UNIVERSITI TEKNOLOGI MALAYSIA

Faculty of Science
POSTGRADUATE
HANDBOOK

www.science.utm.my

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Attention

All information in this version of the guide are 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 2018/2019 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.

For further information, please contact:

Dean
Faculty of Science
Universiti Teknologi Malaysia
81310 UTM Johor Bahru
JOHOR DARUL TAKZIM

Telephone No.: 07 - 553 4000
Fax No.: 07 – 556 6162
E-mail: dekan.fs@utm.my
Website: science.utm.my

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A MESSAGE FROM THE DEAN

السلام عليكم ورحمة الله

Salam 1Malaysia

In the name of Almighty Allah and His Messenger who taught us the meaning of life, I would like to welcome all of you to the UTM Campus and the Faculty of Science.

The Faculty of Science, Universiti Teknologi Malaysia fosters future scientists and technologists with the zeal to learn and contribute to society and human kind. The faculty's motto, ***Q- LEAP***, explains the commitment of the staff and students in the endeavour of teaching and learning. The faculty aims at producing scientists and technologists with fundamental academic skills in theory and practice for the advancement of a modern way of life.

It is our mission to develop professionals with a global perspective , who are willing to take an active role in the progress of science and technology. The faculty encourages international interactions through participation of the students in intellectual discourses with international academicians in the Faculty.The Global Outreach Program of the university provides an excellent opportunity for students to travel and learn from their counterparts all over the world.

The university is always looking towards excellence in its programmes. Postgraduates must publish their work in impact journals as part of their graduation requirement. This is an important skill and asset for our graduates to be recognized anywhere in the world, especially by highly ranked universities. In addition, we provide the skills of learning new ideas; designing and perfecting experimental techniques, as well as performing correct data analysis and critical thinking.

Our goal at the Faculty of Science, Universiti Teknologi Malaysia, is to equip you with both the skills and self-confidence to begin your journey and ***Q-LEAP with us!***

Thank you. *Wassalam.*

PROFESOR DR. ABDULL RAHIM B. MOHD YUSOFF
Dean
Faculty of Science, UTM

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 instituition, 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 Instituition 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.

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 Internaltional Campus, Jalan Semarak, Kuala Lumpur. 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 5 faculties and 2 faculty-level schools in UTM International Campus, Kuala Lumpur, as follows:

a. Faculty of Science
b. Faculty of Engineering
c. Faculty of Built Environment and Surveying
d. Faculty of Humanities and Social Sciences
e. Azman Hashim International Business School
f. Razak Faculty of Engineering, Technology and Informatics
g. Malaysia-Japan International Institute of Technology (MJIIT)

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

PHILOSOPHY, VISION, MISSION AND MOTTO OF UTM

PHILOSOPHY

The divine law of Allah is the foundation for science and technology. UTM strives with total and unified effort to attain excellence in science and technology for universal peace and prosperity in accordance with His will.

VISION

To be recognized as a world-class centre of academic and technological excellence.

MISSION

To be a leader in the development of human capital and innovative technologies that will contribute to the nation's wealth creation.

MOTTO

"KERANA TUHAN UNTUK MANUSIA"

In the Name of God for Mankind.

FACULTY OF SCIENCE IN BRIEF

Year		Event
1972	-	The Science Service Unit teachings of 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 establised 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 Deaprtments 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 Bioscience Department previously from Faculty of Biosciences and Medical Engineering merged together with Faculty of Science.

VISION, MISSION, SLOGAN AND OBJECTIVES OF THE FACULTY

VISION

To be a world-renowned Faculty in the advancement of Science and Mathematics.

MISSION

To be a leader in the development of human capital and technology through the generation and dissemination of scientific and mathematical knowledge by quality teaching and learning, innovative research and scholarly publications for the well-being of mankind and the environment.

SLOGAN

...Where great minds are nurtured.

OBJECTIVES

- To provide quality academic programmes in Science and Mathematics, meeting both local and global education needs.
- To facilitate the dissemination of knowledge in Science and Mathematics through innovative and effective teaching and learning.
- To produce competent and versatile graduates guided by high moral and ethical values.
- To undertake frontier and transformative research and development in Biology, Chemistry, Physics, and Mathematics.
- To engage in interdisciplinary and collaborative research.
- To provide an environment conducive to the exchange of knowledge, views, and innovative ideas.
- To contribute to the advancement of knowledge through scholarly publications.
- To engage in science-based smart partnerships and global networking.
- To contribute to the generation of the nation's wealth through research and innovation.
- To contribute to the improvement of quality of life, protection of the environment and conservation of natural resources.

BUSINESS, STATEMENT OF OPPORTUNITY, CORE COMPETENCIES, CUSTOMER CHARTER

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..

CORE COMPETENCIES

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 Information Technology Manager, one Laboratory Manager, one Deputy Registrar and three Assistant Registrars.

Dean
Professor Dr. Abdull Rahim Hj. Mohd Yusoff
B. Sc. (Hons) (Liverpool), M.Phill (Newcastle), Ph.D (Loughborough)

Deputy Dean (Academic)
Associate Professor Dr. Fadhilah Yusof
B.Sc., M.Sc. (Indiana State), Ph.D (UTM)

Deputy Dean (Research, Innovation, Development & Alumni)
Associate Professor Dr. Zaiton Abdul Majid
B.Sc.(Hons) (UTM), M.Sc. (NIU), Ph.D (Malaya),

Assistant Dean (External & Global Engagement)
Professor Dr. Fahrul Zaman B. Huyop
B.Sc.(Hons) (Cardiff), M.Sc. (Bristol, UK), Ph.D (Leicester, UK),

Assistant Dean (Quality & Strategy)
Associate Professor Dr. Normah Bt Maan
B.Sc.(Hons) (Sheffield), M.Sc. , Ph.D (UTM),

Assistant Dean (Continuing & TNE)
Dr. Mohd Bakri B. Bakar
B.Sc.(Hons) (UTM), M.Sc. (UTM), Ph.D (TCDublin),

Director (Chemistry)
Associate Professor Dr. Shajarahtunnur Binti Jamil
B.Sc.(Hons) (UKM), M.Sc. (UTM), Ph.D (UTM),

Director (Physics)
Associate Professor Dr. Wan Muhamad Saridan Wan Hassan
B.Sc. Ed. (Hons) (UTM), M.Sc. (California), Ph.D (Aberdeen)

Director (Mathematical Science)
Associate Professor Dr. Sharidan Shafie
B.Sc. (Hons), M.Sc., Ph.D (UTM)

Director (Biosciences)
Associate Professor Dr. Shafinaz Bt Shahir
B.Sc. (Australia), M.Sc. (UTM), Ph.D (UK)

Lab Manager
Dr. Alina Wagiran
B.Sc. (UM), M. Phill. (Reading, UK), Ph.D (UKM)

Deputy Registrar
Mdm. Nor Azlinda Abu Bakar

Assistant Registrar
Mdm. Syahida Fadilla Moktar
B.Sc. (UTM)

Assistant Registrar
Mdm. Hamidah Mat Arif
B.Sc. (UUM)

Assistant Registrar
Mr. Kiflee Jimpi
B.Sc. (UTM)

The organizational structure of the Faculty of Science is illustrated in the next page.

At present, the Faculty consists of four major divisions:-
i Physics Department
ii Chemistry Department
iii Mathematical Science Department
iv Bioscience Department

Academic Coordinator

Research Program Coordinator (Bioscience) - PhD
Assoc. Prof. Dr. Goh Kian Mau
B.Eng. (UTM), Ph.D (UTM)

Research Program Coordinator (Bioscience) - Master
Dr. Mohd Helmi Sani
B.Sc. (Hons) (IIUM), M.Sc. (UM), Ph.D (United Kingdom)

Mixed Mode Program Coordinator (Biotecnology)
Dr. Wan Rosniza Zana Wan Dagang
B.Eng. (UTM), M.Eng. (UTM), Ph.D (United Kingdom)

Research Program Coordinator (Physics)
Dr.Wan Nurulhuda Wan Shamsuri
B.Sc. (United Kingdom), M.Sc. (UTM), Ph.D (UTM)

Mixed Mode Program Coordinator (Physics)
Dr.Koh Meng Hock
B.Sc. (UTM), M.Sc. (UM), Ph.D (UTM-University of Bordeaux)

Research Program Coordinator (Chemistry)
Dr.Siti Aminah Setu@Sabtu
B.Sc. (UTM), Ph.D (United Kingdom)

Mixed Mode Program Coordinator (Chemistry)
Dr. Khairil Juhanni Abd Karim
B.Eng. (Japan), M.Eng. (Japan), Ph.D (Australia)

Mixed Mode Program Coordinator (Forensic Science)
Dr. Naji Arafat Mahat
B. Biomed.Sc. (Hons)(UKM), M.Sc. (Australia), Ph.D. (USM)

Research Program Coordinator (Mathematics)
Dr. Fuaad Mohd Siam
B.Sc. (UTM), M.Sc. (UTM), Ph.D (United Kingdom)

Mixed Mode Program Coordinator (Mathematics)
Dr. Hazzirah Izzati Mat Hassim
B.Sc. (UTM), Ph.D (UTM)

Mixed Mode Program Coordinator (Engineering Mathematics)
Dr. Yeak Su Hoe
B.Sc. (UTM), M.Sc. (UTM), Ph.D (Singapore)

The Faculty of Science is the largest faculty in UTM in terms of the number of academic staff. Currently, the Faculty has 173 highly qualified and experienced academic staff, assissted by 123 dedicated and hardworking supporting staff.

In terms of facilities and equipments, the Faculty has 2 lecture halls, 25 lecture rooms, 6 computer laboratories under the management of the Department of Mathematical Sciences, 32 laboratories/workshops in the Department of Physics, which are used for teaching and research, 65 laboratories, which are used for teaching and scientific research projects, in the Department of Chemistry, and 44 laboratories, which are used for teaching and scientific research projects, in the Department of Biosciences.


innovative • entrepreneurial • global
MANAGEMENT
Faculty of Science
Prof. Dr.
Abdull Rahim B. Mohd Yusoff
DEAN
Prof. Dr.
Fadhilah Bt Yusof
DEPUTY DEAN
(Academic & Student Affairs)
Assoc. Prof.
Dr. Zaiton Bt Abdul Majid
DEPUTY DEAN
(Research, Innovation, Development & Alumni)
Assoc. Prof.
Dr. Wan Muhamad Saridan B. Wan Hassan
DIRECTOR
(Physics)
Assoc. Prof.
Dr. Shajarahtunnur Bt. Jamil
DIRECTOR
(Chemistry)
Assoc. Prof.
Dr. Sharidan B. Shafie
DIRECTOR
(Mathematical Sciences)
Assoc. Prof.
Dr. Shafinaz Bt. Shahir
DIRECTOR
(Biosciences)
Dr. Mohd Bakri B. Bakar
ASSISTANT DEAN
(Continuing & TNE)
Dr. Ezza Syuhada Bt. Sazali
ASSISTANT DEAN
(External & Global Engagements)
Assoc. Prof.
Dr. Normah Bt Maan
ASSISTANT DEAN
(Quality & Strategy)
Dr. Alina Bt Wagiran
LAB MANAGER
Mr. Mohd Zainudin B. Abd. Karim
IT MANAGER
Mdm. Hjh. Nor Azlinda Bt. Abu Bakar
DEPUTY REGISTRAR
Mr. Kiflee B. Jimpi
ASSISTANT REGISTRAR
Mdm. Syahida Fadilla Bt. Moktar
ASSISTANT REGISTRAR
Mdm. Hamidah Bt Mat Arif
ASSISTANT REGISTRAR

