GRADUATE STUDIES HANDBOOK

FACULTY OF SCIENCE 2015/2016

FACULTY OF SCIENCE
UNIVERSITI TEKNOLOGI MALAYSIA

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2015/2016

Faculty of Science
UTM Johor Bahru Johor
Darul Ta'zim Malaysia

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FACULTY OF SCIENCE

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CONTENTS **Page No**

UTM
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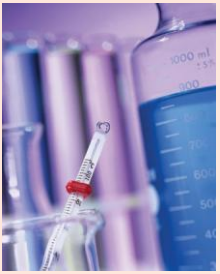

A MESSAGE FROM THE DEAN

A MESSAGE FROM THE DEAN

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!***

Professor Dr. Norsarahaida S. Amin
Dean, Faculty of Science
September 2015

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ABOUT UTM

UNIVERSITI TEKNOLOGI MALAYSIA

PHILOSOPHY

The divine law of ALLAH is the foundation for science and technology. Universiti Teknologi Malaysia strives with total and unified effort to develop 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

In The Name of God for Mankind

UNIVERSITY'S THEME

innovative • entrepreneurial • global

BUSINESS, CORE UNIVERSAL VALUES

Committed
Communicative
Creative
Consistent
Competent

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

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ABOUT FACULTY OF SCIENCE

FACULTY OF SCIENCE

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 disseminationof scientific and mathematical knowledge by quality teaching and learning, innovative research and scholarly publications for the wellbeing of mankind and the environment.

MOTTO

Q-LEAP with us.
(Quantum Leap: Learn, Explore, Apply and Practise

OBJECTIVES

- To provide quality academic programmes in science and mathematics to meet 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 scientific based smart partnership and global netwoking.
- To contribute to the generation of the nation's wealth through research and innovation.
- To contribute to the improvement of the quality of life, protection of the environment and conservation of natural resources.

BUSINESS

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

STATEMENT OF OPPORTUNITY

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

FACULTY'S COMPETENCY

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

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UTM'S PROFILE

INSTITUITION PROFILE

A Fine Place To Study

Since 1972, Universiti Teknologi Malaysia (UTM) has enjoyed an enviable reputation as a provider of high quality learning and is now a well-established university with a wide range of undergraduate courses as well as high-caliber postgraduates. Currently, both postgraduate Taught Course and Research (Mixed mode) and Research modes are available which reflect the vast experience of the academic staff of the university. In line with the University's aspiration to become a research university, UTM has forged forward to produce quality postgraduates.

The University offers a friendly and supportive study in the fields of science and technology. UTM offers more than 100 postgraduate programmes in engineering, science, technology and social science supported by more than 500 graduate faculty staff with reputable academic excellence, research experience and international exposure as well as many distinguished award-winning research stars. Every student has an academic advisor who is a highly qualified academic staff. Courses are taught by experienced faculty and guest lecturers, and other professionals are often invited to address a class. UTM has more than 30 years of experience in tertiary level engineering education and has produced more than 80,000 graduates, including 5,000 postgraduates. The majority of the academic staff are actively involved in teaching, research and consultancy work with local industries and have international links with many countries.

UTM is a leading innovation-driven research-intensive university in science and technology located both in Kuala Lumpur and Johor Bahru, Malaysia with a student population of more than 11,500 postgraduates and 13,000 undergraduates including more than 4,500 international students. It is renowned for being at the forefront of engineering and technological knowledge and expertise with more than 2,200 PhD students enrolled in science and technology research programmes. UTM has established a reputation for innovative education and leading-edge research contributing significantly to intellectual property generation for the nation. UTM is also actively involved in research collaboration with renowned universities such as Cambridge, Oxford, MIT, Imperial College, Stanford Research Institute, Kyoto and Tokyo, to name a few. The university offers a wide range of Executive Education programmes from industrial doctorate (Eng. D.) up to market-driven diploma courses.

UTM is also set to become an important player in global education by targeting to attract at least 50% of its postgraduate and 5% of its undergraduate students from overseas by 2013. Currently, UTM has 1801 international postgraduate students and 671 international undergraduate students from more than 40 countries. The number is increasing rapidly with UTM's reputable standing as a well-known technological university abroad. UTM is continuously enhancing its internationalisation effort and initiatives such as programmes to promote Student Mobility internationally by establishing academic linkages with foreign universities through Study Abroad, Student Exchange and Global Outreach Programmes. These initiatives aim to provide UTM students with international exposure and a global perspective, while enhancing their chances of employability abroad.

Apart from that, UTM has embarked on various initiatives to boost its credentials and enhance its visibility in the international arena. Efforts to this end include enhancing networking and creating partnership with renowned universities, research centres and professional bodies. Thus far, collaborative efforts have been established with Oxford University, Harvard University, MIT, Cambridge University, CALTECH and Imperial College London, to name a few. Another initiative is the formation of the Iskandar Malaysia Academic Partnership (IMAP) resulting from the Inaugural UTM University Presidents Forum. This partnership further enhances cooperation among participating universities from more than 21 countries across the globe to strengthen collaboration in academic and research programmes and intensify student and staff exchange for a more effective and purposeful academic, social and cultural engagement.

The University aims to meet the need for highly trained professional engineers continue to be successful in attracting substantial research funding. In line with UTM's aspiration of becoming a world class university is the establishment of several centres of excellence, including 'Centre for Artificial Intelligence and Robotic' (CAIRO) and 'Centre of Advanced Software Engineering' (CASE), which are research based centres. Ibnu Sina Institute for Fundamental Science Studies (IIS), set up in 1997 as a centre of excellence in Science, has provided the platform towards a better fundamental

science research in UTM. In 2010, UTM has been awarded Research University by Datuk Seri Mohd Najib Tun Razak in parliament when he presented the 10th Malaysia Plan on June 10th, 2010. This well deserved attainment is a timely acknowledgement of UTM's effort and achievement as it undergoes a dynamic transformation process these past few years towards becoming an innovation-led Research University. The strategic action undertaken by the university is in tandem with Malaysia's aspiration towards becoming a knowledge-based, innovation-led economy grounded in creativity and innovation with high value creation.

It is highlighted that the transformation of UTM is based on organisational strategy, structure and culture, three vital elements crucial to the success of any organization. Through a comprehensive and integrated Strategic Plan, UTM functions and operates on a KPI-based management system with clear goals and targets set to achieve its strategic objectives.

UTM has also established a reputation for innovative education and leading-edge, proven by becoming the three-time winner for the National Intellectual Property Award for organization category. A stimulating research culture exists in UTM through 11 Research Alliances (RA) in strategic disciplines namely Sustainability, Infocomm, Water, Cybernetics, Biotech, Construction, Materials & Manufacturing, K-Economy, Energy, Transportation and Nanotechnology. In addition there are 28 Centres of Excellence (CoE) in addition to academic faculties to service technological education and research needs of the university.

UTM is also actively engaged in research collaboration with renowned institutions such as Harvard University, MIT, University of Oxford, Imperial College of London, University of Cambridge, Tokyo University and Meiji University on areas of mutual interests. To facilitate further engagement and networking in academic and research undertakings, international satellite offices have been established in Tokyo, and already in the pipeline are plans to establish satellite offices in Doha (Qatar), Madinah (Saudi Arabia), and in Boston (USA).

Location

Set in a splendid campus, with modern buildings and excellent facilities, UTM main campus is superbly located to take advantage of the best that Johor has to offer. The main Johor Bahru campus is situated on a 1,222 - hectares site that provides a lovely setting of landscape gardens for the bustling academic village and residences. The main campus is easily accessible by road, rail and air. Regular flights from Senai Airport connect the state capital of Johor Bahru to Kuala Lumpur and other domestic destinations. Transport services at the airport are also readily available. Taxis are the most popular cheap means of transport. Air-conditioned coaches are also available to and from Johor Bahru to other states in Peninsular Malaysia. The KTM (Malayan Railway) offers numerous train services connecting Singapore and other states in Malaysia through Johor Bahru station. A 18-hectare UTM City Campus is situated at Jalan Semarak, Kuala Lumpur.

International Students

The university encourages the admission of international students, and seek to serve the aspirations of all with the ability and motivation to benefit from higher education. The university arranges special induction and orientation programmes for international students. More than 2700 international students from over 40 countries are represented on campus. An exciting and dynamic learning environment is enhanced by the contributions from students from a diverse background. International schools conveniently situated in the nearby Johor Bahru city permit children of married students for primary and secondary education. The University also provides a full range of admission, welfare and student services to meet the needs of international students.

The International Student Centre (ISC) of Universiti Teknologi Malaysia's Office of International Affairs helps international students adjust to life at Universiti Teknologi Malaysia, and make the most of what Universiti Teknologi Malaysia has to offer through a host of services and activities. Some 2,700 international students representing more than 40 countries call Universiti Teknologi Malaysia home.

The International student Centre (ISC) provides support and services to help UTM international students before and after arrival to adjust seamlessly into the academic system in UTM and to adapt

smoothly to the Malaysian culture and tradition. This is to ensure a conducive learning environment and an experience that is enjoyable, safe, and successful. The ISC office also provides programmes and resources for internationally-minded students looking for opportunities both inside and outside of Malaysia. Our Study Abroad and Student Exchange Programmes make studying abroad affordable and accessible. The ISC office provides opportunities for all Universiti Teknologi Malaysia students to internationalise their education and gain cross-cultural experiences.

