistency as well as the relevant theorems. Methods of numerical linear algebra, specific to the structures of the algebraic linear systems in each category are reviewed; specifically, tridiagonal systems, block tridiagonal systems, domain decomposition techniques and results on eigenvalue. The numerical analysis and parallel performance indicators are used to investigate the validation of the numerical methods and its parallel algorithm.

MSCM 1333 : FINITE ELEMENT METHOD

This course discusses solutions to the one- and two-dimensional (1D, 2D) boundary value problems (BVP) using the finite element method (FEM). Strong and weak forms of the problems are explained as well as the variational method. Finite element formulation using the Galerkin method in 1D and 2D BVP involving ordinary and partial differential equations. Case studies on 1D problems including heat transfer, string displacement, linear elasticity, beam bending and truss analysis. FEM error analysis is discussed. Nonlinear problems: Burger's equation is discussed. Case studies on 2D problems involving mesh elements formation, and their representations in the form of isoparametric and serendipity elements. Case studies on 2D problems including heat transfer, fluid dynamic and plate/plane formulation. Finally, mesh generation and 3D FEM is introduced.

MSCM 1353 : PARALLEL COMPUTING

The course will familiarize the students' knowledge and concept in the field of parallel and distributed processing concepts for high performance computing. Beginning with a parallel architecture, parallel programming models, parallel computing software, parallel algorithms for solving multidimensional PDE with elliptic, hyperbolic and parabolic types. This course discusses mainly issues on synchronization, data distribution, load balancing, data partitioning, interconnection networks, data communication and computational cost. The message passing paradigm will be consider on shared memory and distributed architectures for solving a large sparse problem. Hands on practice will help students to know how to use the bus-based computing platforms, numerical analysis and parallel performance evaluations. The students should be able to identify the intelligent system and emergent technologies as tools for fast, stable and robust solutions. The course will also include a significant laboratory component involving the design, implementation and evaluation of parallel programs on message passing paradigm using parallel virtual Machine (PVM), Message Passing Interface (MPI), Matlab Distributed Computing and Multicore computing.

MSCM 1363 : NUMERICAL INTEGRAL EQUATION

The course introduces linear integral equations and their classifications. The topics covered are Fredholm alternative theory, Fredholm equations of the second kind, quadratures rules, finite difference methods, expansion methods, linear programming solutions and variational methods. It also discusses singular equations. Voltera equations of the second kind and integral equations of the first kind. Further, eigenvalue problems, nonlinear integral equations, integro-differential equations and iterative integral equations will be discussed.

MSCM 1393 : NUMERICAL LINEAR ALGEBRA

A fundamental course in Numerical Analysis in the sense that most numerical approaches to solving problems invariably reduce the problems to solving or analysing systems of algebraic equations. Covers four main topics, namely the numerical solution of systems of linear algebraic systems, the least squares problem, the algebraic eigenvalue problem, and the singular value decomposition. The backward error analysis will be introduced. The problem of conditioning of a problem will be discussed. The quest for a stable algorithm usually involves a transformation using unitary matrices. Naturally the MATLAB/Octave is used extensively as a black box as well as for programming purposes

MSCM 1403 : ADVANCED MATHEMATICAL STATISTICS

This course stresses on mathematical aspects of statistics, emphasizing on probability, probability distributions and densities, as well as classical statistical inference. Bayesian approach to analysis is also introduced as an alternative approach to the classical approach. The course begins with a review of probability concepts, followed by the explorations of random variables, extending from univariate to multivariate phenomena. Common probability distributions are also covered in terms of their properties and moment generating functions, if exist. Properties of estimators and different methods of parameter estimation are also discussed in detail. Finally, the course also investigates the hypothesis test and its possible errors.

MSCM 1423 : PROBABILITY THEORY

This course introduces students to the basic principles of the theory of probability and its applications. Topics include measure theory used in computing probabilities, the axioms of probability, conditional probability and independence of events; discrete and continuous random variables; jointly distributed random variables, properties of expectation; convergence, laws of large numbers and the central limit theorem. Students will be encouraged to use R to write programs on the algorithms. Upon completion, students should be in a proper and well-structured way to apply probability theory that is not necessarily directly addressed in the course material. The student is also clearly able to present and interpret the results, explain concepts, methods and theories used in the implementation.