POSTGRADUATE STUDENT SOCIETY, FACULTY OF SCIENCE (PGSSFS)

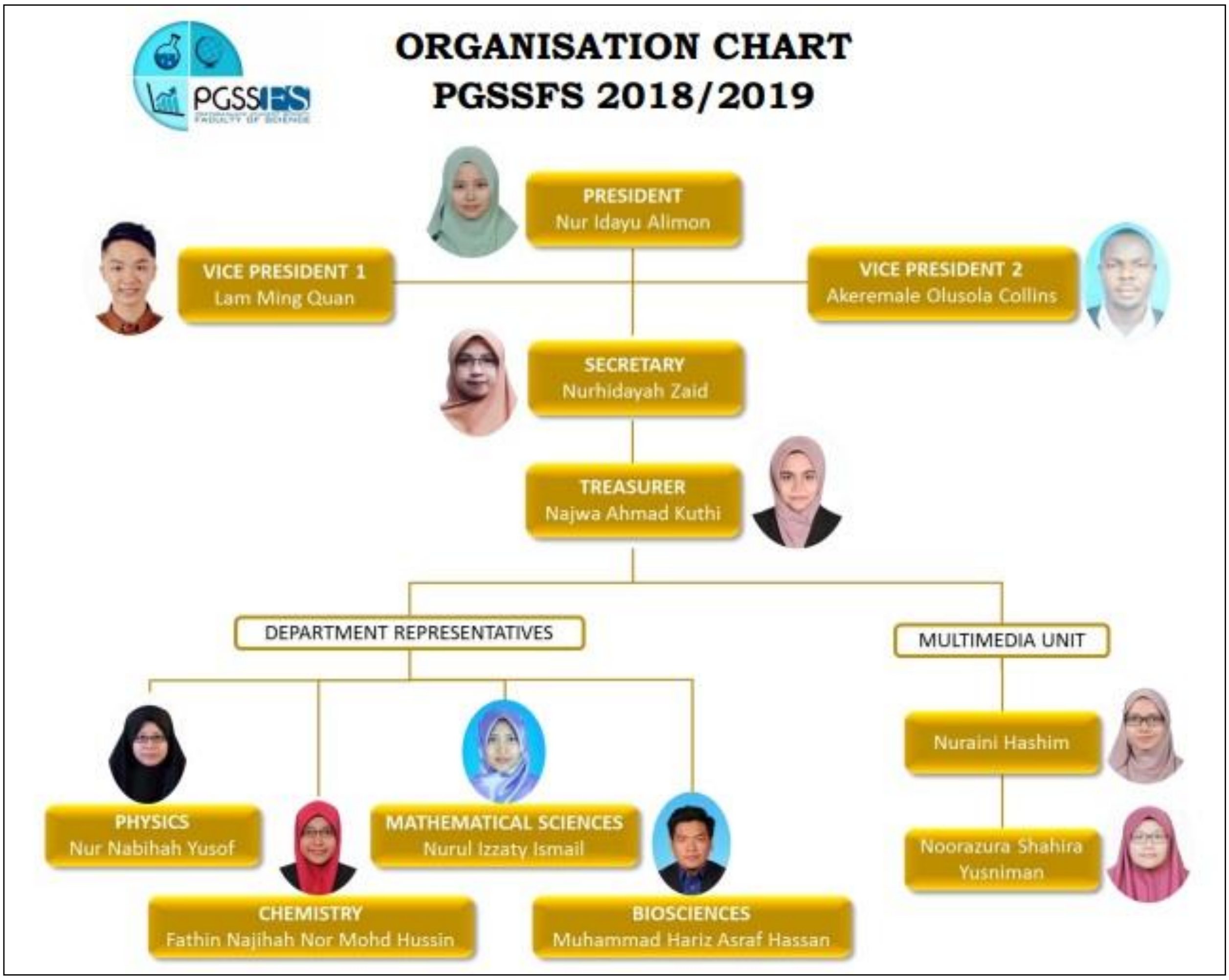
The Postgraduate Student Association, Faculty of Science (PoSAFS) which is also known in the Graduate School (SPS) as the Postgraduate Student Society, Faculty of Science (PGSSFS) is a representative society which is concerned with all the interests of postgraduate students at Faculty of Science, UTM. The members of PGSSFS are selected by a polling process during the Annual General Meeting (AGM). PGSSFS is more than simply a student society : it exists to voice the needs of all Master and PhD students in the Faculty.

Vision

The vision of PGSSFS is to be the voice of postgraduate students in the Faculty, and act as a bridge between FS administration/staff and postgraduate students of Faculty of Science.

Objectives

1. To represent and promote the interests of its members, as a whole, in all matters, both within the Faculty and beyond.
2. To provide a means of communication between members and the Faculty Authorities and between the members and any other body.
3. To offer support to members during their programme of study.
4. To promote co-operation amongst members for educational, social, and cultural activities and such other purposes as are beneficial to the community.



POSTGRADUATE RESEARCH

Academic staffs in the Faculty of Science are very active in research. Some of the research areas are as follows:

CHEMISTRY	MATHEMATICS
• biotechnology • catalysis • chemometrics • computational chemistry • environmental chemistry • forensic science • nanostructured materials • natural products • organic synthesis • organometallics • polymer electrolytes • Separation science • solid state chemistry • zeolites	• Algebra and Analysis, • Applied and Computational Mathematics • Numerical Analysis • Statistics and Operational Research
PHYSICS	**BIOSCIENCE**
• material physics • nuclear and radiation physics • optical physics • space physics	• Biocatalysis and Fermentation Technology • Biofuel and Renewable Energy • Bioinformatics and Molecular Modelling • Biosensor Technology • Environmental Bioengineering Research • Materials for Biology and Medical Application • Medical Biotechnology • Molecular and Plant Biotechnology

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
- CO2 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
- Luminescence UV-Vis Spectrophotometer
- Seed Storage Chamber
- Pelletizer Bailing Granulator
- Electrochemistry Startup System
- 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 encourage to participate in activities organized by the Postgraduate Student Society (PGSSFS) or the Chemistry Postgraduate Students Club (Chem Club). Apart from that, students also have access to the department Postgraduate Activity Room which is equipped with computers and internet facilities.

POSTGRADUATE PROGRAMMES

MODES OF STUDY

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

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

TAUGHT COURSE AND RESEARCH (MIXED MODE)

The Taught Course and Research (Mixed Mode) programme is offered for the master's programme only. In this mode, the candidate must complete a minimum of 40 credits and must obtain a final Cumulative Grade Point Average (CGPA) of at least 3.0 on a scale of 4.0. The minimum 40-credit Taught Course and Research (Mixed Mode) consists of several courses including the faculty compulsory, faculty electives, a University elective and a Master's dissertation.

RESEARCH (R)

A Masters or Doctor of Philosophy candidate is supervised by one or more graduate faculty staff who holds a PhD and/or a minimum an Associate Professor post. 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 institution 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 Masters or PhD thesis submitted at the completion of study.

TYPES OF PROGRAMMES

Mainstream programmes are programmes offered on weekdays at the UTM Johor Bahru main campus or UTM Kuala Lumpur International Campus. External or off-campus programmes are conducted on weekends at the UTM Johor Bahru main campus or UTM Kuala Lumpur International Campus.

External programmes are designed to cater for executives and working professionals as well as specific target groups. UTM also conducts the programmes at strategic locations around the country, in the vicinity of the workplaces of candidates. Majority of these programmes are offered as Taught Course and Research (Mixed Mode) Master's programmes (unless stated otherwise).

POSTGRADUATE PROGRAMMES OF THE FACULTY OF SCIENCE

The Faculty of Science currently offers 14 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 are **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 Masters Degree, students may register either for the Masters by Research Programme or Masters by Taught Course and Research (Mixed Mode).

No.	Program Name	Modes of Study
1	Master of Science Specialization : Chemistry	Taught Course and Research
2	Master of Science Specialization : Forensic Science	Taught Course and Research
3	Master of Science Specialization : Mathematics	Taught Course and Research
4	Master of Science Specialization : Engineering Mathematics	Taught Course and Research
5	Master of Science Specialization : Physics	Taught Course and Research
6	Master of Science Specialization: Biotechnology	Taught Course and Research
7	Master of Philosophy Field of Research : Chemistry	Research
8	Master of Philosophy Field of Research : Mathematics	Research
9	Master of Philosophy Field of Research : Physics	Research
10	Master of Philosophy Field of Research : Bioscience	Research
11	Doctor of Philosophy Field of Research : Chemistry	Research
12	Doctor of Philosophy Field of Research : Mathematics	Research
13	Doctor of Philosophy Field of Research : Physics	Research
14	Doctor of Philosophy Field of Research : Bioscience	Research

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

- **UHAP 6013** : Seminar on Global Development, Economic and Social Issues
- **UICW 6023** : Philosophy of Science and Civilization
- **UPPF 6023** : Dynamics of Leadership

In addition, International students are required to take 3 credit hours of the following university courses:

- **UHAZ 6123** : Malaysian Society and Culture (international students of non-Malay race)
- **UHAZ 6323** : Bahasa Malaysia Penulisan Ilmiah (international students of Malay race)

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

- **USCP 0010** : Research Methodology (HW)

MASTER OF PHILOSOPHY (M.PHIL) AND DOCTOR OF PHILOSOPHY (PH.D)

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 referred 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 12. 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 and description for different programmes

CHEMISTRY	MATHEMATICS	PHYSICS	BIOSCIENCE	DESCRIPTION
MSCK 1100	MSCM 1100	MSCF 1100	MMBB 1100	Research
MSCK 1200	MSCM 1200	MSCF 1200	MMBB 1200	Research
MSCK 2100	MSCM 2100	MSCF 2100	MMBB 2100	Research
MSCK 2200	MSCM 2200	MSCF 2200	MMBB 2200	Research
MSCK 3100	MSCM 3100	MSCF 3100	MMBB 3100	Research
MSCK 3200	MSCM 3200	MSCF 3200	MMBB 3200	Research
MSCK 4100	MSCM 4100	MSCF 4100	MMBB 4100	Research
MSCK 4200	MSCM 4200	MSCF 4200	MMBB 4200	Research

PhD by Research course codes and description for different programmes

CHEMISTRY	MATHEMATICS	PHYSICS	BIOSCIENCE	DESCRIPTION
PSCK 1100	PSCM 1100	PSCF 1100	PMBB 1100	Research
PSCK 1200	PSCM 1200	PSCF 1200	PMBB 1200	Research
PSCK 2100	PSCM 2100	PSCF 2100	PMBB 2100	Research
PSCK 2200	PSCM 2200	PSCF 2200	PMBB 2200	Research
PSCK 3100	PSCM 3100	PSCF 3100	PMBB 3100	Research
PSCK 3200	PSCM 3200	PSCF 3200	PMBB 3200	Research
PSCK 4100	PSCM 4100	PSCF 4100	PMBB 4100	Research
PSCK 4200	PSCM 4200	PSCF 4200	PMBB 4200	Research

PSCK 5100	PSCM 5100	PSCF 5100	PMBB 5100	Research
PSCK 5200	PSCM 5200	PSCF 5200	PMBB 5200	Research
PSCK 6100	PSCM 6100	PSCF 6100	PMBB 6100	Research
PSCK 6200	PSCM 6200	PSCF 6200	PMBB 6200	Research
PSCK 7100	PSCM 7100	PSCF 7100	PMBB 7100	Research
PSCK 7200	PSCM 7200	PSCF 7200	PMBB 7200	Research
PSCK 8100	PSCM 8100	PSCF 8100	PMBB 8100	Research
PSCK 8200	PSCM 8200	PSCF 8200	PMBB 8200	Research

For the **M.Phil** programmes in Chemistry, Mathematics, Physics and Bioscience, the subject code for research is given as MSCK wxyz, MSCM wxyz, MSCF wxyz and MMBB wxyz respectively.