Scholarship & Assistantship

A limited number of research grants and teaching assistantships are available. Enquiries should be made direct to the Faculty. The following scholarship and assistanship are available for:

- Malaysian Students – MyBrain15 (MyPhD, MyMaster, MyPhd Industry), PGD, SLAI, SLAB, Hadiah Latihan Persekutuan, SLTP, Biasiswa Sukan, Biasiswa Khas Tenaga Akademik, IPTA, PTPTN, JPA, MARA.
- Malaysian & International Students –RSG, TAS, Industrial Research Sponsorship, Fees Reduction
- International Students – IDF, IDB, FUIW, MIS, MTCP, CSFP.

Accommodation

Students are guaranteed accommodation in their first year. University housing is available at both campuses. Hostels are available for more than 20,000 students and most colleges are equipped with computer rooms and internet facilities. Apartments for married students are also available.

At present, there are 13 residential colleges on Skudai main campus, which can accommodate more than 17500 students. There are two types of room available in each college: single and double . Some colleges provide single accommodation for students with each room having a network port and its own attached bathroom. There are about 301 units of 2 bed-room and 3-bedroom family apartments available in 3 colleges, usually reserved for international students. Most of the units are well equipped, fully furnished with ports for telephone and access to campus IT facilities and the Internet.

Among the facilities provided at each residential college are a cafeteria, a multipurpose hall, a Muslim prayer room, tennis courts, an internet and computer center, a convenient store and a common room besides other facilities in the students' rooms.

Full time students are eligible to apply for accommodation on campus. All new single international postgraduates are guaranteed a room on campus. Since there are very limited on-campus accommodation currently available for families, the accommodation for families with children are subjected to availability.

Facilities

UTM provides various facilities to support all kinds of students and staff activities. There are auditoriums, seminar rooms, laboratories, a medical centre, student hostels, guest houses, a mosque, banks, a post office and a stadium. The University has a large and spacious library that can accommodate up to 2,500 students at any one time. The library is equipped with more than 300,000 books, some 5,000 journals, on-line references and internet access. Sporting and recreational facilities in the university are extensive and encompass nearby all interest which include canoeing and horse riding. These are complemented by the varied opportunities for leisure activities in the nearby progressive city of Johor Bahru, and together they make UTM a conducive place for studying.

Masjid Sultan Ismail

The construction of the Sultan Ismail Mosque began in 1986 and was completed in 1990. The mosque can accommodate about 10,000 worshippers and has many facilities such as mini-library, seminar rooms, lecture hall, morgue and offices. The planning of the Skudai campus was based on the concept of centralising the main activities of common interests around the mosque. The mosque is located right at the centre of the campus surrounded by other buildings within walking distance, and is the most outstanding building of the university.

Its location at the centre of the campus is in line with the concept of Islamic learning in which the mosque is the source of the acquisition and dissemination of knowledge and in life as well with the university motto, "For God and Mankind".

Dining

UTM main campus has at least 20 food centres (cafeteria) where students can have breakfast, lunch as well as dinner at a discounted student rate. Some cafeterias open 24 hours a day and some even offering western food style. Average spending on food per day is RM10.00. The cafeteria are a walking distances from the hostels.There are more than 100 catering outlets across the campus, including air-conditioned restaurants, cafeterias, fast-food restaurants selling a whole variety of food including traditional Malay, Chinese, Indian and Western cuisines. There are many shops on campus including bookstores, photocopy centers, mobile phone centers, news agents, launderettes, hair dressing and beauty saloons, computer shops, travel agencies and more than 20 mini grocery stores, mostly within the students' residential colleges. Just outside UTM campus, through second gate (you have to go through padang kawad), there is a McDonald Family Restaurant that open 24 hours a day.

Nearby Shopping Places

Basic necessity for students (not luxury) can be found at discounted rate on campus. There is a Kedai Universiti (The University Shop), managed by Uni-Technologies Sdn. Bhd., a business arm of the University. It offers a wide range of high quality goods including stationaries, paintings, batik, ceramic and clothing items, some of them imprinted with the University's logo. It is located in the Student Union Building. If you need to buy things which are not available on campus, or you want go shopping or eating outside, there is a shopping centre, eg. JUSCO and GIANT which are just around 3 km from UTM. The bus services are about 250 meters away from the mosque heading towards south.

Bank & Post Office

CIMB Bank becoming is the official bank for UTM. But there are more than ten ATM/Teller booth machines of Bank Simpanan Nasional and RHB bank on campus. If you go further 3 km down south to Taman Universiti, there are at least another 6 banks including Maybank, CIMB Bank, Eon Bank, Hong Leong Bank and Bank Rakyat. One post office is located inside the campus, inside the Student Union Buildings. Pos-Laju and pay-bill services are provided, and the post office is opened during office hours, and alternate Saturday.

Petrol Station

If you run out of petrol while travelling aroung the campus, there are at least 21 petrol stations including Petronas, Shell, BHP, Caltex and Esso Mobil around 5km radius from UTM at Taman Universiti, Taman Sri Pulai and Taman Sri Skudai.

University Short-distance Tranportation Service

The University also provides transport services for students to commute from their on-campus residential colleges or off-campus accommodation to classes. There are more than 30 buses that provide services from 7.15 am to 11.30 pm everyday. The off-campus residential areas covered by the service include Taman Universiti, Taman Sri Skudai, Taman Sri Pulai, Taman Teratai, Taman Desa Skudai and Taman Sri Putri. In addition, there are also public buses such as the Transit Link and Maju bus companies, which ply between Taman Universiti via the ring road of the campus to Johor Bahru City Centre.

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MANAGEMENT TEAM & POSTGRADUATE COMMITTEE

FACULTY OF SCIENCE IN BRIEF

The Faculty of Science was established in 1973 at Jalan Semarak, Kuala Lumpur. In the early years it was known as the Centre of Science Studies. In 1981 the Centre was upgraded and renamed the Faculty of Science of the Universiti Teknologi Malaysia. The faculty was initially comprised of four departments namely the Chemistry, Physics, Mathematics, and the Science & Technical Education Departments. In 1988 the faculty was officially relocated to Skudai Johor. Since then, the Faculty has expanded in terms of physical facilities, academic programmes, number of students and staff members.

To date, we house three main departments; the Department of Chemistry, Physics, and Mathematics, plus two additional institutes; the Ibnu Sina Institute for Fundamental Science Studies (IIS) and the Advanced Photonic Science Institute (APSI). The departments and centres provide excellent teaching facilities, well-equipped laboratories and qualified academic staff.

The Faculty of Science currently conducts Undergraduate Programmes leading to the Bachelor of Science Degrees in Industrial and Pure Physics, Chemistry and Mathematics. In addition, we offer Post-graduate programmes (MSc and PhD) in the fields of Physics, Chemistry and Mathematics. The MSc programmes are conducted either through Research or Taught Course and Research (Mixed mode), while the PhD programmes are purely research. In addition, our academic staff are also involved in active research, either in dynamic research groups within the respective departments or other faculties of the university.

FACULTY OF SCIENCE MANAGEMENT TEAM

Prof. Dr. Norsarahaida Saidina Amin – Dean, Faculty of Science
Prof. Dr. Wan Azlee Wan Abu Bakar – Deputy Dean (Research & Innovative), Faculty of Science
Prof. Dr. Mohd. Nor Mohamad – Deputy Dean (Academic), Faculty of Science
Assoc. Prof. Dr. Zaiton Abdul Majid – Head, Department of Chemistry
Assoc. Prof. Dr. Wan Muhamad Saridan Wan Hassan - Head, Department of Physics
Assoc. Prof. Dr. Rohanin Ahmad - Head, Department of Mathematical Sciences
Mr. Ismail Kamis – Academic Manager (External Program)
Assoc. Prof. Dr. Umi Kalthom Ahmad – Laboratory Manager
Dr. Abd. Khamim Ismail - Information Technology Manager
Assoc. Prof. Dr. Zainab Ramli – Academic Manager (Chemistry)
Assoc. Prof. Dr. Yusof Munajat – Academic Manager (Physics)
Assoc. Prof Dr. Nor'aini Aris – Academic Manager (Mathematical Sciences)
Mr. Abd Razak Abdul Aziz – Deputy Registrar
Mr. Kiflee Jimpi – Senior Assistant Registrar