MSCM 1433 : STOCHASTIC PROCESSES

The aim of this course is to develop skills and relevant theories to a range of traditional techniques in understanding random phenomena. The focus is on understanding and describing stochastic models to make appropriate analysis and decisions with modern flavour. The stochastic models considered might include both discrete and continuous processes: Counting process and Brownian motion. The application of stochastic process in decision and analysis cover population model, queueing system, finance and dynamical system. Examples and assignments involve computing in R software. There is no prerequisite for this course. However, students should have working knowledge of probability, statistics, matrix algebra and R software.

MSCM 1453 : GENERALIZED LINEAR MODELS

This course provides an overview of generalized linear models, which extend the linear modelling framework to allow response variables that are not Normally distributed. The course is divided into three parts, each comprising a lecture session and a practical session using R. The first part reviews the general linear model and considers its restrictions, motivating the development of generalized linear models (GLMs). An overview of the theory of GLMs is given, including estimation and inference. The part concludes with an introduction to fitting GLMs in R. The practical for this part considers the use of GLMs for continuous data, in particular comparing the log-Normal and Gamma models. The second part focuses on the analysis of binary data. The lecture session begins by considering the exploration of binary data before introducing GLMs for binary data. Examples are given of both grouped and ungrouped binary data, providing case studies for model selection, model evaluation, interpretation, prediction and residual analysis. In the practical, two examples with a binary response are analysed using logistic regression. GLMs are most commonly applied to binary or count data and the latter type of data is the focus of the final part. The analysis of rate data is considered first, introducing the concepts of offsets and overdispersion. Then an introduction is given to log-linear models for contingency tables. The practical covers both rate data and contingency table analysis using Poisson or quasi-Poisson models.

MSCM 1483 : TIME SERIES ANALYSIS

The course explores the time series analysis and forecasting models. Topics covered will start with basic concepts of descriptive methods, plots, smoothing, differencing; estimation, modelling and forecasting with series regression and exponential smoothing for non-stationary and seasonal time series data. The discussion will end with the ARIMA and GARCH model processes using the Box-Jenkins methodology and Lagrange multiplier test approach. The Analyses will be performed using Excel and the freely available package R and RStudio.

MSCM 1493 : ADVANCED MULTIVARIATE ANALYSIS

The aim of this course is to develop skills and relevant theories to modern statistical techniques for multivariate data analysis. The focus is on understanding the underlying statistical methodologies to the multivariate techniques and hands-on practical in selecting appropriate analysis, preparing data for analysis, interpreting output, and presenting results. The statistical techniques are broadly categorized into five data analysis approaches: Comparison of Means, Dimension Reduction, Measures of Association and Predictive Analysis Examples and assignments involve computing in R software. There is no prerequisite for this course. However, students should have working knowledge of probability, statistics, matrix algebra and R software.

MSCM 1613 : ADVANCED OPTIMIZATION TECHNIQUES

This course is an advanced course in optimization techniques. The subject matter of the course is optimization algorithms meant for finding local and global solutions of unconstrained optimization problems. The course will start with some preliminary results from multivariable calculus and discussions on a few basic algorithms for unconstrained problems. The algorithms presented will be local searches; uni-variate methods and multivariate methods. The flaws in each algorithm will be discussed and based on these; extensions of the algorithms will be presented. With local searches as a basis, global searches will be discussed for finding global solutions. Students will be encouraged to use MATLAB to write programs on the algorithms. Upon completion, students should be at ease to use these methods for finding local and global solutions for the majority of unconstrained optimization problems.

MSCM 1623 : MATHEMATICS OF OPERATIONS RESEARCH

This course covers a selection of mathematical models and tools for Operations Research, in particular, linear programming, integer linear programming, dynamic programming and network algorithms. Students are encouraged to use EXCEL SOLVER / LINGO to run the algorithms. Besides the computation of the method, the mathematical foundation underlying the problems and methods are also discussed. Upon completion, students should be able to formulate and solve optimization problems using appropriate Operations Research models and methods discussed in the course and interpret the solution. Students are also expected to be able to explain related theoretical concepts of the methods discussed in the course.

MSCM 1633 : GAME THEORY

This course offers an insight into game theory and its applications. It covers a selection of game theory models of competition, cooperation and multi-party decision making. Examples will be drawn from economics, social and traditional games.

MSCM 1643 : HEURISTIC OPTIMIZATION METHODS

The subject matter of the course is on various types of heuristic optimization methods: the basic concept, the algorithm and the implementation. Speedup mechanisms in heuristic design (neighbourhood reduction and data structures) will also be discussed. The course starts with local search heuristics and its improvement which include Constructive Heuristics, Composite Heuristic, Multi-level Heuristic and Perturbation Heuristic. The course also provides an elementary introduction to metaheuristics methods such as Simulated Annealing, Tabu Search and Genetic Algorithms which are the most commonly used metaheuristics. Swarm intelligence inspired techniques such as Ant Colony and Particle Swarm will also be presented in the course.