For the **PhD** programmes in Chemistry, Mathematics, Physics and Bioscience, the subject code for research is given as PSCK wxyz, PSCM wxyz, PSCF wxyz, and PMBB 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, 0

MASTER OF SCIENCE (M.Sc)

Programmes By Taught Course and Research (Mixed Mode) (Full-time and Part-time)

General Information

Students have to take at least 42 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	

ADMISSION REQUIREMENTS

In order to ensure the quality and integrity of the programmes both the mainstream and off-campus or external programmes maintain the following entry requirements:

ENTRY REQUIREMENT

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 a 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.

For further information, please refer admission.utm.my.

APPLICATION CLOSING DATES

POSTGRADUATE ADMISSION

Postgraduate student may APPLY ONLINE at any time, however closing date for study by mixed-mode is on **30 November and 30 June**. Application received after the closing date will be offered for next registration.

February Admission (Semester II)
Closing date is on **31st December**

September Admission (Semester I)
Closing date is on **31st July**

MASTER AND PhD BY RESEARCH

Application for Master and PhD by research-mode is open throughout the year and registration will be on **February, May, September and November.** However, candidate can registered at any time at the Student Recruitment and Admission Division office at Block F54, UTM Johor Bahru or School of Graduate Studies, Level 8, Menara Razak, UTM Kuala Lumpur.

CHEMISTRY PROGRAMMES

MASTER OF SCIENCE
SPECIALIZATION : CHEMISTRY
– by Taught Course and Research (Mixed Mode)

This is a 3-semester full-time programme, which comprises 42 credits that include 3 physics core courses (9 credits), 2 elective courses (6 credits), 1 University course (3 credits), Research Methodology and Dissertations (21 credits). Typical distributions of courses are as follows:

SEMESTER 1

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

SEMESTER 2

COURSE CODE	COURSE	CREDIT
MSCK 1613	Advanced Organic Chemistry	3
MSCK 1xx3	*Elective Course*	3
MSCK 1xx3	*Elective Course*	3
Total		**9**

x = a code number

SEMESTER 3

COURSE CODE	COURSE	CREDIT
MSCK xx80	Dissertation	**21**

TOTAL CREDITS	**42**

The course code for dissertation is given as **MSCK XY80/XY90**
'X' refers to the year and 'Y' refers to the semester in which the student is enrolled
'8' refers to full time students and **'9'** refers to part time students
Note : Dissertation can only be taken after completion of all courses

LIST OF COURSES
Core Chemistry Courses

COURSE CODE	COURSE	CREDIT
MSCK 1413	Advanced Physical Chemistry	3
MSCK 1613	Advanced Organic Chemistry	3
MSCK 1713	Advanced Inorganic Chemistry	3

Elective Courses

COURSE CODE	COURSE	CREDIT
MSCK 1213	Advanced Analytical Chemistry	3
MSCK 1243	Advanced Separation Methods	3
MSCK 1263	Advanced Electroanalytical Chemistry	3
MSCK 1323	Advanced Biochemistry	3
MSCK 1333	Advanced Biotechnology	3
MSCK 1443	Advanced Solid State Chemistry	3
MSCK 1463	Quantum Chemistry and Spectroscopy	3
MSCK 1473	Advanced Surface and Colloid Chemistry	3
MSCK 1653	Advanced Organic Spectroscopy	3
MSCK 1723	Characterisation of Inorganic Compounds	3
MSCK 1743	Bioinorganic Chemistry	3
MSCK 1753	Inorganic Reaction Mechanism	3

Please refer to **Appendix A** for the synopses of courses.

SPECIAL ADMISSION REQUIREMENTS

A Bachelor's Degree in Chemistry or in a related field with good honours from any recognized institution of Higher learning;

OR

An equivalent Bachelor's Degree with at least two years working experience relevant to Chemistry.

MASTER OF SCIENCE
SPECIALIZATION IN FORENSIC SCIENCE (MIXED-MODE)
– by Taught Course and Research (Mixed Mode)

This is a 3-semester full-time programme comprising a total of 42 credits that include five core courses (12 credits), one elective course (3 credits), one research methodology course (3 credits), one University compulsory course (3 credits) and Forensic research project and dissertation (21 credits). The following is a typical course distribution for the MSc Taught Course and Research (Mixed Mode) in Forensic Science:

SEMESTER 1

COURSE CODE	COURSE	CREDIT
MSCN 1803	Forensic Evidence and the Aspects of Law *Bukti Forensik dan Aspek Perundangan*	3
MSCN 1853	Forensic Practical *Amali Forensik*	3
MSCN 1303	Research Methodology *Kaedah Penyelidikan*	3
MSCN 19X3	Forensic Elective *Elektif Forensik*	3
	Total credits	**12**

SEMESTER 2

COURSE CODE	COURSE	CREDIT
MSCN 1823	Forensic Chemistry *Kimia Forensik*	3
MSCN 1813	Forensic Analytical Instrumentation *Analisis Berinstrumen Forensik*	3
MSCN 1830	Expert Testimony and Moot Court *Keterangan Pakar dalam Mahkamah*	HW**
UHAX 6XX3	University Compulsory Course *KursusWajibUniversiti*	3
	Total credits	**9**

x = a code number
** HW = Attendance is compulsory

SEMESTER 3

COURSE CODE	COURSE	CREDIT
MSCN XX80/XX90	Dissertation *Dissertasi*	21
	Total credits	**21**

Note : Dissertation can only be enrolledupon completion of all courses from semester 1 and semester 2.

LIST OF ELECTIVE COURSES

COURSE CODE	COURSE	CREDIT
MSCN 1913	Crime Scene Investigation *Siasatan Tempat Jenayah*	3
MSCN 1923	Biological Aspects of Forensic Sciences *Aspek Biologi Sains Forensik*	3
MSCN 1933	Examination of Questioned Documents *Pemeriksaan Dokumen yang dipertikaikan*	3
MSCN 1943	Quality Assurance in Forensic Science *Jaminan Kualiti dalam Sains Forensik*	3
MSCN 1953	Forensic Engineering *Kejuruteraan Forensik*	3
MSCN 1963	Computer Forensics *Komputer Forensik*	3
MSCN 1973	Fire and Explosion Investigation *Siasatan Kebakaran dan Letupan*	3
MSCN 1983	Firearms and Forensic Ballistics *Senjata dan Balistik forensik*	3
MSCN 1993	Forensic Toxicology and Drugs of Abuse *Toksikologi Forensik dan Dadah yang disalahgunakan*	3

SPECIAL ADMISSION REQUIREMENTS

A Bachelor of Science (Chemistry, Industrial Chemistry, Forensic Science, Applied Science, Health Science or related courses) with CPA ≥ 3.0 from any institution of higher learning recognized by the Senate

OR

Bachelor of Science or equivalent and recognized with CPA> 2.7 and work experience for at least two years in related field.

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.

MASTER OF PHILOSOPHY AND DOCTOR OF PHILOSOPHY
FIELD OF RESEARCH: CHEMISTRY
- By Research (Full time)

The Department of Chemistry offers two research based programmes leading to the Masters and PhD degrees in Chemistry. These programmes served to those who are interested in research and require in-depth knowledge and experience in chemistry through individual and specialised research projects. The programmes allow the students to acquire advanced knowledge in their fields of interest. Students will work in outstanding facilities together with experienced academic supervisors.

PhD candidates are also required to present seminar related to their research findings as part of their training. They are also required to publish papers in indexed journals.

All research students are required to attend Compulsory Department Courses as follows during their 1st and 2nd semester (at least one of the course for PhD student)

For PhD programme, students are completing to present at national or international conference

All PhD student are required to take any 2 courses (status :HS offered) by master MSCK Mixed Mode.
(*refer to Msc : Chemistry by Taught Course & Research*)

AREAS OF RESEARCH

The Department of Chemistry has more than 50 active researchers with the following research areas:

1. Environmental Chemistry: Water quality, environmental monitoring, modelling.
2. Analytical Techniques: Spectroscopy, Electroanalysis, Chromatography and Capillary Electrophoresis.
3. Hybrid and mesoporous materials for microextractions
4. Forensic Analysis: Forensic Chemistry, serology, toxicology and Entomology
5. Natural products chemistry: phytochemicals, essential oil and bioactivities
6. Organic Synthesis: Synthesis and reactions of macrocyclics, polymers and bioactive natural compounds.
7. Synthesis, characterisation and mechanistic studies of metal complexes, metal oxides and nano materials
8. Photophysical and photochemical studies of processes and surface properties.
9. Fuel cells and batteries.
10. Zeolites and mesostructured materials and application
11. Extraction of metals using bacteria and bioremediation of metals
12. Production of pigments from bacteria
13. Chitosan chemistry and its application
14. Chemometrics and computer aided chemistry

MATHEMATIC PROGRAMMES

MASTER OF SCIENCE
SPECIALIZATION: MATHEMATICS
- by Taught Course and Research (Mixed Mode)

This is a 3-semester full-time course comprising a total of 42 credits that include 2 mathematics core subjects (6 credits), 3 elective mathematics subjects (9 credits), Research Methodology (3 credits), university subject (3 credits) and Dissertation (21 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:

SEMESTER 1

COURSE CODE	COURSE	CREDIT
MSCM1043	Mathematical Methods I	3
MSCM1XY3	Elective mathematics subject	3
MSCM1XY3	Elective mathematics subject	3
**Uxxx 6XY3	University compulsory subject	3
Total		**12**

**University compulsory subject

SEMESTER 2

COURSE CODE	COURSE	CREDIT
MSCM1053	Computational Mathematics	3
MSCM1XY3	Elective mathematics subject	3
MSCM1033	Research Methodology	3
Total		**9**

SEMESTER 3

COURSE CODE	COURSE	CREDIT
MSCMXYZ0	Dissertation	21

Total credits	**42**

X – year of study ;
Y – 1st or 2nd semester;
Z – 8 if full time, 9 if part time;

LIST OF COURSES

Core courses

COURSE CODE	COURSE	CREDITS
MSCM1043	Mathematical Methods I	3
MSCM1053	Computational Mathematics	3
MSCM1033	Research Methodology	3
MSCM XYZ0	Dissertation	21

Elective courses

COURSE CODE	COURSE	CREDITS
MSCM 1113	Advanced Engineering Mathematics	3
MSCM 1123	Theoretical Mechanics	3
MSCM 1133	Solitons & Nonlinear Waves	3
MSCM 1143	Fluid Mechanics and Heat Transfer	3
MSCM 1153	Applied and Computational Complex Analysis	3
MSCM 1163	Mathematical Methods II	3
MSCM 1173	Partial Differential Equations	3
MSCM 1213	Group Theory I	3
MSCM 1223	Galois Theory	3
MSCM 1233	Mathematical Analysis	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 1393	Numerical Linear Algebra	3
MSCM 1333	Finite Element Methods	3
MSCM 1353	Parallel Computing	3
MSCM 1363	Numerical Integral Equation	3
MSCM 1413	Mathematical Statistics	3
MSCM 1423	Probability Theory	3
MSCM 1433	Stochastic Processes	3
MSCM 1453	Generalized Linear Models	3
MSCM 1463	Time Series	3
MSCM 1473	Multivariate Statistical Analysis	3
MSCM 1613	Advanced Optimization Techniques	3
MSCM 1623	Mathematics of Operations Research	3
MSCM 1633	Game Theory	3
MSCM 1643	recognized Heuristic Optimization Methods	3
MSCM 1663	Supply Chain Modelling	3

Please refer to **Appendix C** for the synopsis of each course.