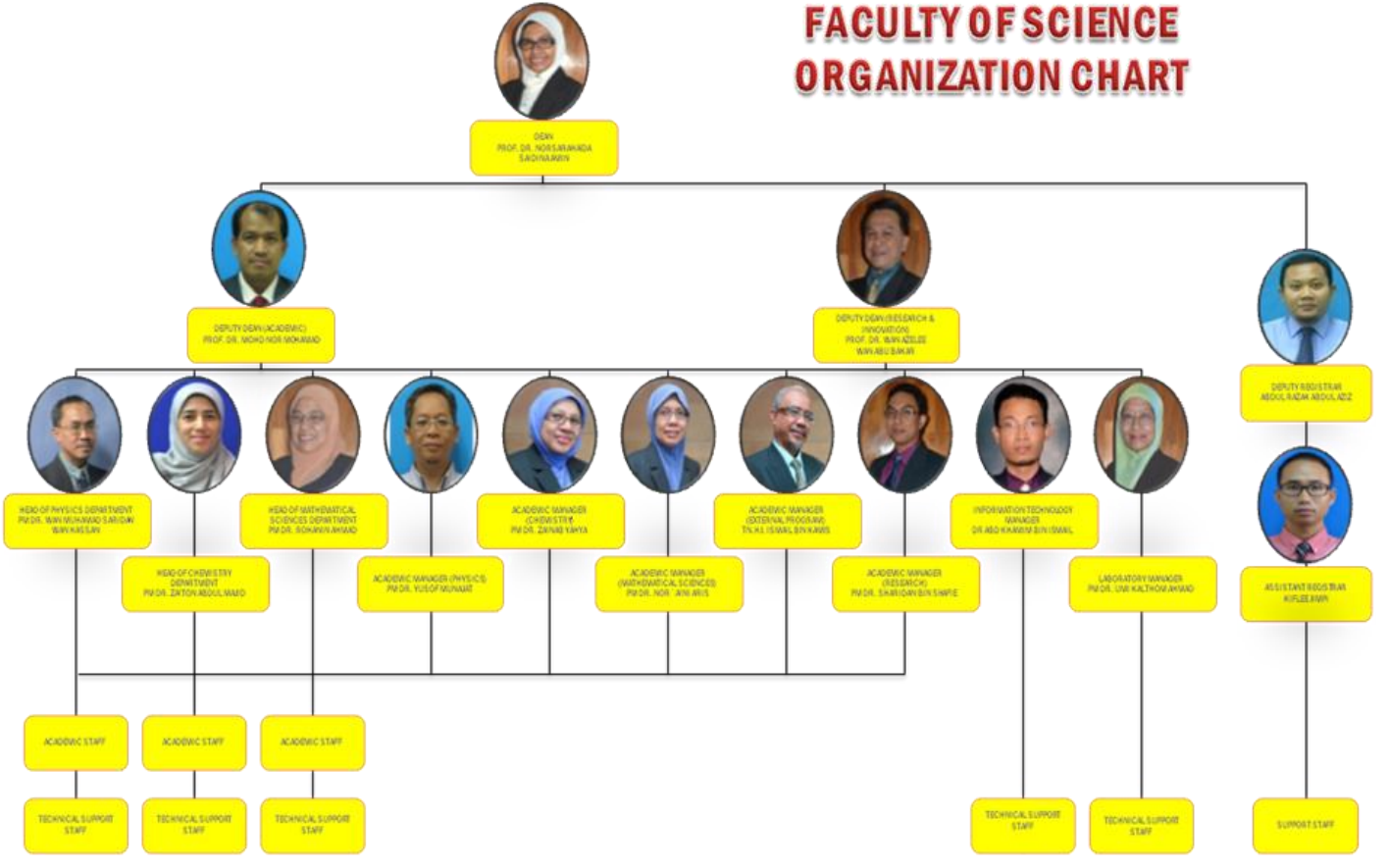
Postgraduate Studies Committee
Faculty of Science
Prof. Dr. Norsarahaida Saidina Amin – Chairman
Prof. Dr. Mohd. Nor Mohamad – Deputy Dean (Academic)
Assoc. Prof. Dr. Zaiton Abdul Majid – Head, Department of Chemistry
Assoc. Prof. Dr. Wan Muhamad Saridan Wan Hassan - Head, Department of Physics
Assoc. Prof. Dr. Rohanin Ahmad – Head, Department of Mathematical Sciences
Assoc. Prof. Dr. Zainab Ramli – Academic Manager (Chemistry)
Assoc. Prof. Dr. Yusof Munajat – Academic Manager (Physics)
Assoc. Prof Dr. Nor'aini Aris – Academic Manager (Mathematical Sciences)
Assoc. Prof. Dr. Farediah Ahmad – Head of Programme Research (Chemistry)
Assoc. Prof. Dr. Hazri Bakhtiar – Head of Programme Research (Physics)
Assoc. Prof. Dr. Fadhilah Yusof – Head of Programme Research (Mathematics)
Dr. Mohd Bakri Mamat – Head of Programme Master Mixed-Mode (Chemistry)
Dr. Amiruddin Shaari – Head of Programme Master Mixed-Mode (Physics)
Dr. Fuaada Mohd Siam – Head of Programme Master Mixed-Mode (Mathematics)
Dr. Yeak Su Hoe – Head of Programme Master Mixed-Mode (Engineering Mathematics)
Shahliza bt Shaharudin – Managemant of VIVA
Siti Amirah bt Abd. Wahab – Management of all Students Affairs, Department of Mathematical Sciences
Norafidah bt Nordin – Management of all Students Affairs, Department of Physics
Masitah Saihoni – Management of all Students Affairs, Department of Chemistry

Postgraduate Studies Committee
Department of Chemistry
Assoc. Prof. Dr. Zainab Ramli – Academic Manager and Department Postgraduate Committee Chairperson
Assoc. Prof. Dr. Farediah Ahmad – Head of Programme Research (Chemistry)
Dr. Mohd Bakri Mamat – Head of Programme Master Mixed-Mode (Chemistry)
Dr. Naji Arafat Mahat – Head of Programme Master Mixed-Mode (Forensic Science)
Dr. Roswanira Abdul Wahab

Postgraduate Studies Committee
Department of Physics
Assoc. Prof. Dr. Yusof Munajat – Academic Manager and Department Postgraduate Committee Chairperson
Assoc. Prof. Dr. Hazri Bakhtiar – Head of Programme Research (Physics)
Dr. Amiruddin Shaari – Head of Programme Master Mixed-Mode (Physics)
Dr. Ramli Arifin
Dr. Suhairul Hashim

Postgraduate Studies Committee
Department of Mathematical Sciences
Assoc. Prof. Dr. Nor'aini Aris – Academic Manager and Committee Chairperson
Assoc. Prof. Dr. Fadhilah Yusof – Head of Programme Research (Mathematics)
Dr. Fuaada Mohd Siam – Head of Programme Master Mixed-Mode (Mathematics)
Dr. Yeak Su Hoe – Head of Programme Master Mixed-Mode (Engineering Mathematics)
Prof. Dr. Mohd Nor Mohamad
Assoc. Prof. Dr. Munira Ismail
Assoc. Prof. Dr. Sharidan Shafie
Dr Shariffah Suhaila Syed Jamaludin
Dr. Nor Muhainiah Mohd Ali
Dr. Syarifah Zyurina Nordin

FACULTY OF SCIENCE ORGANIZATION CHART



LOCATION OF FACULTY OF SCIENCE

We are right in the middle of the University's Activity Centre. The Library (PSZ), the University Administrative Building, the CIMB Bank, the Mosque (MSI), the main cafeteria, the Student Union Building, and the University's Assembly Hall are all surroundings of the faculty.

The map shows the location of the UTM Campus, the Faculty of Science and the Ibnu Sina Institue for Fundamental Science Studies.

SELECTED STUDENT PROFILES

Bakhtiar Ul-Haq PhD(Physics)
Pakistan

I joined UTM as a PhD student in Physics on 24 Nov 2011. Now as it is the final stages of my Ph.D, I am realizing that joining UTM was one of the best decisions in my life. Here I found a highly educational environment that provokes individuals to utilize all skills in the guidance of highly qualified, hardworking and devoted staff. The teamwork with focused and well mannered students and teachers enhance confidence level. Regarding research activities, UTM provides all latest facilitates that modern and quality research demands for. Being a leading university in Malaysia and across the globe, it has attracted thousands of students from all over the world including Africa, Middle East, Central Asia, South Asia, China, Europe, Australia and America. The friendly attitude of different faces from all over the world have led UTM a multicultural university, where one can feel the essence of a mini universe within an area of 122 hectares. Such incredible capacities have made UTM an outstanding platform for academic, research and cultural activities.

Syazeven Effatin Azma Mohd Asri, PhD (Chemistry)
Malaysia

I was a student in Bachelor of Science (Chemistry) in UTM between 2008-2011. After I completed my degree, I decided to pursue my studies at PhD level in UTM. This is because UTM provides inspiring environment to the students by providing of arts instruments, professionals and academic services in an effort to enhance research quality. In addition, the informations regarding research and studies are easily obtained through mailing list, facebook and websites. Thus, I personally think that UTM is the perfect platform for students to excel in postgraduate studies.

Abdul Rahman Mohd Kasim PhD (Mathematics)
Malaysia

For me, Universiti Teknologi Malaysia is a place where the world cultures gather. We celebrate many festivals here. The students in various countries have been given opportunity to present their customs. Lots of event has been conducted to promote the excellent research and study environment. One of them is Global Outreach Program (GOP) where the student has been given the opportunity to travel over the globe to gain different experience while completing their studies. People in UTM are very friendly and the academic staffs are very knowledgeable in their field. Being here for such a long time starting bachelor degree until completing the PhD studies, I would say I am enjoying my university life very much. If anyone thinking to study in Malaysia the UTM is definitely the best choice.

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POSTGRADUATE STUDENTS SOCIETY FACULTY OF SCIENCE (PGSSFS)

POSTGRADUATE STUDENT SOCIETY, FACULTY OF SCIENCE (PGSSFS) IN BRIEF

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.

Activities

- Appreciation ceremony for Graduate of Faculty of Sciences (24 May 2014)
- Departmental Seminar
- Workshop : Plagiarism and Paraphrasing
- Latex Workshop
- National Convention of Forensic Medicine & Sciences
- Workshop on Numerical Methods for Solving Two Dimensional Navier- Stokes Equations Problems
- Honorus Recognition Ceremony
- Ez Template + Mendeley Workshop
- Sepetang Bersama Pemegang PhD Termuda Malaysia
- Introductory Data Analysis using SPSS
- 3MT Competition
- ISPC 2015
- Annual General Meeting

Achievement

Outstanding Achievement Award:
Best Postgraduate Student Society 2011/2012 from
School of Graduate Studies

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POSTGRADUATE RESEARCH

POSTGRADUATE RESEARCH

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

Chemistry: Separation science, zeolites, nanostructured materials, catalysis, polymer electrolytes, natural products, organic synthesis, organometallics, biotechnology, environmental chemistry, solid state chemistry, forensic science, chemometrics and computational chemistry.

Mathematics: Theory and applications in the following fields: Algebra and Analysis, Applied and Computational Mathematics, Numerical Analysis, Statistics and Operational Research.