MSCM 1663 : SUPPLY CHAIN MODELLING

In this course, students are given a broad exposure and practice-oriented approach to the problems that managers face in modelling Supply Demand Chain. The aims is to develop the understanding of supply chain system in the real world and model them using mathematical model. This includes the development of deterministic inventory model and Probabilistic inventory model. Additionally, this course will also include the types of forecasting and the types of forecasting that are widely used in Supply Chain Management. This will enable students to integrate the knowledge gained from various courses in time series, forecasting and other related knowledge which permit students to approach complex supply chain management or model to decide the best solution. This course also explores effective SCM for decision making. This course also equips the participants with several cross discipline namely the dynamic inventory model, forecasting and analytical skill for the development of effective supply chain strategy for good management practices.

ENGINEERING MATHEMATICS

MSCJ 1303 : RESEARCH METHODOLOGY

This course is to provide a platform for furtherance to knowledge with regards to research skills. It consists of introduction (problem statement, objective and scope), literature review, methodology and expected results. Students are required to attend lectures on research methodology and information retrieval. At the end of the course, students are required to submit a research proposal of not more than 1,500 words (50 pages) and defend their research proposal orally. Students must take this subject before they are allowed to proceed to register for the Dissertation Course.

MSCJ 1523/SSCM5713 (PRISMS) : METHODS OF ENGINEERING MATHEMATICS

This course introduces Appel's symbol, Vandermonde's theorem, Hypergeometric Series, Gamma Function, Analyticity, Limit formulas, Reciprocal of the gamma function, Duplication theorem, Eurler's reflection formula, Solutions of various important differential equations expressible in terms of the hypergeometric series. Integral Transform: Laplace transform, Fourier transform and Mellin, Inversion Integral, Bromwich Integral & Calculus of Residues. Properties of transformations, application of integral transforms to initial or boundary value problems. z-transform, solving difference equation using z-transform and method of convolution.

MSCJ 1533/SSCM5423 (PRISMS) : NUMERICAL METHODS IN ENGINEERING

A general course of numerical methods in engineering. The first part covers the initial value problem (IVP), error analysis, single step, multistep method as well as the system of ordinary differential equation (ODE). The second part covers finite difference method (FDM) in boundary value problem (BVP). A simple irregular boundary is introduced. The third part covers the finite element method (FEM) with applications focus on heat problem as well as eigenvalues calculation for dynamic finite element analysis. The last part covers finite volume method (FVM) in two-dimension diffusion equation. Truncation error is discussed.

MSCJ 1543/SSCM5703 (PRISMS): ADVANCED PARTIAL DIFFERENTIAL EQUATIONS

This course introduces the basic elements of the various solutions techniques for solving the partial differential equations. The solution methods include the method of characteristics, separation of variables, Laplace and Fourier transforms, perturbation and asymptotic methods. Topics include Laplace’s equations, Green’s functions and theorem. Each student will be required to do small project so that they gain experience in the implementation of the method for specific applications.

MSCJ 1733 : SOLITON AND NONLINEAR WAVES

The course introduces students to the basic theories and principles of soliton and nonlinear wave. It will examine some underlying general concepts related to solitons and nonlinear wave equations. These include topics in linear waves, certain nonlinear equations of evolutions, methods of solutions, soliton interaction, general equation of evolution, group velocity and nonlinear waves. The course is designed to facilitate students acquiring knowledge and understanding on principles and techniques of solving nonlinear wave equations and interpreting physically the resulting solutions.

MSCM 1143 : FLUID MECHANICS AND HEAT TRANSFER

This course aims to equip students with the required skills to develop mathematical models for incompressible fluid flow and heat transfer problems. Emphasis is on the derivation of the governing equations of motion for fluid flows and heat transfer in forced, free and mixed convection. The approximate and exact solutions obtained using an appropriate analytical method are discussed. These include the Oseen and Stokes flows and the boundary layer flows in various situations.