SPECIAL ADMISSION REQUIREMENTS

A degree of Bachelor of Science or Bachelor of Education (Mathematics) with good honours in a related field,

OR

A degree of Bachelor of Science or Bachelor of Education (Mathematics), with at least two years job experience in related fields.

MASTER OF SCIENCE
SPECIALIZATION: ENGINEERING MATHEMATICS
- by Taught Course and Research (Mixed Mode)

This is a 3-semester full-time course, which comprises 42 credits that include 2 mathematics core subjects (6 credits), 1 mathematics elective subject, 2 elective engineering subjects (6 credits), 1 University subject (3 credits) and Dissertation (21 credits). Typical distribution of subjects beginning in Semester 1 are as follows:

SEMESTER 1

COURSE CODE	COURSE	CREDIT
MSCJ1523	Methods of Engineering Mathematics	3
MSCJ1533	Numerical Methods in Engineering	3
ULAJ XYZ3**	Elective Foreign Language	3
Mxxx XYZ3	Elective Course (Mathematics or Engineering)	3
Total Credits		**12**

** University compulsory subject

SEMESTER 2

COURSE CODE	COURSE	CREDIT
MSCJ 1033	Research Methodology	3
Mxxx XYZ3	Elective Course (Mathematics or Engineering)	3
Mxxx XYZ3	Elective Course (Mathematics or Engineering)	3
Total Credits		**9**

SEMESTER 3

COURSE CODE	COURSE	CREDIT
MSCJ XYZ0	Dissertation	21
Total Credits		**21**

X – year of study ;
Y – 1^{st} or 2^{nd} semester;
Z – 8 if full time, 9 if part time;

Specialized topics for the projects are selected from on going research projects carried out in the Engineering Faculties or in the Department of Mathematics. Topics will have substantial combination of mathematics and engineering aspects. Students will conduct this research project, demonstrating their ability to critically evaluate existing research literature, to place the research into a theoretical and practical context and to exhibit knowledge and understanding of Engineering Mathematics.

LIST OF COURSES

Core Courses

COURSE CODE	COURSES	CREDITS
ULAJ 6013**	Japanese Language	3
MSCJ 1523	Methods of Engineering Mathematics	3
MSCJ 1533	Numerical Methods in Engineering	3
MSCJ 1033	Research Methodology	3
MSCJ XY80/ MSCJ XY90	Dissertation	21

** University Compulsory Courses

Elective Courses

COURSE CODE	COURSES	CREDITS
Mathematics Electives		
MSCJ 1513	Partial Differential Equations	3
MSCJ 1753	Fluids Mechanics and Heat Transfer	3
MSCJ 1733	Soliton and Nonlinear Waves	3
MSCJ 1713	Statistical Modelling and Simulation	3
Civil Engineering Electives		
MKAB 9073	Environmental Modelling	3
MKAE 1133	Water Pollution Control	3
MKAG1043	Geotechnical Modeling	3
MKAH 1243	Groundwater Hydrology	3
MKAH 1253	Groundwater Modelling	3
MKAH 1313	Computational Fluid Mechanics	3
MKAS 1163	Theory of Plate and Shell	3
Electrical Engineering Electives		
MKEM 1773	Multivariable and Optimal Control Systems	3
MKEM 1833	Linear System Theory	3
MKEM 1853	Discrete Time and Computer Control Systems	3
MKEL 1223	Random Process	3
MKEL 1233	Image Processing	3
Mechanical Engineering Electives		
MMP 1603	CAD/CAM	3
MKMM 1113	Computational Methods for Engineers	3
MKMM 1213	Advanced Engineering Mathematics	3
MKMM 1153	Computational Methods in Solid Mechanics	3
MKMM 1183	Theories of Elasticity and Plasticity	3
MKMM 1543	CAD and its Applications	3

Please refer to **Appendix D** for the synopsis of each subject.

SPECIAL ADMISSION REQUIREMENTS

A degree of Bachelor of Science or Bachelor of Engineering with good honours in a related field,

OR

A recognized degree of Bachelor of Science or Bachelor of Engineering, with at least two years job experience in related fields.

MASTER OF PHILOSOPHY AND DOCTOR OF PHILOSOPHY
FIELD OF RESEARCH: MATHEMATICS
- By Research (Full time)

The Department of Mathematics has expertise in the areas of research listed below. Attendance at Departmental Seminars are compulsory and research students are strongly encouraged to write for publications in indexed journals and presentations at conferences. To increase knowledge in a particular topic, they can attend suitable lectures offered in the M.Sc by Taught Course and Research (Mixed Mode) programme.

AREAS OF RESEARCH

Algebra and Analysis

1. Fuzzy Mathematics and Its Applications: Fuzzy Modelling of Neuro Magnetic Field, Fuzzy Approach for Multivariable Control Systems; Algebraic and Topological Views of Fuzzy Models.
2. Algebraic Computation: Modular Technique, GCD of Generalized Polynomials, Algebraic Geometry Techniques and its Applications.
3. Group Theory and its Applications: Capability of Groups, Nonabelian Tensor Squares, Homological Functors, Probability Theory in Group Theory.
4. Formal Language Theory and its Applications: Splicing Systems and DNA.
5. Vector Bundles.
6. Representation Theory

Applied Mathematics

1. Non-linear Waves: Forced Soliton, Optical Soliton, Surface Waves, Waves Groups.
2. Spin Waves.
3. Theoritical and Computational Fluid Dynamics: Boundary Layer Flows, Low-Gravity, Physiological Flows.
4. Applied and Computational Complex Analysis: Conformal Mapping, Complex Boundary Value Problems.
5. Special Functions.
6. Modelling of Mass Transfer Processes in the RDC Column.
7. Functional Integral in Mathematical Physics.
8. Fuzzy Delay Differential Equations

Numerical Analysis and Computational Mathematics

1. Boundary Value Problems : Finite Element Methods, Boundary Element Methods.
2. Intergral Equation Approach for Numerical Conformal Mapping and the Solution of Riemann Problems.
3. Stiff Differential Equations.
4. Differential Quadrature Method, Meshless Method, Multiscale Technique, Parallel Computing
5. Molecular Modelling
6. Computational Quantum Mechanics

Operations Research

1. Systems Optimization: Nonlinear Optimal Control Algorithm, Hierarchical Optimal Control
2. Routing: VLSI design, Mobile Computing, Wireless Networks, Parallel Computing Systems
3. Scheduling: Multiprocessor Scheduling, Job-shop, Vehicle Routing
4. Location Analysis
5. Financial Mathematics, Game Theory Applications
6. Heuristics Methods for Optimization
7. Numerical Optimization of Nonlinear Functions

Statistics

1. Time Series: Flood Modelling; Extreme Value Distributions.
2. Multivariate Analysis: Detection of Multiple Outliers, Missing Data.
3. Linear Models : Energy Forecasting, Performance Evaluation Methods.
4. Stochastic Processes

PHYSICS PROGRAMMES

MASTER OF SCIENCE
SPECIALIZATION: PHYSICS
- by Taught Course and Research (Mixed Mode)

This is a 3-semester full-time programme, which comprises 42 credits that include 3 physics core courses (9 credits), 2 elective courses (6 credits), 1 University course (3 credits), Research Methodology and Dissertations (21 credits). Typical distributions of courses are as follows:

SEMESTER 1

COURSE CODE	COURSE	CREDIT
MSCF 1113	Quantum Mechanics	3
MSCF 1423	Semiconducting Bulk Materials	3
MSCF 1xx3	Elective Course	3
UHAx 6xx3	University compulsory subject	3
MSCF 1010	Seminar	HW**
Total		**12**

SEMESTER 2

COURSE CODE	COURSE	CREDIT
MSCF 1143	Electrodynamics	3
MSCF 1xx3	Elective Course	3
MSCF 1813	Research Methodology	3
MSCF 1020	Seminar	HW**
Total		**9**

** HW = Attendance is compulsory

SEMESTER 3

COURSE CODE	COURSE	CREDIT
MSCF 2180/ MSCF 2190	Dissertation (full time) / Dissertation (part time)	21
Total		**21**

* Dissertation Codes: xx8x = full time, xx9x = part time

ELECTIVE COURSES

COURSE CODE	COURSES	CREDIT
MSCF 1123	Elementary Particles	3
MSCF 1313	Acoustic & Ultrasonics	3
MSCF 1413	Analytical Techniques	3
MSCF 1433	Semiconductor Devices	3
MSCF 1443	Thin Film Physics	3
MSCF 1453	Non-Crystalline Solid	3
MSCF 1463	Phase Transformation	3
MSCF 1513	Optoelectronics	3

Please refer to **Appendix E** for synopsis of each course.

MASTER OF PHILOSOPHY AND DOCTOR OF PHILOSOPHY
FIELD OF RESEARCH: PHYSICS
- By Research (Full time)

Department of Physics offers research programmes leading to MSc and PhD degree for students who wish to excel in their academic excellence. To ensure that the quality of the project is always up to standard, every student is required to present their project outcome that is evaluated by a panel of experts in the related area. This usually takes place in the third semester. On completion of the project, the candidates are required to submit their thesis for evaluation by external and internal examiners appointed by the Faculty.

PhD candidates are also required to present seminar related to their research findings as part of their training. They are also required to publish papers in indexed journals.

All research students are required to attend Compulsory Department Courses as follows during their 1st and 2nd semester (at least one of the course for PhD student)

COURSE CODE	COURSES	CREDIT
MSCF 1133	Advanced Numerical Method and Modelling	HS
MSCF 1473	Advanced Spectroscopic Technique	HS
MSCF 1483	Advanced Condensed Matter	HS

AREAS OF RESEARCH

The Department of Physics has more than 50 active researchers with the following research areas:

Material physics
- Characterization of surface structures: IR, Raman, NMR
- Materials: Thin-film, bioceramics, glass, phosphor, functional
- Solid Oxide Fuel Cell
- Solar cells

Nuclear & radiation physics
- Environmental radioactivity monitoring and nuclear siting
- Medical physics/imaging by gamma and x-rays
- Neutrino physics
- Nuclear safety/security assessment
- Nuclear structure and reaction
- Nuclear waste materials
- Radiation dosimetry

Scientific computing & instrumentation
- Condensed matter physics using ab-initio and Monte Carlo method (quantum and classical)
- Nano device simulations (quantum cascade lasers, photodetectors, organic light emitting diode (OLED), single electron transistor (SET) and quantum dots (QDs)
- Space plasma physics, focusing on ionospheric irregularities using GPS/GNSS, radar, optical imager and satellite in-situ measurement
- Electromagnetic simulation using FDTD for ground penetrating radar (GPR), waveguides/transmission lines, gradient coils dielectric properties of mixtures
- Designing semiconductor quantum well heterostructures for nonlinear optics applications
- Quantum Computing based on Electron Spin Resonance (ESR)

Optical physics

Areas of research

1) Advanced Fiber Optics
    - Light-guiding phenomenon in optical fiber
    - Studies of Optical nonlinear effects in optical fiber
    - Studies of signal amplification and lasing in gain optical fiber
    - Development of advanced sensors based on glass and plastic optical fiber for various applications

2) Laser matter interaction
    - Studies of Laser–Particle Interaction and Plasma Formation
    - Studies of collisional and resonance absorption of light
    - Particle Acceleration in an Intense Laser Field and its effects

BIOSCIENCE PROGRAMMES

MASTER OF SCIENCE
SPECIALIZATION : BIOTECHNOLOGY
– by Taught Course and Research (Mixed Mode)

Master of Science Specialization Biotechnology programme by mixed mode (taught course and research). The programme is offered as full-time. Full time programme can be completed within three semesters (1½ years).