Physics: Material Science, Advanced Material, Nanotechnology, Crystalgrowth & fabrication, Glass, ceramics and amorphous materials,Magnetic,dielectric materials and devices, Bulk semiconductor and thin film devices, Superconductors, Instrumentation, Nondestructive Testing, Instrumention in NDT, Intelligent instrumention; Digital signal processing; Parallel processing, Image and signal processing, Computer interfacing, Process automation, Development and application of microcontroller; Sensors,transducers and displays, Geomagnetic devices, Computational physics, Radiation Physics,Medical Physics, Radiation Protection, Environmental Protection,Environmental radioactivity level, Medical imaging;Theoretical nuclear physics, Neutron activation analysis, Photonics, Photonics components, Optoelectronics,Laser interferometry, Optical imaging, Terahertz imaging and spectroscopy, Laser and Electro-optics, Fibre optics sensors, Fibre Bragg Grating devices, Fiber laser, Laser applications.

Research Facilities

The faculty has a range of well equipped research laboratories and computing facilities to support research and teaching. Research facilities include nuclear magnetic resonance spectrometer (liquid and MAS NMR), gas chromatography (GC) and liquid chromatography (LC) systems, ion chromatography (IC), capillary electrophoresis unit, gas chromatography-mass spectrometer (GC-MS), inductively coupled-mass spectrometer (ICP-MS), transmission electron microscope (TEM), field emission scanning electron microscope (FESEM) and X-ray diffractometer (XRD), atomic absorption spectrometer (AAS), surface analyzer, thermogravimetric analyzer (TGA), voltammetric equipment, crystal growth and ultrasonic equipment, thin film coating, Fiber Bragg Grating Fabricator, Fiber Coupler Machine, Laser Welding Machine, Nd;YAG laser, Nitro-Dye laser, CO_2 Laser, Photonic Training Facilities, Thin Film Fabrication, PECVD, MOVPE, NDT Ultrasonic Testing, Material Analysis Laboratory, Crystal Growth Laboratory; Crystal Growth & Fabrication, Nuclear Laboratory. 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.

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POSTGRADUATE PROGRAMMES

ACADEMIC INFORMATION FOR POSTGRADUATE STUDIES

MODES OF STUDY

Faculty of Science students may enroll in any one of the two modes of study: Taught Course and Research (Mixed Mode) or 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 11 postgraduate programmes leading to the Masters of Science, Master of Philosophy or Doctor of Philosophy Degrees in areas of science and mathematics. The normal duration of study for full time students are 2–6 semesters (1–3 years) for the Master's programmes and 6–12 semesters (3–6 years) for the Doctor of Philosophy programmes. For part-timers, the normal duration for the Master's programmes are 4-8 semesters (2-4 years) and 8-14 semesters (4-7 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).

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
- UHAF 6033 – 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)

Summary of Programmes offered by Faculty of Science

Programmes	Mode
Master of Science Specialization : Chemistry	Taught Course and Research
Master of Science Specialization : Forensic Science	Taught Course and Research
Master of Science Specialization : Mathematics	Taught Course and Research
Master of Science Specialization : Engineering Mathematics	Taught Course and Research
Master of Science Specialization : Physics	Taught Course and Research
Master of Philosophy Field of Research : Chemistry	Research
Master of Philosophy Field of Research : Mathematics	Research
Master of Philosophy Field of Research : Physics	Research
Doctor of Philosophy Field of Research : Chemistry	Research
Doctor of Philosophy Field of Research : Mathematics	Research
Doctor of Philosophy Field of Research : Physics	Research

Master of Philosophy (M.Phil) and Doctor of Philosophy (Ph.D)

Programmes By Research (Full-time and Part-time)

General Information

Faculty of Science offers Master of **Philosophy** and Doctor of Philosophy programmes by research in all fields of specialisation (Chemistry, Mathematics and Physics). 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	Full Time	Part Time
M.Phil	Semester 2	Semester 3
PhD	Semester 3	Semester 5

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		Description
FT	PT	FT	PT	FT	PT	
MSCK 1100	MSCK 1110	MSCM 1100	MSCM 1110	MSCF 1100	MSCF 1110	Research
MSCK 1200	MSCK1210	MSCM 1200	MSCM 1210	MSCF 1200	MSCF 1210	Research
MSCK 2100	MSCK 2110	MSCM 2100	MSCM 2110	MSCF 2100	MSCF 2110	Research
MSCK 2200	MSCK 2210	MSCM 2200	MSCM 2210	MSCF 2200	MSCF 2210	Research
MSCK 3100	MSCK 3110	MSCM 3100	MSCM 3110	MSCF 3100	MSCF 3110	Research
MSCK 3200	MSCK 3210	MSCM 3200	MSCM 3210	MSCF 3200	MSCF 3210	Research
	MSCK 4110		MSCM 4110		MSCF 4110	Research
	MSCK 4210		MSCM 4210		MSCF 4210	Research
					MSCF 4010	Research
					MSCF 4910	Research

*FT = Full Time
*PT = Part Time
*Codes: xx0x = full time, xx1x = part time

PhD by Research course codes and description for different programmes

Chemistry		Mathematics		Physics		Description
FT	PT	FT	PT	FT	PT	
PSCK 1100	PSCK 1110	PSCM 1100	PSCM 1110	PSCF 1100	PSCF 1110	Research
PSCK 1200	PSCK 1210	PSCM 1200	PSCM 1210	PSCF 1200	PSCF 1210	Research
PSCK 2100	PSCK 2110	PSCM 2100	PSCM 2110	PSCF 2100	PSCF 2110	Research
PSCK 2200	PSCK 2210	PSCM 2200	PSCM 2210	PSCF 2200	PSCF 2210	Research
PSCK 3100	PSCK 3110	PSCM 3100	PSCM 3110	PSCF 3100	PSCF 3110	Research
PSCK 3200	PSCK 3210	PSCM 3200	PSCM 3210	PSCF 3200	PSCF 3210	Research
PSCK 4100	PSCK 4110	PSCM 4100	PSCM 4110	PSCF 4100	PSCF 4110	Research
PSCK 4200	PSCK 4210	PSCM 4200	PSCM 4210	PSCF 4200	PSCF 4210	Research
PSCK 5100	PSCK 5110	PSCM 5100	PSCM 5110	PSCF 5100	PSCF 5110	Research
PSCK 5200	PSCK 5210	PSCM 5200	PSCM 5210	PSCF 5200	PSCF 5210	Research
PSCK 6100	PSCK 6110	PSCM 6100	PSCM 6110	PSCF 6100	PSCF 6110	Research
PSCK 6200	PSCK 6210	PSCM 6200	PSCM 6210	PSCF 6200	PSCF 6210	Research
	PSCK 7110		PSCM 7110		PSCF 7110	Research
	PSCK 7210		PSCM 7210		PSCF 7210	Research
	PSCK 8110		PSCM 8110		PSCF 8110	Research
	PSCK 8210		PSCM 8210		PSCF 8210	Research

* FT = Full Time
* PT = Part Time
* Codes: xx0x = full time, xx1x = part time

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

For the PhD programmes in Chemistry, Mathematics and Physics, the subject code for research is given as PSCK wxyz, PSCM wxyz and PSCF wxyz, respectively.

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

TUITION FEES
Postgraduate tutition fees (as of academic year 2014/2015)

Masters (MSc)	**Malaysian students**		**International students**
	Full time (3 semesters)	Part time (4 semesters)	Full time (3 semesters)
Taught Course and Research (Mixed Mode)	RM 9,355	RM 8,290	RM 22,330
Master of Philosophy	RM 8,255	RM 7,490	RM 18,980

Doctor of Philosophy (PhD)	**Malaysian students**		**International students**
	Full time (6 semesters)	Part time (8 semesters)	Full time (6 semesters)
Taught Course and Research (Mixed Mode)	RM 18,860	RM 16,730	RM 44,810
Research	RM 15,860	RM 14,330	RM 37,310

ADMISSION REQUIREMENTS

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

Master's Degree

- A Bachelor's Degree with good honours (CGPA of at least 3.0) in a relevant field from Universiti Teknologi Malaysia or any other institutions of higher learning recognized by the UTM Senate; or
- Other qualifications equivalent to a Bachelor's Degree and experience in a related field recognized by the UTM Senate

Doctor of Philosophy

- A Master's Degree in a relevant field from Universiti Teknologi Malaysia or any other institutions of higher learning recognized by the UTM Senate

International Student Entry

International applicants must satisfy the academic admission and English language proficiency requirement (IELTS band 6 or TOEFL score of 550) and any other conditions specified.
Candidates from English speaking countries are exempted from the UTM English language requirement. Please visit the SPS (School of Graduate Studies) website at www.sps.utm.my for more information.

APPLICATION PROCEDURES

- All applications must be made online through the School of Graduate Studies (SPS) official website www.sps.utm.my

- Copies of degrees/diplomas/certificates, transcripts, identity card/passport, two (2) passport-sized photographs, TOEFL/IELTS certificates (for international applicants only) and research proposal (for Research applicants only) must be uploaded through the SPS official website or mailed to the following address:

Dean
School of Graduate Studies
Universiti Teknologi Malaysia,
81310 UTM Johor Bahru
Johor Darul Ta'zim, Malaysia

*Only applications with complete supporting documents will be considered for admission.