MSCJ 1763 : MODELING OF DYNAMICAL SYSTEMS

This course provides insight and practice in how dynamical system models can be used to better understand the real process in many areas of engineering. The focus will be on formulating models, model analysis, using numerical tools to comprehend models and drawing conclusions based on model outcomes. The course consists of first, an introduction to modeling, basic model elements, analytical modeling, and model linearization. The second is about types of model including Linear graph, State model, Frequency-Domain Model, Transfer-Function Linear Graphs block Diagram and State-Space Model, System analysis, parameter estimation and Simulation. The students will also experience a series of case studies that emphasis both on how to build a model of a system (application), mathematical analysis (technique), and how numerical solutions increase understanding of the system. Most of the concepts and examples will be supplemented with Mathlab-based code. Solving the case study will involve a combination of mathematical analysis and numerical solution in MATLAB.

MSCJ 1773 : GENERALIZED LINEAR MODELS WITH ENGINEERING APPLICATIONS

This course provides an overview of generalized linear models, which extend the linear modelling framework to allow response variables that are not Normally distributed. The course comprises lectures and practical sessions using R. The course content reviews the general linear model and considers its restrictions, motivating the development of generalized linear models (GLMs). An overview of the theory of GLMs is given, including estimation and inference. The application for this course considers the use of GLMs in engineering problems with different types of data consisting of continuous, binary and counts.

MSCJ 1280 : RESEARCH PROPOSAL

Students are required to execute a thorough literature review under an identified supervisor in an agreeable field of chemistry and produce a written proposal on their findings. Students will gather information on chosen topics through literature survey/review activities, construct research methodology, anticipate expected results, write current findings, and references. Finally, students are required to submit a research proposal and a draft project/research report comprising of Title, Introduction, Statement of Problem, Research Objectives, Literature Survey/Review, Research Methodology, Expected Findings, Conclusion and References.

MSCJ XY80 : DISSERTATION

Dissertation is a follow-up research work to Research Methodology. At the end of the semester the student will be required to submit a research dissertation based on the research topic that would be assigned and approved by the postgraduate committee. Topics must be related to ongoing research projects carried out in the FKA, FKM, FKE or Mathematics Department. The committee will only approve topics, which have substantial combination of mathematics and engineering aspects. Many areas of applied mathematics such as fluid dynamics, magneto hydrodynamics and wave phenomena can be considered for this research project.

DISSERTATION CODES

CODE	NAME	STUDENT'S SEMESTER
MSCJ 2180	DISSERTATION	3
MSCJ 2280	DISSERTATION	4
MSCJ 3180	DISSERTATION	5
MSCJ 3280	DISSERTATION	6
MSCJ 4180	DISSERTATION	7
MSCJ 4280	DISSERTATION	8

Guidelines for Dissertation codes:

MSCJ XY80
X – year of study ;
Y – 1st or 2nd semester;

PHYSICS

MSCP1303: RESEARCH METHODOLOGY

This course is to provide a platform for furtherance to knowledge with regards to research skills. It consists of introduction (problem statement, objective, and scope), literature review, methodology and expected results. Students are required to attend lectures on research methodology and information retrieval. At the end of the course, students are required to submit a research proposal of not more than 1,500 words (50 pages) and defend their research proposal orally. Students must take this subject before they are allowed to proceed to register Dissertation Course.

MSCP1203: ADVANCED QUANTUM MECHANICS

This course reinforces the basic quantum mechanics at the postgraduate level and extends further topics to the course. Basic formalism of quantum mechanics will be reviewed. Harmonic oscillators, hydrogen atoms and identical particles will be covered. The approximation methods which include perturbation theory, variational principle and WKB approximation will be studied. Lastly scattering theory will be discussed.

MSCP1403: ELECTRODYNAMICS

Electromagnetic Theory (EMT) is fundamentally involved everywhere and is perhaps one of the largest branches of modern physics. The course starts with a brief introduction in explaining the basic notions of electromagnetic wave equations, their solution in different mediums and Poynting theorem. The state of polarization, dispersion, reflection, refraction, and scattering will be explored in depth. Theory of gauge, waveguides, covariant formulation, conservation laws, power loss and electromagnetic field generation are the recurring themes. Finally, the theory of vector and scalar potentials, moving charges, multi-pole fields and their detailed applications will be presented.

MSCP1503: ADVANCED SOLID-STATE PHYSICS

This course is an extension of the introductory course on solid state physics and will be bridging the gap between basic solid-state physics and quantum theory of solids. The basic concepts in solid state physics with emphasis on roles of phonon and electrons in a solid by using various models will be introduced. Students will be introduced to the theory of magnetism and ferromagnetism, magnetic ordering, and spin waves. Students will be able to understand the many-body interactions, Green's function method including the Hartree-Fock approximation and Landau's fermi liquid theory. In addition, students will be exposed to semiclassical theory of electron and electrodynamics of metals. In the superconductivity topic, students will focus on Cooper pair, BCS and microscopic theory of superconductivity before proceeding to quantum hall effect.