Students are required to successfully complete a minimum of 42 credits which include at least:

(a) six core courses (18 credits)
(b) one compulsory university course (HW*)
(c) one university elective course (3 credits) and
(d) dissertation (21 credits).

ASSESSMENTS

Project dissertation has to be submitted at the end of the respective semesters. Course assessment will be conducted via direct (examination, tests, quizzes) and indirect (peer assessment) methods. Generic skills will be incorporated during teaching and learning process. Synopsis of course is available in **Appendix F**.

COURSE DISTRIBUTIONS

The courses are categorized as university electives, core programmes and elective programmes, such as the followings.

SEMESTER 1

CODE	COURSE	CREDIT	PRE-REQUISITE
UMBP 0013	Research Methodology	HW*	-
MMBT 1713	Bioinformatics	3	
MMBT 1173	Biochemistry and Microbial Physiology	3	Microbiology, Biochemistry, Molecular Biology
MMBT 1153	Molecular Mechanisms in GeneExpression and Regulation	3	Microbiology, Biochemistry, Molecular Biology
MMBT 1683	Protein Engineering	3	Enzyme Technology
	Total credits	12	

*HW = Hadir Wajib/Compulsory Courses

SEMESTER 2

CODE	COURSE	CREDIT	PRE-REQUISITE
UHX XXX3	University Elective Course	3	-
MMBT 1233	Industrial Technology & Bioreactor Design	3	Microbiology, Biochemistry, Molecular Biology
MMBT 1563	Environmental Bioengineering	3	Microbiology, Biochemistry, Molecular Biology
MMBT 1280	Dissertation	6	
	Total credits	15	

*To be selected from the list provided by SPS; X = a code number

SEMESTER 3

CODE	COURSE	CREDIT	PRE-REQUISITE
MMBT 2180	Dissertation	15	
	Total credits	15	

SPECIAL ADMISSION REQUIREMENTS

Bachelor of Science (Biology, Biochemistry, Biotechnology, Microbiology, Bioscience, Chemistry, Chemical Engineering, Bioprocess Engineering, Environmental Engineering, Genetics or equivalent) with CPA ≥ 3.0 will be considered for this programme;

OR

Bachelor of Science with CPA < 3.0 and one year working experience in areas related to Biotechnology.

MASTER OF PHILOSOPHY
FIELD OF RESEARCH : BIOSCIENCE
- By Research (Full Time)

The Department of Biosciences offers Master of Philosophy program by research. This program is offered as a full-time. A student will carry out research in any one of the areas of research chosen. Each research project is supervised by a lecturer of the Graduate Faculty. A Graduate Faculty member is an academic staff who has a doctoral degree qualification or an academic staff who holds an academic post at least senior lecturer and is involved directly or indirectly in the postgraduate programs. Co-supervisor may also come from a related industry.

ASSESSMENT

Assessment is done by examining **first assessment reports** (research proposal), **second assessment report** (mini-viva), each semester's **progress reports**, and **thesis examination** (viva-voce). All students registered for MPhil programmes must undergo the first assessment by presenting their research proposal, and the second assessment (mini-viva) by presenting their on-going research's progress in regards to their research proposal. Students who opted for the double degree programme must undergo the first assessment at their home university and only the second assessment at their partner university. To be inaugurated by any degree, all students must undergo thesis examination which can be done at least two-months after the second assessment. The first assessment and the second assessment are scheduled according to the student's appropriate semester of study as described below:

TASK	FULL TIME
First Assessment (Proposal)	Week 10/11 (Semester 1 or 2)
Second Assessment (Mini-Viva)	Week 10/11 (Semester 2 or 3)
Progress report	Week 12 (Every semester)
Notice of Thesis Submission	Students who are submitting the final draft of their thesis should send in the Notice of Thesis Submission to the Faculty at least 3 months prior to the date of submitting their thesis.

ADDITIONAL REQUIREMENTS

In addition to the university compulsory courses, research students may be required to attend lectures related to their research fields. The courses to be taken shall be determined by the respective department graduate committee from time to time. As part of their training, students are required to present in seminars and conferences, as well as producing technical reports or papers for publications in proceedings or journals.

SPECIAL ADMISSION REQUIREMENTS

Bachelor of Science (Biology, Biochemistry, Biotechnology, Microbiology, Bioscience, Plant Sciences, Chemistry, Chemical Engineering, Bioprocess Engineering, Environmental Engineering, Genetics or equivalent) with CPA $\geq$3.0 will be considered for this programme;

OR

Bachelor of Science with CPA $<$ 3.0 and one year working experience in areas related to Biotechnology

DOCTOR OF PHILOSOPHY
FIELD OF RESEARCH : BIOSCIENCE
- By Research (Full Time)

The Department of Biosciences offers Doctor of Philosophy program by research. This program is offered as a full-time. A student will carry out research in any one of the areas of research chosen. Each research project is supervised by a lecturer of the Graduate Faculty. A Graduate Faculty member is an academic staff who has a doctoral degree qualification or an academic staff who holds an academic post at least senior lecturer and is involved directly or indirectly in the postgraduate programs. Co-supervisor may also come from a related industry.

ASSESSMENT

Assessment is done by examining first assessment report and presentation (research proposal), each semester's progress reports, second assessment report and presentation (mini viva) and thesis examination (viva voce). All PhD students must undergo first assessment report and presentation by presenting their research proposal. They also must undergo **second assessment report and presentation** (mini viva) at the middle of their study to present their progress. The first and second assessments are scheduled according to the student's appropriate semester of study as described below:

TASK	FULL TIME
First Assessment (Proposal)	Week 10/11 (Semester 2)
Second Assessment (mini-Viva)	Week 10/11 (Semester 3 or 4)
Progress report	Week 12 (Every semester)
Notice of Thesis Submission	Students who are submitting the final draft of their thesis should send in the Notice of Thesis Submission to the Faculty at least 3 months prior to the date of submitting their thesis.

ADDITIONAL REQUIREMENTS

In addition to the university compulsory courses, research students may be required to attend lectures related to their research fields. The courses to be taken shall be determined by the respective department graduate committee from time to time. As part of their training, students are required to present in seminars and conferences, as well as producing technical reports or papers for publications in proceedings or journals.

SPECIAL ADMISSION REQUIREMENTS

Master of Science (Biology, Botany, Plant Sciences, Biochemistry, Biotechnology, Microbiology, Bioscience, Chemistry, Chemical Engineering, Bioprocess Engineering, Environmental Engineering, Genetics or equivalent) with CPA ≥ 3.0 will be considered for this program;

OR

Other qualifications equivalent to a Master's degree and experience in the relevant field recognized 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.

APPENDIX A

CHEMISTRY– SYNOPSES OF COURSES

MSCK 1413: ADVANCED PHYSICAL CHEMISTRY

This course presents the principles and methodology for materials preparation and characterization. In particular, 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 in the solid state scope 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 1613:ADVANCED ORGANIC CHEMISTRY

This course discusses the advanced concepts of organic chemistry. These include stereochemistry analysis of enantiomers, diastereomers and meso compounds. Conformations analysis of acyclic and cyclic compounds and asymmetric synthesis will be introduced. Types of organic reactions and mechanisms of reactions such as oxidation-reduction, substitution, elimination, condensation and rearrangement will also be included.

MSCK1713:ADVANCED INORGANIC CHEMISTRY

This course is offered as a core subject for students under Masters of Science Program by mixed mode. The course will cover on Classification of Advanced Inorganic Compounds. Coordination compounds: metal-carbonyl, metal-imine, metal-phosphine, metal-hydride, metal-nitrosyl. Organometallic compounds: Complex sigma: metal-alkyl and metal-aryl. Complex sigma/pi: metal-alkane, metal-alkene, metal-alkyene, metal-allyl and metal-cyclopentadiene. Cluster compounds. Synthesis, Reaction and Characterization of coordination compounds. Primary reactions of Organometallic compounds: ligand substitution, addition-oxidation/ reduction-elimination, insertion, and coordinated ligand reactions. Characterization of organometallic compounds. The students will be given a group assignment related to the topics discussed during lectures and an oral presentation will be executed.

MSCK1303/USCP0010 :RESEARCH METHODOLOGY

This course provides students with the necessary background knowledge on Research Methodology to enable them to identify, evaluate, and select an appropriate topic for a postgraduate research project. Students will be guided to find appropriate literature resources relevant to the chosen topic; prepare a concise, synthesized and critical literature review with appropriate references and free of plagiarism, formulate problem statement, purpose statement and research objectives and develop an appropriate research design for a study. At the end of the course, students are required to prepare and present a research proposal.

MSCKXY80/ MSCK XY90: DISSERTATION

Students must have completed the Research Methodology Course (MSCK 1303) and pass all coursework courses before they are allowed to register for this course. In this course students will implement the research proposal prepared in MSCK1303.Students will conduct research workina chemistry laboratory, computer lab or a validated laboratory/company under the guidance of supervisor. At the end of the course,each student is required to submit the final research dissertation and sit for an oral examination via viva voce.

MSCK1213: ADVANCED ANALYTICAL CHEMISTRY

This course covers technical aspectsand applications of analytical separation methods, spectroscopy and analytical electrochemistry for qualitative and quantitative analysis. 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. Analytical electrochemistry covers the development and applications of finite-current-controlled techniques including linear sweep and cyclic voltammetry, pulse and differential pulse voltammetry, stripping analysis and chemical sensors with emphasis on chemically modified electrodes.

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 Ultra Performance Liquid Chromatography (UPLC), advances in Capillary Electrophoresis (CE), Hydrophilic Interaction Liquid Chromatography (HILIC), Tandem mass spectrometry (MS/MS), and Nanomaterials in Microextraction techniques, 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 provide students with an understanding of the principles of analytical electrochemistry. Fundamental aspects of electrode reactions and structure of the interfacial region and application of electrode reactions to electrochemical characterization are included. Major electroanalytical techniques will be discussed including potentiometry, amperometry, polarography, cyclic voltammetry, pulse and differential pulse voltammetry, square wave voltammetry, and stripping analysis. Introduction to the principles of chemical and biochemical sensors will also be discussed. Recent trends in electroanalysis.

MSCK1323 :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.

MSCK1333 : ADVANCED BIOTECHNOLOGY

This course discusses on 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 based on information obtained from reputable journals.

MSCK1463 :QUANTUM CHEMISTRY ANDSPECTROSCOPY

This course discusses 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.

MSCK1473 : ADVANCEDSURFACE 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 familiarize the students with the fundamentals of surface and colloid chemistry, adsorption isotherms and the application of interfacial phenomena to technologies reliant upon colloid and surface science such as in environmental remediation, detergency, biological systems, food, and agriculture. Attempting to better understand these technologies gives the impetus to investigate the underlying theories, principles and methods of surface and colloid and chemistry. Upon completion, students should be able to develop and apply knowledge in describing processes related to interfacial phenomena.

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) and circular dichroism (CD) as well as mass spectrometry (MS) technique including EIMS, CIMS and FABMS will also be discussed

MSCK1743 :BIOINORGANIC CHEMISTRY

Bioinorganic chemistry is the study of inorganic species especially metal ions in biological system. The course will begin with the principles of coordination chemistry and a survey of biological molecules and ligands. Study on metalloproteins: metal storage and transport; dioxygen transport in mammals and lower organisms. Electron transfer in biology: iron cytochromes, and iron-sulfur clusters. Metalloenzymes: copper enzymes, zinc enzymes and hydrolytic enzymes Vitamin B_{12}, nitrogenases and hydrogenases and the use of metal complexes as therapeutic agents.