- Payment for the application fee of RM20.00 (for Malaysian applicants) or USD30 (for Malaysian PR/International applicants) must be made by one of the following means:
  1. By cash (in Malaysian Ringgit only) at the School of Graduate Studies (SPS) Office, Universiti Teknologi Malaysia, Johor Bahru or the UTM International Campus, Jalan Semarak, Kuala Lumpur.
  2. By cheque / bank draft / cashier's order payable to
     BENDAHARI UNIVERSITI TEKNOLOGI MALAYSIA
     Account number: 0118-0000002-05-4
  3. By electronic funds transfer. Bank swift code: CIBBMYKL, Bank: CIMB Bank Berhad

APPLICATION DEADLINE

- Applications for full research programmes (Master and PhD) are open throughout the year.
- Applications for Taught Course and Research (Mixed mode) programmes are open only for the September intake and the closing date is **31st May** (for Malaysian and International applicants).

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CHEMISTRY PROGRAMMES

CHEMISTRY PROGRAMMES

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

The Department of Chemistry offers the Master of Science programme by Taught Course and Research (Mixed Mode). Candidates are required to successfully complete a minimum of 42 credits which include at least 3 advanced chemistry courses (9 credits), 2 elective courses (6 credits), one research methodology course (3 credits), one compulsory University course (3 credits) and research project and dissertation (21 credits). The following is a typical course distribution for the MSc Taught Course and Research (Mixed Mode) in Chemistry :

Semester 1

Course Code	Course	Credit
MSCK 1413	Advanced Physical Chemistry	3
MSCK 1713	Advanced Inorganic Chemistry	3
MSCK 1xx3	Elective Course I	3
UHAX 6xx3	University compulsory course	3
	Total credits	12

Semester 2

Course Code	Course	Credit
MSCK 1613	Advanced Organic Chemistry	3
MSCK 1303	Research Methodology	3
MSCK 1xx3	Elective Course II	3
	Total credits	9

x = a code number

Semester 3

Course Code	Course	Credit
MSCK xx80/xx90	Dissertation	21
	Total credits	21

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

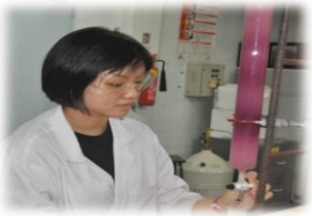
Course Code	Course	Credit
MSCK 1213	Advanced Analytical Chemistry	3
MSCK 1243	Advanced Separation Methods	3
MSCK 1263	Advanced Electroanalytical Chemistry	3
MSCK 1323	Advanced Biochemistry	3
MSCK 1333	Advanced Biotechnology	3
MSCK 1443	Advanced Solid State Chemistry	3
MSCK 1463	Quantum Chemistry and 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.

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.

Each student will be assigned a research project title to prepare a research during their Research Methodology Course. Research topics cover all main areas of chemistry: analytical chemistry, inorganic chemistry, physical chemistry, organic chemistry and biotechnology. Current research areas are as listed in the 'postgraduate programmes by research' section.




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

This is a 3-semester full-time programme comprising a total of 42 credits which 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	3
MSCN 19x3	Forensic Elective Course	3
MSCN 1853	Forensic Practical	3
MSCN 1303	Research Methodology	3
	Total credits	11

Semester 2

Course Code	Courses	Credit
MSCN 1823	Forensic Chemistry	3
MSCN 1813	Forensic Analytical Instrumentation	3
MSCN 1830	Expert Testimony & Moot Court	HW**
UHAX 6xx3	University compulsory course	3
	Total credits	10

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

Semester 3

Course Code	Courses	Credit
MSCN xx80/xx90	Dissertation	21
	Total credits	21

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

LIST OF COURSES

Forensic Elective Courses

Course Code	Courses	Credit
MSCN 1913	Crime Scene Investigation	3
MSCN 1923	Biological Aspects of Forensic Science	3
MSCN 1933	Examination of Questioned Documents	3
MSCN 1943	Quality Assurance in Forensic Science	3
MSCN 1953	Forensic Engineering	3
MSCN 1963	Computer Forensics	3
MSCN 1973	Fire and Explosion Investigation	3
MSCN 1983	Firearms and Forensic Ballistics	3
MSCN 1993	Forensic Toxicology and Drugs of Abuse	3

Please refer to Appendix B for the synopses of courses in Chemistry.

ADMISSION REQUIREMENTS

- A Bachelor's Degree in Chemistry or Forensic Science 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 which relevant to Forensics.

MASTER OF PHILOSOPHY AND DOCTOR OF PHILOSOPHY
FIELD OF RESEARCH : CHEMISTRY
- By Research (Full time and Part 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 & Reserch)*

Area of Research

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

RESEARCH AREAS

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

Please refer to the Department of Chemistry website at www.chem.utm.my for further details.

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MATHEMATICS PROGRAMMES

MASTER OF SCIENCE - by Taught Course and Research (Mixed Mode)
Specialization: Mathematics

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

Subject Code	Subjects	Credit
MSCM1043	Mathematical Methods I	3
MSCM1XY3	Elective mathematics subject	3
MSCM1XY3	Elective mathematics subject	3
**Uxxx 6XY3	University compulsory subject	3
	Total credits	**12**

**University compulsory subject

Semester 2

Subject Code	Subjects	Credit
MSCM1053	Computational Mathematics	3
MSCM1XY3	Elective mathematics subject	3
MSCM1033	Research Methodology	3
	Total credits	**9**

Semester 3

Subject Code	Subjects	Credit
MSCMXYZ0	Dissertation	21
	Total credits	**21**

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

LIST OF SUBJECTS

Core subjects

Subject Code	Subjects	Credits
MSCM1043	Mathematical Methods I	3
MSCM1053	Computational Mathematics	3
MSCM1033	Research Methodology	3
MSCM XYZ0	Dissertation	21

Elective subjects

Subject Code	Subjects	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 subject.

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 - by Taught Course and Research (Mixed Mode)
Specialization: Engineering Mathematics

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

Subject Code	Subjects	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

Subject Code	Subjects	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

Subject Code	Subjects	Credit
MSCJ XYZ0	Dissertation	21
	Total Credits	**21**

X – year of study ; Y – 1st or 2nd 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		3
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.

ADMISSION REQUIREMENTS

- A degree of Bachelor of Science or Bachelor of Engineering with good honours in a relatedfield, 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
(Full time and Part 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

Please refer to Appendix G for the list and details of research groups in the Department of Mathematics.

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PHYSICS PROGRAMMES

PHYSICS PROGRAMMES

Physics: Laser and Nonlinear Optics, Advanced Photonics, Quantum Structures, Advanced Optical Material, Phosphor Material, Applied Radiation Science and Scientific Computing and Instrumentations.

Research Facilities

The faculty has a range of well equipped research laboratories and computing facilities to support research and teaching. Research facilities include nuclear magnetic resonance spectrometer (liquid and MAS NMR), gas chromatography (GC) and liquid chromatography (LC) systems, ion chromatography (IC), capillary electrophoresis unit, gas chromatography-mass spectrometer (GC- MS), inductively coupled-mass spectrometer (ICP-MS), transmission electron microscope (TEM), field emission scanning electron microscope (FESEM) and X-ray diffractometer (XRD), atomic absorption spectrometer (AAS), surface analyzer, thermogravimetric analyzer (TGA), voltammetric equipment, crystal growth and ultrasonic equipment, thin film coating, Fiber Bragg Grating Fabricator, Fiber Coupler Machine, Laser Welding Machine, Nd:YAG laser, Nitro-Dye laser, CO_2 Laser, Photonic Training Facilities, Thin Film Fabrication, PECVD, MOVPE, NDT Ultrasonic Testing, Material Analysis Laboratory, Crystal Growth Laboratory; Crystal Growth & Fabrication, Nuclear Laboratory. The research facilities are supported by a team of qualified and trained technical staff.

MASTER OF PHILOSOPHY AND DOCTOR OF PHILOSOPHY – by Research (Full time and Part 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

Area of Research

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

Laser and Nonlinear Optics

- Design laser systems and components
- Application of laser for specific purposes in nonlinear optic studies, laser surface treatments and laser annealing
- Single photon generation and detection

Advanced Photonics
- Design, modelling and fabrication of photonic components & devices
- Development of fibre optic probes and sensors for various applications
- Terahertz spectroscopy & imaging
- Applied Optics

Quantum Structures
- Quantum dots and nanowires in: GaAs, Si,
- Quantum nano-structure for SETs,
- Quantum dots solar cells,
- Silicon nano-crystal

Advanced Optical Material
- Studies of of Growth of Nd:YAG, $LiNbO_3$ and Ti-sapphires single crystals
- Rare earth-doped glasses: Tellurite, phosphate, borate and silicate lasing glasses
- Metallic nanoparticle based nanoglass
- Metallic nanoparticle based glass ceramics
- Plasmon and plasmonic
- Magnetic glass
- Glass corrosion

Phosphor Material
- Inorganic Luminescent Materials
- Oxide Based Phosphor
- Rare-earth-activated Inorganic Material
- Long-lasting Phosphorescence Properties
- Solid-state Lighting
- Phosphors and Display Materials
- Phosphor Coatings
- Phosphor Sensor

Applied Radiation Science
- Radiation dosimetry: Thermoluminescence and optically simulated luminescence (OSL) dosimetry
- Radiological environmental monitoring
- Radiation imaging
- Neutron activation analysis

Scientific Computing and Instrumentations
- Monte Carlo Dose Calculation In Snyder Analytical Head Phantom
- Modelling a Gate Turn-Off (Gto), Thyristor and MOSFETS
- Non-Linear Transport In Single Electron Transistor
- Density Functional Theory (DFT) calculation on semiconductors compound nano-cluster
- Wireless Data Communication System using RF signal
- Infrared Transceiver for serial devices communication
- Non-destructive testing evaluations and instrumentations
- Corrosion monitoring and measurements.
- Electromagnetic wave and ground penetrating radar modelling and measurements.

Please refer to Appendix G for the list and details of research groups in the Department of Physics.