MSCP1113: MATERIALS CHARACTERIZATION AND ANALYSIS I

Introduction to advanced analytical techniques in all branches of physics. In this part I course, students will get working knowledge on advanced tools related to optical, thermal, structure and electrical characterisations. Students will be familiar with Photoluminescence Spectroscopy (PL), UV-Vis-NIR Spectroscopy, Abbe Refractometer for optical characterisation. Thermal properties of material analyse using DTA and DTG will be covered. Raman Spectroscopy, FTIR Spectroscopy, Nuclear Magnetic Resonance (NMR), Electron Spin Resonance (ESR), X-ray Diffractometer (XRD), X-ray Reflectivity (XRR) will be discussed in detail. They will acquire good understanding on the I-V and C-V measurement of bulk materials and nanomaterials for electrical characterisation. In addition, post analysis using selected software will be practised to translate results obtained into meaningful information.

MSCP1213: MATERIALS CHARACTERIZATION AND ANALYSIS II

This course is a continuation of Material Characterization and Analysis I. This course will discuss material characterisation techniques which are based on microscopy approaches and their related analytical techniques. Students will get working knowledge on advanced tools like, Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Scanning Tunnelling Microscopy (STM) and Atomic Force Microscopy (AFM). Complementary analytical techniques related to above instruments such as Energy Dispersive X-ray Spectroscopy, Electron Energy Loss Spectroscopy (EELS), X-ray Photoelectron Spectroscopy (XPS), Auger Spectroscopy and Electron Diffraction will be learned in detail. Analysis of results to obtain desired information using several software will be trained.

MSCP1313: ADVANCED CONDENSED MATTER PHYSICS

This course is an extension of the introductory course on condensed matter physics. The basic concepts in solid state physics with emphasis on roles of phonon and electrons in a solid by using various models and some of the basic concepts of introductory condensed matter physics will be revisited. Students will be introduced to fermi liquid theory including the Hartree-Fock approximation and Landau's fermi liquid theory. In addition, students will be able to understand the idea of elementary theories and basic principles of condensed matter physics including band structure theory and many-body theory in addition to the advanced concepts of condensed matter. Students will acquire working knowledge on electronic structure, the physical nature of magnetism, glasses, spintronics and glass dielectric. In the superconductivity topic, students will focus on superfluid, Bose-Einstein condensate, gauge symmetry breaking and high temperature superconductivity before proceeding to quantum hall effect. Students will be introduced to the theory of magnetism and ferromagnetism, glass, spintronics, dielectric diamagnetic and paramagnetic response in solids through a semi-classical approach. In addition, students will be exposed to nanostructures and their properties, nano photonics, and varieties of applications of nano systems in modern devices.

MSCP1123: ELEMENTARY PARTICLES

This course is designed to expose student to understand the most fundamental components of nature using the quark model and their recent experimental development. Some topics of interest would be: the quantum number, spin, parity and charge conjugation involved in formation of baryons and mesons by combination of quarks, interactions between particles will be dealt with in terms of the four types of forces and the exchange of particles between them including the conservation theory of various interactions and draw them using Feynman diagram, the recent experimental updates on particle detectors, accelerators and data interpretation, also included in the course will be remarks on physics beyond the standard model of physics. At the end of the course, the student will be exposed to the understanding of the unification theory of forces which incorporate the mechanics of the strong, weak, and electromagnetic interactions into a single theory.

MSCP1223: NUCLEAR TECHNIQUES AND ANALYSES

This course is divided into two main parts which are radioactivity analysis and nuclear techniques. Radioactivity analysis focuses on the techniques and principles used to measure the disintegration rates of radioactive nuclides and the types and energies of radiation emanating from radionuclides. Meanwhile, nuclear techniques play an important role in many facets of our daily life and are an integral part of our socioeconomic development. Despite the perception that nuclear activity is unsafe due to the occurrence of several accidents, nuclear techniques serve a great number of beneficial applications for health, welfare, and the environment. This course will discuss various nuclear techniques and their applications in various industrial fields.