MSCK1753 :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

APPENDIX B

FORENSIC SCIENCE – SYNOPSES OF COURSES

MSCN 1303 : RESEARCH METHODOLOGY

This course provides students with the necessary background knowledge on Research Methodology to enable them to identify, evaluate, and select an appropriate topic for a postgraduate research project. Students will be guided to find appropriate literature resources relevant to the chosen topic; prepare a concise, synthesized and critical literature review with appropriate references and free of plagiarism, formulate problem statement, purpose statement and research objectives and develop an appropriate research design for a study. At the end of the course, students are required to prepare and present a forensic research proposal

MSCN XX80/MSN XX90 : DISSERTATION

Students must have completed the Research Methodology course (MSCN 1303) before they are allowed to register for this course. In this course students will implement the research proposal prepared in MSCN 1303. Students will conduct research work in a forensic chemistry laboratory, computer lab or a validated laboratory/external forensic institution. At the end of the course, each student is required to submit the final research dissertation and sit for an oral examination via viva voce. In addition, each student is also required to write and submit at least one technical paper for publication in a scientific journal

MSCN 1853 : FORENSIC PRACTICAL

This course covers the practical areas of forensic chemistry and serology related to the theory which has been presented 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.

MSCN 1803 : FORENSIC EVIDENCE AND THE ASPECTS OF LAW

This course introduces forensic science. It also 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.

MSCN 1813 : FORENSIC ANALYTICAL INSTRUMENTATION

This course provides the basic principles and application of various instrumental methods to the examination of physical evidence, including microscopy, spectrophotometric and chromatographic techniques, electrophoresis and mass spectrometry, as well as specific forensic analytical apparatus like Video Spectral Comparator.

MSCN 1823 : FORENSIC CHEMISTRY

This course covers the principal areas of forensic chemistry - trace evidence and alcohol analysis. Included also are statistics and data analysis, as well as sample preparation and current analytical techniques. Case examples will also be presented and discussed.

MSCN 1830 : EXPERT TESTIMONY & MOOT COURT

This course enables the student to prepare and present evidence in a simulated court - being cross examined by trial attorneys.

MSCN 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.

MSCN 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.

MSCN 1933 : EXAMINATION OF QUESTIONED DOCUMENTS

This course covers aspects relating to the work of Questioned Document Examiners, Historical Dating, Fraud Investigations, Paper & Ink analysis, Document Forgery Handwriting and Typewriting Analysis.

MSCN 1943 : QUALITY ASSURANCE IN FORENSIC SCIENCE

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.

MSCN 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.

MSCN 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.

MSCN 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.

MSCN 1983 : FIREARMS AND FORENSIC BALLISTICS

This course covers aspects of the forensic firearms examination and ballistics. *Inter alia*, these aspects include the class characteristics of firearms, the individual characteristics imparted by firing a weapon, gunshot residue detections as well as estimation of the distance of the shot.

MSCN 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.

APPENDIX C

MATHEMATICS – SYNOPSES OF COURSES

MSCM 1043 : MATHEMATICAL METHODS I

The course discusses special functions comprising of Appel's symbol, Vandermonde's theorem, Hypergeometric series, Gamma function, analyticity, limit formulas, reciprocal of the Gamma function, duplication theorem, Eurler's reflection formula and the solutions of various important differential equations expressible in terms of the hypergeometric series. The course also covers integral transforms such as the Laplace transform and Fourier transform. The properties of transformations, the inversion integrals, Bromwich integral, Calculus of Residues and the application of integral transforms to initial or boundary value problems of engineering science are also considered. Topics on conformal mapping, invariance of Laplace Equation and Dirichlet problem and Poisson Integral formula are also to be included in the course materials.

MSCM 1053 : COMPUTATIONAL MATHEMATICS

The course begins with introducing the software stuctures which include concepts, conventions that support object-oriented programming, identification of class structure, problem partitioning, and abstraction. Students will be exposed to components of object-oriented language using C++ to algorithmic program design such as objects, methods and events, as well as program control that include abstraction of data, variable types, arrays, functions and pointers. The course provide opportunities to students to develop user inferface using Visual C++ for visualizing the problems as well as their solutions. C++ techniques for providing solutions to numerical-intensive mathematical problems, design of algorithms and schematic techniques in solving numerical problems, scientific problem modeling and simulation, and graphical-user interface design for data visualization will also be discussed. The students' programming skills are challenged by solving case studies and developing software on selected problems in numerical methods, graph theory and discrete-event simulations

MSCM 1233 : 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 emphasize on the applications of Banach Fixed Point Theorem to system of linear equations (Jacobi and Gauss-Siedal iterations), differential equations (Picard's existence and uniqeness theorem) and integral equations (Fredholm integral equation and Volterra integral equation).

MSCM 1113 : ADVANCED ENGINEERING MATHEMATICS

The course begins with the pertubation 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 pertubation problems and singular pertubation problems. The course will also touch on the solutions of trancendental equations and the solutions of initial value problems. In addition regular pertubation 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 pertubation 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 deals with three parts: the mechanics of particles and rigid bodies, oscillations and wave motions and analytical mechanics of material systems whose behaviour is governed by Newton's Law of Motion. The mechanics of particles and rigid bodies: The course begins with Newton's Law of Motion. Emphasis is given to ideas of conservation of linear and angular momentum, energy, and to the relation between these conservation laws and Newton's Laws. These laws are formulated in general vector notation, and applications include a study on planetary motion. The notions of inertial and non-inertial frames are discussed and illustrated by considering motion relative to the rotating earth. The discussion of rigid body problems is mainly concerned with planar motions but somenon planar motions will also be considered. Oscillations and wave motions: Discussion on simple harmonic motion which is later generalised to include frictional damping, forcing terms and nonlinear effects. Emphasis will be put on demonstrating unification obtained as a result of the mathematical formulation of a variety of physical phenomena. The analysis will be extended to study a variety of harmonic and more general wave motion. Analytical mechanics of material systems: Attention is given to the advanced mathematical developments of the subject that are due, especially to Lagrange and Hamilton. The applications considered include such diverse problems as the dynamics of crystal (atomic) structures, the solar system and gyroscopes. Classical mechanics is a key subject in scientific enquiry; and it is, moreover, the gateway to the study of many important subjects in applied mathematics (fluid mechanics, solid mechanics, control theory) and mathematical physics.

MSCM 1133 : SOLITONS & NONLINEAR WAVES

The course introduces student to the basic theories and principles of nonlinear waves. It will examine some underlying general concepts related to solitons and nonlinear waves equations. These include topics in linear waves, some nonlinear equations of evolutions, soliton interaction, general equation of evolution, group velocity and nonlinear waves.

MSCM 1143 : FLUID MECHANICS AND HEAT TRANSFER

This course aims to equip students with the required skills to develop mathematical models for fluid flow and heat transfer problems, and the ability to interpret their solutions and physical meanings. 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 methods of solutions in the limiting case of low and high Reynolds number flows 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 Laurent series, residue theory, conformal mapping and their applications. Topics include Laurent series (with applications to Bessel function and Fourier series), residue theory (with applications to improper integrals and summing of series), numerical complex integration, conformal mapping (bilinear transformation, symmetry principle, Schwarz-Christoffel transformation, Riemann map) with applications in solving boundary value problems of science and engineering. This course also integrates the use of Mathematica software to study numerical complex integration, conformal mapping and boundary value problems.

MSCM 1163 MATHEMATICAL METHODS II

This course teaches advanced mathematical methods techniques that graduate students will find useful in their research. We will aim to cover topics on complex variables – Bromwich integral & residues on branch cuts and on various asymptotic methods – integration by parts, Watson Lemma, Laplace methods and steepest descent method.

MSCM 1173 : PARTIAL DIFFERENTIAL EQUATIONS

This course begins by introducing the basic elements of the element method. It covers topics that include Laplace's equation in two dimensions, Green's functions and theorem, integral equation formulation and boundary element formulation. Each student will be required to do a small project to gain experience in the implementation of the method for specific applications.

MSCM 1213 : GROUP THEORY I

This course consists of two parts. The first part includes introduction to groups, types of groups, isomorphisms between groups, 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 which are 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.

MSCM 1273 : GROUP THEORY II

Advanced group theory which covers simple groups, series of groups, group action on a set, isomorphism theorems, free abelian groups, free groups, group presentations are exposed. Properties ofrings and field, integral domains, rings of polynomials,factor rings and ideals,Grobner bases for ideals are covered.The final part of the course exposes the students to the underlying theory of extension fields**,** vector spaces and algebraic extensions.

MSCM 1223 : GALOIS THEORY

The course introducesgeneral properties of rings, integral domains and fields. Fundamental homomorphism theorem, quotient rings, prime and maximal ideals are exposed. The fundamentals of Galois theory, polynomial rings, principle ideal domain, Euclidean domain,test for irreducibility, polynomial factorizations and zeros of polynomials are covered. The field of quotients of an integral domain, the underlying properties offield extensions, Kronecker's Theorem, minimal polynomial, algebraic and transcendental extensions, evaluation homomorphism,primitive element, splitting fields, normal and separable extensions constitute the ideas behind Galois Theory. The final part of the course includes the Theorem of primitive element, Galois group, Galois correspondence and extensions.

MSCM 1253 : THEORY OF MATRICES

Introduction to linear algebra for the graduate students which covers linear algebra on complex numbers and finite fields, eigen vectors and values, quadratic and normal forms, simalirity and selected topics will be exposed. Further topics such as modules and spectral theorem are included.

MSCM 1263 : POINT SET TOPOLOGY

This is an advanced course in Topology. It covers the metric spaces which include the normed vector spaces, subspace metrics, open subsets and continous maps, and metrics on product, as well as the topological spaces which include the continuous maps, bases, the axiom of countability, product topologies. It also covers compact spaces that include the Hausdorff separation axiom, compactness, products of compact spaces, the one-point compactification and properness. Quotient topology and gluing are also the main interest of the course that discussthe quotient topology, gluing surfaces out of charts, compatibility of quotient topology with products. The course ends with the identification of topological and quotient groups.

MSCM 1313 : NUMERICAL ORDINARY DIFFERENTIAL EQUATIONS

This course exposes student to the basic theory of the general linear multi-step methods, explicit/implicit methods, order and the convergence of the methods to solve initial value problems for first order ordinary differential equations. Problems in applying the methods, local and global truncation error, and weak stability theory of the methods will be discussed. The application of some implicit methods such as the predictor-corrector method including step-control policy will be highlighted. The students will derive the classical Runge-Kutta method (explicit/implicit), determine order and convergence of methods and their error estimates. The course also covers extrapolation methods such as polynomial and rational

extrapolations and the existence of asymptotic expansion. The students will eventually be able to solve higher order ordinary differential equation problems and the problem of stiffness arising in first order system. Further, the students will solve two-point boundary value problems using shooting method and finite difference method.

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, such as the Householder matrix. Naturally the MATLAB is used extensively as a blackbox as well as for programming purposes.

MSCM 1323 : FINITE DIFFERENCE METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS

This course discusses finite difference methods for solving partial differential equations. The models used for equations of the parabolic, hyperbolic, and elliptic used are the heat conduction, wave, and Poisson's equations, respectively. For each of these equations, the corresponding finite difference methods are developed. Discussion begins with one-dimensional problems for the parabolic and hyperbolic equations and two-dimensional problems for the elliptic equations. Extensions to two- and three-dimensional problems are then made for the former. Nonlinear parabolic equations are also discussed. For two-dimensional problems finite-difference methods based on polar coordinates are also covered. For one-dimensional hyperbolic equations, finite-difference schemes based on characteristic curves are given preference over those based on rectangular coordinates. 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, and results on eigenvalues.