MASTER OF SCIENCE - 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 1123	Elementary Particles	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 1113	Quantum Mechanics	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 (page 86) for synopsis of each course.

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SYNOPSES OF COURSES (CHEMISTRY)

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 methods, thin film techniques and solid state process. The course features essential characterization tools in the solid state scope including X-ray techniques, Nuclear Molecular Resonance (NMR) Spectroscopy, Magnetic Resonance Imaging (MRI) and Electron Spin Resonance (ESR) Spectroscopy and their applications. Illustrations of the preparation and characterization techniques will be discussed in detail based on real researched materials through individual project works.

References:

1. Dann, S. E., Reactions and Characterization of Solids, New York, NY : Royal Society of Chemistry, 2002.
2. Atkins, P and DePaula, J., Physical Chemistry, 8th Edition. Oxford University Press, 1997.
3. Abragam, A. and Blaney, B., *Electron Paramagnetic Resonance of Transition Ions*, Dover Publication New York, 1986.

MSCK 1613 : ADVANCED ORGANIC CHEMISTRY

This course covers the principles of stereochemistry. These include enantiomers, diastereomers, labeling stereogenic centers with R and S, molecules with optical activity, conformations of acyclic and cyclic compounds stereochemistry of reactions and asymmetric synthesis. It also covers the mechanisms of reactions such as substitutions, elimination and rearrangement.

References:

1. March, J., Advanced Organic Chemistry: Reactions, Mechanisms and Structures", Wiley, New York, 4th Edition, 1992.
2. Carey, F.A, and Sundberg, R.J., Advanced Organic Chemistry. Part A: Structure and Mechanisms, Kluwer Academic / Plenum Publishers, 4th Edition, 2000.
3. Carey, F.A, and Sundberg, R.J., Advanced Organic Chemistry. Part B: Reactions and Synthesis, Springer, 4th Edition, 2001.
4. Morrison, R.J., and Boyd, R.N.,Organic Chemistry, Prentice Hall International, Inc. 6th Edition, 1992.
5. Smith, J.G., Organic Chemistry, Mc Graw-Hill International Edition, 3rd Edition, 2010.

MSCK 1713 : ADVANCED INORGANIC CHEMISTRY

This course emphasises the principles and trends in the chemistry of the elements and on the essentials of structure, bonding, and reactivity of inorganic systems. Recent advances in the subject and reviews of topics in inorganic chemistry, the underlying principles of experimental and theoretical techniques employed to study inorganic systems will be explored. Topics include bonding and Group theories, main group chemistry on boron and phosphorus, transition metals and organometallic chemistry, special topics on inorganic cluster compounds and multinuclear NMR studies.

References:

1. Douglas, B., McDaniel, D., Alexander, J.,Concepts and Models of Inorganic Chemistry, 3rd Edition; John Wiley and Sons: New York, 1994.
2. Miessler, G. L., Tarr, D. ,Inorganic Chemistry, 3rd Edition; Pearson Prentice-Hall: New York, 2003.

3. Atkins, P., Overton, T., Rourke, J. Weller, M. and Amstrong, F. Inorganic Chemistry, 3rd 5th Edition; Oxford University Press: London, 2009
4. Cotton, F. A., Wilkinson, G., Murillo, C. A., Bochmann, M., Advanced Inorganic Chemistry, Sixth Edition; Wiley-Interscience: New York, 1999.
5. Journals related to Inorganic Chemistry, Coordination Compounds, Organometallics etc.

MSCK 1303 /USCP 0010 : 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.

References:

1. Berg, B. L., Qualitative research methods for the social sciences, 7th Edition. Boston :Allyn & Bacon, 2009.
2. William, S. Jr., White, E. B. and Angell, R. Basic research methods : an entry to social science research. The Elements of Style, 4th ed., Longman, 2000.
3. Blake, G. and Bly, R. W., Elements of Technical Writing, 1st Edition, 1993.
4. Leedy, P. D. and Ormrod J. E., Practical Research: Planning and Design, 7th Edition. 2001.
5. Graziano, A. M. and Raulin, M. L., Research Methods: A Process of Enquiry, 5th Edition 2004.
6. Journals that cover innovations and applications in the field of Pure and Applied Chemistry as well as Forensic Science such as Science & Justice, Journal Forensic Sciences, Journal of Chromatography A, The Analyst, Analytica Chimica Acta, Analytical Chemistry, Talanta, Analytical Letters, Analytical and Bioanalytical Chemistry.

MSCK xx80/MSCK xx90 : 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 MSCK 1303. Students will conduct research work in a 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.

References:

1. Strunk W. Jr., White, E.B. and Angell, R., The Elements of Style, 4th ed.,Longman, 2000.
2. Blake G. and Bly, R.W., Elements of Technical Writing, 1st ed., 1993.
3. Lakatos, I., Worral, J. and Currie, G., The Methodology of Scientific Research Programs, Eds., Cambridge, Cambridge University Press, 1978.
4. Leedy P. D. and Ormrod J. E., Practical Research: Planning and Design, 7th Edition. 2001.
5. Graziano, A. M., and Raulin, M. L., Research Methods: A Process of Enquiry, 5th Edition. 2004.
6. Journals that cover innovations and applications in the field of Pure and Applied Chemistry as well as, Journal of Chromatography A, The Analyst, Analytica Chimica Acta, Analytical Chemistry, Talanta, Analytical Letters, Analytical and Bioanalytical Chemistry.

MSCK 1213 : ADVANCED ANALYTICAL CHEMISTRY

This subject largely covers technical aspects and 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) and its advances, high performance liquid chromatography (HPLC) and its advances, and capillary electrophoresis (CE) and its advances. The spectroscopic methods include atomic absorption spectroscopy (AAS), atomic emission spectroscopy (AES), inductively-coupled plasma spectroscopy (ICP), ICP coupled with mass spectrometry (ICP-MS) and its advances. Analytical electrochemistry covers current advances in the development and application of finite-current-controlled techniques including cyclic voltammetry, chronoamperometry, polarography, pulse and differential pulse voltammetry, square wave voltammetry, and stripping analysis; potentiometry; chemical sensors with emphasis on the technology and modification of electrodes (including the ultramicroelectrodes and modified electrodes).

References:

1. Mohd Marsin Sanagi, Teknik Pemisahan Dalam Analisis Kimia, Skudai: Penerbit UniversitiTeknologi Malaysia, 1998.
2. Christian, G. D. and O'Reilly, J. E, Instrumental Analysis, 2nd Edition, Boston: Allyn and Bacon,1986.
3. Skoog, D. A, Holler, F. J. and Nieman, T. A, Principles of Instrumental Analysis, 5th Edition,Forth Worth: Saunders College Publ., 1998.
2. Willard, H. H, Merritt, L. L, Dean, J. A. and Settle, F. A, Instrumental Method of Analysis, 7thEdition, Belmont: Wardsworth, 1988.
3. Wan Aini Wan Ibrahim et al., Research Monograph on Enantioseparation of selected triazolefungicides using micellar electrokinetic chromatography: effect of cyclodextrin concentration, UTM, 2008.
4. Journals in analytical chemistry, such as Analytical Chemistry, Analytica Chimica Acta,Analytical Instrumentation, Analytical Communications, Analyst, Applied Spectroscopy, Journal of the Association of Official Analytical Chemists, Spectrochimica Acta, Talanta, Journal of Analytical Atomic Spectrometry, and Trends in Analytical Chemistry.
5. Journals in chromatography and other separation techniques, such as Journal of Chromatography A, Journal of Liquid Chromatography, and Journal of Chromatographic Science.

MSCK 1243 : ADVANCED SEPARATION METHOD

This course introduces the basic principles, instrumentation and applications of separation methods commonly used in chemical analysis. A general overview and classifications of common separation methods is first given followed by their basic principles of separation. Major separation methods and its applications discussed include extraction, chromatography and electrophoresis

References:

1. Mohd Marsin Sanagi , Second Printing (2001) "*Teknik Pemisahan dalam Analisis Kimia*", Skudai: Penerbit UTM.
2. J. P. Cutter (2005), *Separation Methods in Microanalytical Systems*, CRC Press.
3. C. Poole (2009), *Handbook of Methods and Instrumentation in Separation Science*, Academic Press.
4. H. J. Issaq (Editor) (2001), *A Century of Separation Science,* CRC Press.
5. Relevant journals on separation sciences such as: *Journal of Chromatography*, *Journal of Chromatographic Science*, *Anaytica Chimica Acta, Chromatographia*, *Analytical Chemistry*, etc. Relevant websites on separation methods

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

References:

1. Joseph Wang, "Analytical Electrochemistry", Wiley-VCH, 2006.
   Hubert H. Girault, "Analytical and Physical Electrochemistry (Fundamental Sciences), EFPL Press, Switzerland, 2004.
2. Kenneth I. Ozomwna, "Recent Advances in Analytical Electrochemistry 2007", Transworld Research Network, India, 2007.
3. Wilfred Plieth, "Electrochemistry for Materials Science", Elsevier Science, 2008.
   Journals that cover innovations and applications in the field of electroanalytical chemistry: Bioelectrochemistry and Bioenergetics, Biosensors and Bioelectronics, Electroanalysis, Electrochemistry Communications, Electrochimica Acta, Journal of Applied Electrochemistry, Journal of Electroanalytical and Interfacial Electrochemistry, Journal of the Electrochemical

MSCK 1323 : ADVANCED BIOCHEMISTRY

This course focuses on the integration of the major metabolic processes in mammals. It covers an overview of metabolic processes and a description of the major metabolic contributions of several major organs. Discussion of the feeding fasting cycle, which illustrates several important control mechanisms, will also be included. In addition, a brief review of the major mammalian hormones and their mechanisms of action will also be discussed.