MSCP1133: COMPUTATIONAL SPACE PHYSICS

This course is designed for students who have a reasonably good foundation in basic physics and mathematics. Students will be introduced to the concepts, principles and methods in space physics which includes modelling and observation of the space environment. The basic topics such as the interaction between space plasma and electromagnetic waves will be introduced to explain the space environment. An observation of space plasma using satellites and magnetohydrodynamics modelling are embedded in this course. Finally, advanced data analytics, processing, handling, visualization, and distribution of large data sets will be introduced.

MSCP1233: SCIENTIFIC COMPUTING

This course will introduce the general computational techniques used in physics. This starts with an introduction to Schrodinger's Equation and its numerical solutions. The discussion will then move to numerical solutions to perturbation theory, variational calculations, diffusion, Monte Carlo simulations, Genetic Algorithms and Molecular Dynamics. Each theory discussed will include the hands-on session to strengthen student understanding.

MSCP1333: SEMICONDUCTOR DEVICES FABRICATION

This course is designed to focus on the theoretical concepts, properties, characteristics, fabrication process, building blocks and materials and operating principle of the semiconductor devices. The fabrication process such as crystal growth, doping process, lithography, deposition, implantation, etching, metallization, and contact materials of the semiconductor will be covered through a series of lectures, experimental works, and project-based assignment. The latest fabrication process technology using UV, e-beam and x-ray lithography also will be discussed. The characteristics of p-n junction, Schottky contact/diode and metal-semiconductor (m-s) junction also will be analysed in detail. This will be followed by the investigation of materials requirement, basic building block and operating principle of the selected semiconductor devices. Finally, micro-nano materials, micro-nano electronics, and micro-nano devices/sensors (e.g., MEMS-NEMS) will be explored toward the end of this course.

MSCP1143: LASER-MATTER INTERACTION

Laser matter interaction emphasizes the practical applications in modern materials and material applications. The course starts with a brief introduction in explaining the basic of laser and laser optics. Laser-material interaction and laser-plasma interaction will be explored. The recent advances in smart and nano scaled materials will be explored in detail employing ultrashort laser pulses in sophisticated material processing. Finally, creating nanostructures with lasers will be presented.

MSCP1243: ADVANCED FIBRE OPTICS

This course aims to provide a deeper understanding of nonlinear phenomena in optical fibres. In-depth knowledge of optical fibre as a light guiding medium is vital for understanding most other areas of optical fibre technology (telecommunications, sensors). Fundamentals of propagation of light through optical fibre will be introduced. Knowledge of optical materials as a fundamental tool for understanding optical fibre, including their various types and fabrication will be covered. The operating principles and key properties of a variety of optical fibre will be followed by technologies relating to fibre fabrication and fibre characterization.

MSCP1103: MATHEMATICAL METHODS FOR PHYSICS

This course reinforces the basic mathematical concepts widely used in Physics through short reviews on vector analysis, complex analysis, and differential equations. Then, the topics extended into areas such as Helmholtz's theorem, Cauchy's integral theorem and Green's function. Bessel, Legendre, Hermite and Laguerre functions will be explored in detail and its application in physical problems will be discussed. Finally, Fourier and Laplace transforms will be covered.

MSCP1180: RESEARCH PROPOSAL

Students are required to execute a thorough literature review under an appointed supervisor and produce a written proposal on their findings. Students will gather information on chosen topics through literature survey/review activities, construct research methodology, anticipate expected results, write current findings, and references. Finally, students are required to submit a research proposal and a draft project/research report comprising of Title, Introduction, Statement of Problem, Research Objectives, Literature Survey/Review, Research Methodology, Expected Findings, Conclusion and References.

MSCP2180: DISSERTATION

All students are required to undertake a MSc dissertation project in the field of specialization that they have chosen. A qualified faculty academician will be assigned as the student's supervisor according to the research field. Students are expected to devote their time fully for conducting research work throughout the semester. In the case whereby the research is to be undertaken outside the University, the student will be assigned an internal and an external supervisor. Students are required to submit a dissertation and sit for an oral examination (viva voce) at the end of the course. Students may also be required to submit a technical paper for publication in a scientific journal.

DISSERTATION CODES

COURSE CODE	COURSE NAME	STUDENT'S SEMESTER
MSCP 2180	DISSERTATION	3
MSCP 2280	DISSERTATION	4
MSCP 3180	DISSERTATION	5
MSCP 3280	DISSERTATION	6
MSCP 4180	DISSERTATION	7
MSCP 4280	DISSERTATION	8

Guidelines for Dissertation codes:

MSCP XY80
X – year of study ;
Y – 1st or 2nd semester;

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