MSCM 1333 : FINITE ELEMENT METHOD

This course begins with using the finite element approximation method to find solutions to the one- and two-dimensional boundary value problems. The course covers strong and weak forms of the problems, and their approximating functions, as well as the formation of elements and nodes for approximation. It also discusses the integral and variational methods, and finite element formulation using the Galerkin method in 1- and 2-dimensional boundary value problems involving ordinary and partial differential equations. Case studies in the course consider one-dimensional and two-dimensional problems. Case studies on one-dimensional problems include heat transfer, string displacement, linear elasticity, beam bending and truss analysis, whereas case studies on two-dimensional problems involve mesh elements formation, and their representations in the form of isoparametric and serendipity elements, heat transfer, fluid dynamic and plate/plane formulation

MSCM 1353 : PARALLEL COMPUTING

The course will familiarize the knowledge and concept in the field of parallel and distributed algorithm on high performance computing platform. This course will emphasize on parallel architecture, parallel programming models, system software, and parallel algorithms for mathematical modelling, graph theory, computational geometry, numerical analysis and combinatorial optimization in solving the grand challenge applications. Issues such as synchronization, data distribution, load balancing, data partitioning, interconnection networks and data communication will be considered for shared memory and distributed architectures. Problems are deal with bus-based computing platforms, communication and computational complexity analysis. Discussion on 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 Programming.

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 variationalmethods.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 1413 : 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 begins with the theory of sets in introducing sample space, event and probability. These are followed by the discussion on the probability measures, basic rules of probability calculus, sampling, counting subsets, discrete distributions, conditional probabilities, independence and Bayes Theorem, the principle of maximum likelihood, random variables, distribution functions, continuous random variables, expectation and moments, covariance and correlation, the law of large numbers, moment generating functions, multivariate distributions, bivariate normal distributions and stochatic process. Upon completion students should be able to understand the mathematical concepts that are used in deriving certain techniques and methods in statistics.

MSCM 1433 : STOCHASTIC PROCESSES

This course begins with the fundamental of stochastic processes that is the probability theory, and proceeds to discussing major stochastic processes, including Markov chains; discrete and continuous Markov chains, Poisson processes, Brownian Motion, and renewal theory. Applications to inventory problems, equipment replacement and queuing theory are also dealt with through examples. Upon completion, students should be able to recognize the relevance of mathematical techniques presented in solving real-world problems, apply the techniques, and demonstrate knowledge of various random processes.

MSCM 1453 : GENERALIZED LINEAR MODELS

Pre-requisite: Mathematical Statistics, Linear Algebra, Calculus.
This course begins by introducing generalized linear models and presenting a unifying framework for many commonly used statistical techniques. Linear regression models and many other models are special cases of GZLM. The main ideas of statistical modelling and theoretical background are covered in the first half of the course. The other half of the course deals with applications of GZLM on multiple linear regression (MLR), analysis of variance (ANOVA), analysis of covariance (ANCOVA)and binary data analysis. The examples used in the lecture involve analysis of relationships between measurements on group of subjects or objects, dealing with one response and several explanatory variables.

MSCM 1463 : TIME SERIES

This course begins with introduction to forecasting, statistics background for forecasting, introduction to stochastic model and deterministic model: the fundamentals of model construction, stationary process, autocorrelation function, linear model: Autoregression process, moving average process, autoregression process and integrated moving average. Forecasting functions: Forecasting correlation error. Model determination: Technique in model determination and model estimation, non-linear model estimation and computer usage in time series.

MSCM 1473 : MULTIVARIATE STATISTICAL ANALYSIS

The course comprises of two parts, namely the theory of multivariate statistics and the applications of multivariate methods. The theoretical part consists of conceptualizing multivariate data from the geometrical aspect and use of matrices to handle multivariate data, multivariate normal distribution, inferences about the mean vector and comparisons of several multivariate means. The application part consists of multivariate data exploration, multivariate linear regression models, principal components, factor analysis and inference for structured covariance matrices and canonical correlation analysis.

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 solving unconstrained and constrained optimization problems.. The course will start with some preliminary results from multivariable calculus and discussions on a few basic algorithms for unconstrained problems. The discussion is then geared towards the solution of constrained problems. Amongst the topics discussed in the course are Lagrange multipliers, Kuhn-Tucker conditions, convexity, transformation methods, linearization methods, and direction generation methods. Students will be encouraged to use MATLAB, C or MATHEMATICA to write programs on the algorithms. Upon completion, students should be at ease to use these methods for solving the majority of unconstrained and constrained optimization problems.

MSCM 1643 : HEURISTIC OPTIMIZATION METHODS

This subject discusses various types of heuristic optimization techniques, their basic concept, algorithm and implementation. The topics include: Introduction to Heuristic Methods; Computational Experiments with Heuristics; Constructive Heuristics: Descent Method, Composite Heuristic, Multi-level Heuristic, Perturbation Heuristic; Meta-heuristics: Simulated Annealing, Tabu Search, Genetic Algorithms; Introduction to other meta-heuristic methods: Ant Colony, Variable Neighbourhood Search, Neural Network.

MSCM 1633 : GAME THEORY

The game theory topics first covers the different types of games, the impartial combinatorial games, take-away games, the game of Nim, graph games, sums of combinatorial games and two-person zero-sum games. Then the strategic form of a game, matrix games, domination and the principle of indifference will be learned. The course also include applications and extensions of game theory by considering the extensive form of a game and solving finite games. The course also intends to further include recursive and stochastic games, two-person general-sum games, bimatrix games - safety levels, noncooperative Games -- equilibria.models of Duopoly, cooperative games, games in coalitional forms and many-person TU games. Imputations and the core, the Shapley value and the nucleolus will also be discussed.

MSCM 1663 : SUPPLY CHAIN MODELLING

This course begins with basic elements of supply chain modeling – logistic system, demand forecasting and collaborative planning, including the component of logistic systems; the interaction between these components; models and techniques for the analysis of logistics systems and the development of information and decision support systems. Demand forecasting - Role of demand forecasting in supply chain, identify the component of a forecast, qualitative and quantitative forecasting, forecast accuracy and explains collaborative planning, forecasting and replenishment in supply chain modeling.

MSCM XY80/MSCM XY90 : DISSERTATION

In the second semester of study, supervisors will be assigned to respective students by the postgraduate program committee. The assignment is based on his area of research preferences revealed by his coursework enrolment and performance. However the students can only register for dissertation in the third semester upon completing all his courseworks with a cumulative grade point average exceeding 3.0. The dissertation intends to expose and consolidate basic research skills such as doing literature review and formulating research problems, doing preliminary dissertation research work prior to the final dissertation research. At the final stage of the dissertation, the student will be required to submit a research dissertation report. Assessment by elected postgraduate committee members will be based on the student's Dissertation presentation and report.

DISSERTATION CODES FOR FULL TIME STUDENTS

CODE	NAME	STUDENT'S SEMESTER
MSCM2180	DISSERTATION	3
MSCM2280	DISSERTATION	4
MSCM3180	DISSERTATION	5
MSCM3280	DISSERTATION	6

Guidelines for Dissertation codes:

MSCM XYZ0
X – year of study ;
Y – 1st or 2nd semester;
Z – 8 if full time, 9 if part time;

DISSERTATION CODES FOR PART TIME STUDENTS

CODE	NAME	STUDENT'S SEMESTER
MSCM2290	DISSERTATION	4
MSCM3190	DISSERTATION	5
MSCM3290	DISSERTATION	6
MSCM4190	DISSERTATION	7
MSCM4290	DISSERTATION	8

APPENDIX D

ENGINEERING MATHEMATICS – SYNOPSES OF COURSES

MSCJ 1533 : NUMERICAL METHODS IN ENGINEERING

This is the first course of numerical methods in engineering.
The first part covers the ordinary differential equation (ODE), error analysis, single step, multistep method as well as the system of ODE. The second part covers finite difference technique in hyperbolic elliptic as well as parabolic equations. 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 meshless element free Galerkin (EFG) method in one-dimension. Moving least-square approximant is introduced with Lagrange multiplier in order to solve simple 1-dimensional boundary value problem.

MSCJ1513 : PARTIAL DIFFERENTIAL EQUATIONS

Introduces the basic elements of the element method. Topics include Laplace’s equation in two dimensions, Green’s functions and theorem, integral equation formulation and boundary element formulation. Each student will be required to do small project so that they gain experience in the implementation of the method for specific applications.

MSCJ 1523 : METHODS OF ENGINEERING MATHEMATICS

Special Functions: 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 1713 : STATISTICAL MODELING AND SIMULATION

This subject provides students a platform to study the theoretical and practical aspects of modeling in sciences and engineering. It begins with data exploration and analysis using statistical package. Then it continues with the fundamental idea of statistical modelling which include the maximum likelihood approach of model fitting, model evaluation and fulfilling the law of parsimonious model. The theoretical and practical aspects of modeling include the regression model, analysis of variance, logistic regression and response surface modeling. The generalised linear model (glm) is introduced to categorise models which fit in this class of model.

MSCJ 1733 : SOLITONS & NON LINEAR WAVES

The course introduces student to the basic theories and principles of nonlinear waves. It will examine some underlying general concepts related to solitons and nonlinear waves equations. These include topics in linear waves, some nonlinear equations of evolutions, soliton interaction, general equation f evolution, group velocity and nonlinear waves.

MSCJ 1753 : FLUID MECHANICS AND HEAT TRANSFER

This course aims to equip students with the required skills to develop mathematical models for fluid flow and heat transfer problems, and the ability to interpret their solutions and physical meanings. 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 methods of solutions in the limiting case of low and high Reynolds number flows are discussed. These include the Oseen and Stokes flows and the boundary layer flows in various situations.

MSCJ 1033 : RESEARCH METHODOLOGY

Research Methodology comprises of the following components:

1. Lectures on Mathematical Modelling and Research Methodology
2. Research colloquiums
3. Research Proposal

This process is intended to expose and consolidate basic research skills to students who will be undergoing research activities in the following semester. At the end of the semester the student will be required to submit a research proposal based on the research topic that would be assigned and approved by the postgraduate committee. Topics must be related to on going 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 project.

MSCJ XYZ0 : 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 on going 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 FOR FULL TIME STUDENTS

CODE	NAME	STUDENT'S SEMESTER
MSCJ2180	DISSERTATION	3
MSCJ2280	DISSERTATION	4
MSCJ3180	DISSERTATION	5
MSCJ3280	DISSERTATION	6

DISSERTATION CODES FOR PART TIME STUDENTS

CODE	NAME	STUDENT'S SEMESTER
MSCJ2290	DISSERTATION	4
MSCJ3190	DISSERTATION	5
MSCJ3290	DISSERTATION	6
MSCJ4190	DISSERTATION	7
MSCJ4290	DISSERTATION	8

Guidelines for Dissertation codes:

MSCJ XYZ0
X – year of study ;
Y – 1st or 2nd semester;
Z – 8 if full time, 9 if part time;

APPENDIX E

PHYSICS – SYNOPSES OF COURSES

MSCF 1113 : QUANTUM MECHANICS

This course reinforces the basic quantum mechanics at the undergraduate level and extends further topics to the course. Basic formalism of quantum mechanics will be reviewed. Harmonic oscillator, hydrogen atom 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.

MSCF 1123 : ELEMENTARY PARTICLE

This course is designed to expose student to understand the most fundamental components of nature using the quark model. Some topics of interest would be the structure, definition, flavor and the combination of quarks to form other particles. Classifications of particles and their interactions into a number of easily identifiable categories, and a number of empirical rules will also be studied. Interactions between particles will be dealt with in terms of the four types of forces and the exchange of particles between them. Also included in the course will be the conservation theory of various interactions in terms of lepton number, parity, charge conjugate and time reversal. At the end of the course, the student will be exposed to the understanding of unification theory of forces which incorporate the mechanics of the strong, weak, and electromagnetic interactions into a single theory.