References:

1. Hames, B.D., Hooper, N.M. and Houghton, J.D., Instant Notes in Biochemistry. Bios Scientific Publishers Limited, 1997.
2. McKee, T. and McKee, J, Biochemistry The Molecular Basis of Life.McGraw Hill, New York, 3rd Edition, 2003.
3. Journals related to Biochemistry.

MSCK 1333 : ADVANCED BIOTECHNOLOGY

This course covers the importance of industrial enzymes in biotechnology. Some of the enzymes that have importance in industrial biotechnology include lipases, proteases and amylases. An introduction to protein chemistry will be discussed, 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. Preparation and application of enzymes used in the industry will be discussed based on information from reputable journals.

References:

1. Polaina, J. and MacCabe, A. P. Editors, Industrial Enzymes Structure, Function and Applications. Springer, Dodrecht, The Netherlands, 2007.
2. Hames, B.D., Hooper, N.M. and Houghton, J.D., Instant Notes in Biochemistry, Bios Scientific Publishers Limited, 1997.
3. McKee, T. and McKee, J, Biochemistry The Molecular Basis of Life. McGraw Hill, NewYork, 3rd Edition, 2003.
4. Journals related to Biochemistry and Biotechnology

MSCK 1463 : QUANTUM CHEMISTRY AND SPECTROSCOPY

This is an elective course that presents 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.

References:

1. Struve, W. S., Fundamentals of Molecular Spectroscopy, Wiley & Sons, New York. 1989
2. Atkins, P.W. and de Paula, J., Physical Chemistry, 8th Edition. Oxford University Press. 2006.
3. S. Svanberg, Atomic and Molecular Spectroscopy: Basic Aspects and Practical Applications, Springer, Germany 2004
4. Sanders, J.K.M., Modern NMR Spectroscopy, Oxford University Press, 2005.
5. Levine, I.N., Molecular Spectroscopy, John Wiley & Sons, New York. 1975
6. Vincent, A. Molecular Symmetry and Group Theory, 2nd Edition. John Wiley & Sons. 2001.
7. Pauling, L., Wilson, E.B., Introduction to Quantum Mechanics with Applications to Chemistry. Dover. New York. 1985
8. Barnwell, C.N. and McCash, E.M., Fundamentals of Molecular Spectroscopy, 4th Edition, McGraw Hill, 1994.
9. Lambert, J.B. and Mazzola, E.P., Nuclear Magnetic Resonance Spectroscopy: An Introduction to Principles, Application and Experimental Methods. Pearson Education Inc., 2004.
10. Jaan, L. (Editor), Frontier of Molecular Spectroscopy, Elsevier S & T, 2008.

MSCK 1473 : ADVANCED SURFACE AND COLLOID CHEMISTRY

This is an elective course 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.

References:

1. Hussain, A., Mohd. Saiyudi, N.K.W and Abdul Majid, Z., Introduction to Surface and Colloid Chemistry, 3rd Edition, UTM, 2008.
2. Pashley, R.M. and Karaman, M.E., Applied Colloid and Surface Chemistry. John Wiley & Sons, Ltd., 2004.
3. Myers, D., Surface, Interface and Colloid: Principles and Application, VCH Publisher, Inc., 1991.
4. Shaw, D.J., Kimia Kolloid dan Kimia Permukaan. Edisi 1, Dewan Bahasa dan Pustaka, (Terjemahan oleh Satapah Ahmad), 1989.
5. Adamson, A.W., Physical Chemistry of Surfaces. 4th Edition, John Wiley and Sons, 1982.
6. Gregg, S.J. and Sing, K.W., Adsorption, Surface Area and Porosity. 2nd Edition, Academic Press,1982.

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

References:

1. D Pavia, GM Lampman and GS Kriz, Introduction To Spectroscopy, 4th Ed, Brooks/Cole, Thomson Learning, US, 2009.
2. LD Field, S. Sternhell and JR Kalman, Organic Structures from Spectra, 2nd Ed, John Wiley and Sons, UK, 1995.
3. NE Jacobsen, NMR Spectroscopy Explained: Simplified Theory, Applications and Examples for Organic Chemistry and Structural Biology, Wiley-Interface, 2007.
4. PY Bruice, Organic Chemistry, 5th Ed, Pearson Prentice Hall, US, 2007.
5. JB Lambert, HF Shurverll, D Lightner, RG Cooks, Organic Structural Spectroscopy, Prentice-Hall, USA, 1998

MSCK 1743 : BIOINORGANIC CHEMISTRY

Bioinorganic chemistry is the study of inorganic species especially metal ions in biological system. The course covers the principles of coordination chemistry and a survey of biological molecules and ligands. Topics considered include 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 andhydrolytic enzymes Vitamin B12, nitrogenases and hydrogenases. The use of metal complexes as therapeutic agents is also studied.

References:

1. Cowan, A.J., Inorganic Biochemistry: An Introduction, VCH Publishers,1993.
2. Lippard, S.J., and Berg, J.M., Principles of Bioinorganic Chemistry, USB, Ca., 1994.
3. da Silva, F., and Williams, R. J. P., The Biological Chemistry of the Elements: The Inorganic Chemistry of Life, 2nd Edition, OUP, Oxford, 2001.
4. Journals related to Bioinorganic Chemistry, Coordination Compounds, Organometallics etc

MSCK 1753 : INORGANIC REACTIONS MECHANISM

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

References:

1. J. Burgess and M.L. Tobe. Inorganic Reaction Mechanisms. Prentice-Hall, 2000.
2. R.B. Jordan. Reaction Mechanisms of Inorganic and Organometallic Systems. 3rd Edition. OUP, USA. 2007.
3. P.W.N.M. van Leeuwen, Homogenous Catalysis: Understanding the Art, Kluwer, 2004.
4. J.D. Atwood. Inorganic and Organometallic Reaction Mechanisms. Wiley-VCH Verlag, 2nd Edition. 1996
5. R.G. Wilkins, Kinetics and Mechanisms of Reactions of Transition Metal Complexes, VCH, 1991

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SYNOPSES OF COURSES (FORENSIC SCIENCE)

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

References:

1. Berg, B. L., Qualitative research methods for the social sciences, 7th Edition . Boston: Allyn & Bacon, 2009.
2. William, S. Jr., White, E. B. and Angell, R. Basic research methods : an entry to social science research. The Elements of Style, 4th ed., Longman, 2000.
3. Blake, G. and Bly, R. W., Elements of Technical Writing, 1st Edition, 1993.
4. Leedy, P.D. and Ormrod J. E., Practical Research: Planning and Design, 7th Edition . 2001.
5. Graziano, A. M. and Raulin, M. L., Research Methods: A Process of Enquiry, 5th Edition 2004.
6. Journals that cover innovations and applications in the field of Pure and Applied Chemistry as well as Forensic Science such as Science & Justice, Journal Forensic Sciences, Journal of Chromatography A, The Analyst, Analytica Chimica Acta, Analytical Chemistry, Talanta, Analytical Letters, Analytical and Bioanalytical Chemistry

MSCN xx80/MSN xx90 : DISSERTATION

Students must have completed the Research Methodology Course (MSN 0010) before they are allowed to register for this course. In this course students will implement the research proposal prepared in MSN 0010) Students will conduct research work in a forensic chemistry laboratory, computer lab or a validated laboratory/external forensic institutions. 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

References:

1. William Strunk Jr., E.B. White and Roger Angell, The Elements of Style, 4th ed.,Longman, 2000.
2. Gary Blake And Robert W. Bly, Elements of Technical Writing, 1st ed., 1993.
3. Lakatos, I., John Worral, J. and Gregory Currie, G., The Methodology of Scientific Research Programs, Eds., Cambridge, Cambridge University Press, 1978.
4. Leedy P. D. and Ormrod J. E., Practical Research: Planning and Design, 7th Edition. 2001.
5. A. M. Graziano, and M. L. Raulin, Research Methods: A Process of Enquiry, 5th Edition. 2004.
6. Journals that cover innovations and applications in the field of Pure and Applied Chemistry as well as Forensic Science such as Science & Justice, Journal Forensic Sciences, Journal of Chromatography A, The Analyst, Analytica Chimica Acta, Analytical Chemistry, Talanta, Analytical Letters, Analytical andBioanalytical Chemistry

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.

References:

1. Bell, S., Forensic Chemistry, Prentice Hall, New Jersey, USA, 2006.
2. Umi Kalthom Ahmad dan Abdul Rahim Yacob, Pengenalan Sains Forensik, Penerbit UTM, 2003.
3. Saferstein, R., Handbook of Forensic Science, Prentice Hall, Vol. 1 & 2, 1988.
4. Saferstein, R., Criminalistic, An Introduction to Forensic Science, Prentice Hall, 1998.
5. Journals that cover innovations and applications in the field of Pure and Forensic Chemistry such as Science & Justice, Journal Forensic Sciences, Journal of Chromatography A, The Analyst, Analytica Chimica Acta, Analytical Chemistry, Talanta, Analytical Letters, Analytical and Bioanalytical Chemistry.

MSCN 1803 : FORENSIC EVIDENCE AND THE ASPECTS OF LAW

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

References:

1. Slide presentation and video clip on the internet. http://elearning.utm.my
2. Umi Kalthom Ahmad dan Abdul Rahim Yacob, Pengenalan Sains Forensik, Penerbit UTM, 2003.
3. Saferstein, R., Handbook of Forensic Science, Prentice Hall, Vol. 1 & 2, 1988.
4. Saferstein, R., Criminalistic, An Introduction to Forensic Science, Prentice Hall, 1998.
5. Mimi Kamariah Majid, Criminal Procedure in Malaysia, 3rd ed., University of Malaya Press, 1999.
6. Francis Ng Aik Guan, Criminal Procedure, Malayan Law Journal, 2000.