MSCF 1813 : RESEARCH METHODOLOGY

This course discusses the fundamental and practical aspects of conducting good scientific research, mainly in the area of physics. The course will start with an introduction to research methods, approach, procedures and its philosophy, setting title, problem formulation, literature review, research methodology and design, data collection procedures, data analysis, writing research proposal and thesis and research management. Making an effective presentation and submission of research paper in high impact journal will also be discussed.

MSCF 1143 : 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 medium 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 theme. Finally, the theory of vector and scalar potentials, moving charges, multi-pole fields and their detailed applications will be presented.

MSCF 1313 : ACOUSTIC & ULTRASONICS

The course will emphasizes on the theory and the applications of acoustic waves and focusing on the ultrasonic range. The course begin with introduction on the physical properties of the acoustic waves and its interaction with the surrounding media. This will be followed by the discussion on the physical principles of acoustic and ultrasonic wave transduction and their transduction behaviour. The ultrasonic wave interaction with media will be further discussed to establish the foundation for the various ultrasonic processes and measurement principles. The principles of various ultrasonic measurement system and instrumentations will be described. In general the course provides a deep understanding of acoustic and ultrasonic wave behaviour and the underlying physical principles of various applications.

MSCF 1413 : ANALYTICAL TECHNIQUES

Radiation and Matter: Electromagnetic Radiation, basic features of electromagnetic radiation, Velocity of light, Polarization, Electromagnetic Spectrum, types of electromagnetic-radiation sources, The interaction of electromagnetic radiation with matter, absorption and emission of radiation, Planck law, Transition Probabilities General methods of spectroscopy, Quantization and Molecular Energy Levels, Line broadening (natural, Doppler, and pressure), Fourier transform, rotational energy states, vibrational energy states, Born-Oppenheimer Approximation,, Microwave spectroscopy and Rotational Spectroscopy, Types of microwave spectrometer, Molecular applications; Rotational constants and molecular structure, Selection rules, Applications, Vibrational Spectroscopy, Infrared spectroscopy, Infrared instrumentation, Analysis of absorption spectra, characteristic IR bands, instrumentation and technique,: normal and symmetry coordinates, symmetry species of vibrational coordinates, selection rules, classifications of vibrational transitions, chemical applications of vibrational spectroscopy, Characteristic vibrations, Infrared (IR) absorption spectroscopy, Raman Spectroscopy, Raman effect, Rotation-vibration spectroscopy, instrumentation and technique Raman spectroscopy, Nuclear magnetic spectroscopy (NMR), principle, cw-NMR instruments and FT-NMR instruments, Experimental methods, applications of NMR

MSCF 1423 : SEMICONDUCTING BULK MATERIALS

The course begins with Atomic bonding: Ionic, covalent and mixed bonding. Band structure: Ideal, real semiconductors, energy gap, direct and indirect gaps, cyclotron resonance. It is followed by discussion onExtrinsic semiconductors: Impurity atoms and ionization energy. Thermal equilibrium of electrons and holes concentrations, degenerate and non-degenerate semiconductors, compensated semiconductors, Fermi level positions, excitons. Carrier transport phenomena in semiconductors: Drift current density, mobility, conductivity, diffusion current density, total current density, the Einstein relation. Non-equilibrium excess carriers in semiconductors: Excess carrier generation and recombination, traps and recombination centres, kinetics of electron traps, kinetics of recombination centres, The Shockley-Read-Hall theory, space charge in semiconductors, relaxation effects. Optical properties of semiconductors: Photoemission, photoconductivity, practical photoconductors, luminescence, characteristic and non-characteristic luminescence, electroluminescence. Amorphous semiconductors: Electronic states, defects and structure, charge transportare discussed towards the end of the course.

MSCF 1433 : SEMICONDUCTOR DEVICES

This course is designed to review the semiconductor field, semiconductor growth and the physical properties of semiconductor. Special focus will be on semiconductor device: Schottky, ohmic contacts, metal-semiconductor junction, p-n Junction; fabrication, photolithography, doping layering, patterning, heat treatment, Principle and operation; equilibrium condition, forward and reserve bias, junction capacitance, varactor, Type of Diode; Junction diode, Tunnel diode, Zener diode, Photo diode, Light Emitting Diode (LED), Laser diode, Photovoltaic. Transistor; Bipolar Junction Transistors (BJT), Field Effect Transistors (FET).

MSCF 1443 : THIN FILM PHYSICS

Introduction to Thin Films, Gas Kinetic and Nucleation, Physical Vapour Deposition, Chemical Vapour Deposition, Characterization Measurements, Properties – structural, optical, electrical and magnetic, Novel Properties – quantum effect, giant magnetoresistance, Thin Film Solar Cells, Layered Magnetic Nanostructures - GMR sensors, Single-Electron Devices.

MSCF 1453 : NON-CRYSTALLINE SOLID

The course starts with a brief classification of solids and the amorphous state. The transition of liquid to crystal and glass will be explained kinetically which is temperature dependent. Then, the theory for glass formation, structure of liquid and glass using a radial distribution function will be given. Next is the optical properties which include the inter-band absorption edge and the activation energy of the system. Then the amorphous part will be discussed especially that which of carbon and silicon especially in term of their structure and the electro-optical properties. Finally some applications of amorphous material will be discussed.

MSCF 1463 : PHASE TRANSFORMATION

The course starts with a brief basic concept of thermodynamics and equilibrium system. After that, the driving force for phase transformation especially for solidification process for multi-type of solution will be given. A construction of a simple binary phase diagram for a system with a miscibility gap will be presented. Then, a mechanism of multi-type of diffusion will be touch. The atomic mobility in some alloys will also be touch in detail.

MSCF 1513 : OPTOELECTRONICS

This course is designed to expose the students to optoelectronics with emphasis on the functions of components and devices in optoelectronic and fibre optic systems. The basic working principles of the various components and devices are described. At the end of this course, students should be able to describe the principles involved in the operation of optoelectronics and fiber optics components, devices and systems. The various types of fibre optic sensors for different applications and the working principles of various components in fibre optic sensing systems. The students should also be able to analyze the functional components of optoelectronic and fiber optics systems and should be grateful to the Creator for the knowledge attained on optoelectronics and fibre optics, together with their applications

MSCF 2180/MSCF 2190 : DISSERTATION

This course is designed to expose the students to the focus study of the research works. Students need to conduct the research work in a laboratory and analyze the data critically to solve the research problem. At the end of the course, students are required to submit the final research dissertation and sit for an oral examination (viva voce). Student is also required to complete a technical paper for publication in a scientific journal.

APPENDIX F

BIOTECHNOLOGY – SYNOPSES OF COURSES

MMBT 1713: BIOINFORMATICS

This is a practical "hands-on" course in Bioinformatics that will emphasize on how to use computers and the web as tools to analyze and represent large collections of biological sequence and structure data. Prerequisites include a basic understanding of protein and nucleic acid structure, and some mathematics and statistics, but no prior knowledge of computer programming or computer hardware is necessary. This course presents the principles and methodology for Bioinformatics. It focuses on the application of computational methods to study biological problems. It will introduce the principles, scope, application and limitations of bioinformatics. This course is designed to introduce bioinformatics at a level appropriate for biology undergraduates having completed an undergraduate core, and for chemistry, computer science, and math undergraduates with an interest in biology. This course is designed so that the content and curricula can rapidly adjust as required to meet changing circumstances during the course of the semester and to evolve with the topics of interest in bioinformatics over time. Students will learn to use conventional software, web-based applications, and software which they download to their machine. By using the well-tested and successful approach of problem-based learning, students will learn through applying the strategies and tools used in bioinformatics to topical problems drawn from ongoing research and applications in a variety of fields. There is to be an integration of the basics of computation and analysis along with chemistry and biology throughout the course.

MMBT 1173: BIOCHEMISTRY AND MICROBIAL PHYSIOLOGY

This course is designed to apply knowledge in basic cellular organization of microorganisms, growth and central metabolic processes to their existence in diverse environment. Knowledge on the genetics, growth and metabolism of microorganisms will be integrated to explain cellular growth and metabolism under normal living conditions to various stressful environments. Hands-on experience in laboratory on several aspects of microbial functions will be provided.

MMBT 1153: MOLECULAR MECHANISMS IN GENE EXPRESSION AND REGULATION

This course is designed to expose the master students in understanding the molecular mechanisms in the expression and regulation of gene in both prokaryotes and eukaryotes. A brief introduction will be included and the overview of the molecular genetics will be looked into. The expression and regulation of proteins is the major theme of the lecture. Regulation and the control of gene expression will be discussed by using several selected operons as model. A general discussion on the biochemical adaptation and gene expression will be given using extreme environmental conditions. Gene expression in recombinant microorganisms will also be discussed.

MMBT 1683: PROTEIN ENGINEERING

This course presents an introduction to protein structure and function which is the basis for design of modified proteins for practical use in medicine or biotechnology as well as fundamental studies. The developing discipline of protein engineering and in particular enzyme engineering has concerns ranging from prediction of protein conformation from primary structure to cost-effective recovery and purification of recombinant proteins. Several successfully case studies on protein engineering will also be discussed. Finally students are required to carry out a guided mini project where they will be introduced to protein *in silico* homology modeling and mutagenesis.

MMBT 1233: INDUSTRIAL TECHNOLOGY AND BIOREACTOR DESIGN

The course will emphasize on industrial technology and bioreactor design for microbial, plant and animal cell cultures. The gene transfer method into animal and plant tissue culture will be discussed. The physiology of microbial growth and product formation in batch, continuous and fed-batch culture will be explained in detail. The students will have knowledge on bioreactor design for microbial, immobilized cell, plant and animal cell tissue engineering and waste water treatment. Subsequently, student will be exposed to the industrial processes flow sheet and emphasis on advance downstream unit operation such as membrane separation and chromatography. Lastly, current Good Manufacturing Practice (cGMP) will be described. This course offers a combination of theoretical (lecture) and practical work.

MMBT 1563: ENVIRONMENTAL BIOENGINEERING

In this course, conventional and recent advances the technology for waste treatment, biodegradation and waste utilization will be discussed. Since pollution is a direct or indirect consequence of waste production, the demand for ‘zero discharge’ can be interpreted as an unrealistic demand for ‘zero waste’. As wastes continues to exist, attempts to abate the subsequent pollution by converting them to less noxious forms are more important. Application of bioengineering will be instilled in biotransformation process of wastes to commodity products or other value-added compounds evaluated based on selected case studies obtained from publications. Bioremediation technologies will be reviewed based on their applicability, performance and limitations. The role of microbes and microbial enzymes used in the processing unit will be described and distinguished. The use of microbiological and molecular techniques in monitoring microbial population and evolution will also be reviewed.

MMBT 2180: DISSERTATION

This researchproject allows students to be involved in research under the supervision of knowledgeable and widely experienced lecturers in specialized fields such as Molecular Biology and Genetic Engineering, Enzyme Technology, Environmental Biotechnology, Plant Molecular Biology and Tissue Culture. Students must prepare a written research proposal approved by the panel of examiners before executing the research. This enriching research experience will enable students to utilize library facilities for updating literature search, to plan and conduct research independently. Research data are collected and analysed before finalizing the research dissertation. Students must complete a written dissertation on the research project to be evaluated by examiners via *viva-voce*.

FACULTY OF SCIENCE

Universiti Teknologi Malaysia
81310 Johor Bahru, Johor
Malaysia

www.science.utm.my