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.

References:

1. Slide presentation and video clip on the internet. http://elearning.utm.my
2. Ho, M. H., Analytical Methods in Forensic Chemistry, New York: E Horwood, 1990.
3. White, P.,Crime Scene to Court -The Essentials of Forensic Science, , The Royal Society of Chemistry, 1998.
4. Yinon, J., Advances in Forensic Application of Mass Spectrometry, CRC Press, Boca Raton, 2004.
5. Petersen, J.K., Understanding Surveillance Technologies, Spy Devices, Their Origins and Applications, CRC Press, Boca Raton, 2001.
6. Journals that cover innovations and applications in the field of Forensic such as Science & Justice & Journal Forensic Sciences.

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.

References:

1. Bell, S., Forensic Chemistry, Prentice Hall, New Jersey, USA, 2006.
2. Umi Kalthom Ahmad dan Abdul Rahim Yacob, Pengenalan Sains Forensik, Penerbit UTM, 2003.
3. Saferstein, R., Handbook of Forensic Science, Prentice Hall, Vol. 1 & 2, 1988.
4. Saferstein, R., Criminalistic, An Introduction to Forensic Science, Prentice Hall, 1998.
5. Journals that cover innovations and applications in the field of Pure and Forensic Chemistry such as Science & Justice, Journal Forensic Sciences, Journal of Chromatography A, The Analyst, Analytica Chimica Acta, Analytical Chemistry, Talanta, Analytical Letters, Analytical and Bioanalytical Chemistry.

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.

References:

1. Moenssens, A. and Starrs, J., Scientific Evidence in Civil and Criminal Cases, Westbury, Foundation Press, 1995.
2. White, P., Crime Scene to Court -The Essentials of Forensic Science, The Royal Society of Chemistry, 1998.
3. Mimi Kamariah Majid, Criminal Procedure in Malaysia, 3rd ed., University of Malaya Press, 1999.
4. Francis Ng Aik Guan, Criminal Procedure, Malayan Law Journal, 2000

MSCN 1913 : CRIME SCENE INVESTIGATION

This course deals with advanced topics relating to the role physical evidence plays in the criminal justice system. Topics include philosophical aspects of crime scene investigation as well as the practical crime scene searching techniques, evidence collection, handling and management and the legal framework as it relates to physical evidence.

References:

1. Horswell, J., The Practice of Crime Scene Investigation, CRC, Boca Raton, 2004
2. Fisher, B.A.J., Techniques of Crime Scene Investigation, 7th edition, CRC, Boca Raton, 2004.
3. Saferstein, R., Handbook of Forensic Science, Prentice Hall, Vol. 1 & 2, 1988.
2. Saferstein, R., Criminalistic, An Introduction to Forensic Science, Prentice Hall, 1998.
3. White, P., Crime Scene to Court -The Essentials of Forensic Science, The Royal Society of Chemistry, 1998.

MSCN 1923 : BIOLOGICAL ASPECTS OF FORENSIC SCIENCE

This course introduces the principles of forensic serology, DNA, pathology, anthropology, odonthology and toxicology. 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.

References:

1. Saferstein, R., Handbook of Forensic Science, Prentice Hall, Vol. 1 & 2, 1988.
2. Saferstein, R., Criminalistic, An Introduction to Forensic Science, Prentice Hall, 1998.
3. Eckert & James. Interpretation of Bloodstain Evidence at Crime Scenes, NY: Elsevier Press. 1989.
4. Gaensslen, R. Sourcebook in Forensic Serology, Immunology, and Biochemistry, NIJ: NCJRS, 1983.
5. Keith Inman and Norah Rudin, Introduction to Forensic DNA Analysis, CRC Press, Boca Raton, 2002.

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.

References:

1. Brunelle, R., "Questioned Document Examination" in R. Saferstein (ed.) Forensic Science Handbook. Englewood Cliffs, NJ: Prentice-Hall, 1982.

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.

References:

1. Handbook of quality assurance for the analytical chemistry laboratory/ James P. Dux, New York: Van Nostrand Reinhold, 1986.
2. Laboratory quality assurance / Peter J. Howanitz, Joan H. Howanitz

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.

References:

1. Carper, K.L., Forensic Engineering, Elsevier, 1989.
2. Lewis, P. R., Reynolds, K. and Gagg, C., Forensic Materials Engineering, 2003.

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.

References:

1. Mohay, G., Computer Intrusion Forensics, Boston Artech House, 2003.
2. Vacca, Jand Hingham, J. R.,Computer Forensics: Computer Crime Investigation, Mass. Charles River Media, 2002.
3. Caloyannides, M. A., Computer Forensics and Privacy, Norwood, Mass., Artech House, 2001.
4. Johnson, T.A., Forensic Computer Crime Investigation, CRC Press Boca Raton, 2006.
5. Middleton, B., Cyber Crime Investigator's Field Guide, 2nd Ed., Averbach, Boca Raton , 2005.

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.

References:

1. Analytical Methods in Forensic Chemistry, editor Mat H. Ho, New York : E Horwood, 1990.
2. Kirk's Fire Investigation, John De Haan, 5th ed., Prentice Hall, 2002.
3. NFPA 921 Guide for Fire and Explosion Investigations, 2008.
4. Modern Methods and Applications in the Analysis of Explosives, J. Yinon and S. Zitrin, John Wiley. 1993.

MSCN 1983 : FIREARMS AND FORENSIC BALLISTICS

This course covers aspects of the forensic firearms examination. The science of ballistics will also be dealt with.

References:

1. Vincent, J. M., Di Maio, M.D., Gunshot wounds: Practical Aspects of Firearms, Ballistics, and Forensic Techniques, 2nd Ed., CRC Press, Boca Raton, Fla., 1998.

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.

References:

1. Fenton, J.J., Toxicology, A Case Oriented Approach, CRC Press, Boca Raton, 2003.
2. Curry, A., Poison Detection in Human Organs, Thomas, Springfield, 1988.
3. Karch, S. B., Drug Abuse Handbook, CRC Press, Boca Raton, 1998.

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SYNOPSES OF COURSES (MATHEMATICS)

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.

References:

1. Arfken, G., *Mathematical Methods for Physicists,* Academic Press, New York, 1985.
2. Bender, C. M. and Orszag, S.A.*Advanced Mathematical Methods for Scientists and Engineers*, McGraw - Hill, 1978.
3. Carlson, B.C. *Special Functions of Applied Mathematics,* Academic Press,New York,1977.
4. Jeffrey, A. *Advanced Engineering Mathematics*, Academic Press, 2003.
5. King, A.C. J. Billingham and S.R. Otto, *Differential Equations: Linear, Nonlinear, Ordinary, Partial,* CambridgeUniversity Press, 2003.
6. Sneddon, I.H. *The Use of Integral Transforms*, 1982.

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.

References:

1. Salleh, S. *C++ Numerical and Visual Programming*, 2008.
2. Jones, R. M. *Introduction to MFC Programming with Visual C++*, Richard M., Prentice-Hall, 2000.
3. Salleh, S., Zomaya, A.Y.,Olariu, S. And Sanugi, B. *Numerical simulations and case studies using Visual C++.Net,* Wiley-Interscience, USA, 2005.
4. Salleh, S., Zomaya, A.Y., and Bakar, S. A. *Computing for Numerical Methods Using Visual C++,* Wiley-Interscience, USA, 2008.

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).

References:

1. Jameson, G.J.O. *Topology and Normed Spaces*, Chapman and Hall, New York, 1976.
2. Kreyszig, E. *Introductory Functional Analysis with Applications*, John Wiley and Sons, New York, 1978.
3. Limaye, B.V. *Functional Analysis*, Wiley Eastern Limited, New Delhi, 1981.
4. Fakhar, K. and Yaacob, Y. *Introduction to Functional Analysis*, UTM Press (in press).

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.

References:

1. Kevokian, J. and Cole, J.D. *Perturbation Methods in Applied Mathematics*. Springer-Verlag , New York, 1980.
2. Bender, C.M. and Orszag, S. A. *Advanced Mathematical Methods for Scientists and Engineers*, McGraw-Hill Book Company, 1978.
3. Nayfeh,. A.H. *Introduction to Pertubation Techniques*. John Wileyand Sons, New York, 1993.
4. Holmes. M.H. *Introduction to Pertubation Methods*. Springer-Verlag, New York, 1995.
5. Hinch. E. J. *Pertubation Methods*. Cambridge University Press, New York, 1991.

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.

References:

1. Spiegel, M. *Theoretical Mechanics*, Schaum Series, Addison-Wesley, 1970.
2. Goldstein, H. *Clasical Mechanics*, Addison-Wesley, 1981.
3. Arnold, V. *Mathematical Methods in Classical Mechanics*, Springer-Verlag,1985.
4. Logan, J.D. *Applied Mathematics*, John Wiley & Sons, 1997.
5. Baruh, H. *Analytical Dynamics*, McGraw-Hill, 1999.

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.

References:

1. Bhatnagar, P.L. *Nonlinear Waves in One-Dimensional Dispersive Systems*. Oxford University Press, Oxford,1979.
2. Toda, M. *Nonlinear Waves and Solitons*. Kluwer Academic Publishers, Dordrecht,1989.
3. Dodd, R.K., Eilbeck,J.C., Gibbon, J.D. and Morris, H.C. *Solitons And Nonlinear Wave Equations.* Academic Press, London,1982.
4. Drazin, P.G. *Solitons.* Cambridge University Press, Cambridge, 1985.
5. Hazewinkel, M., Capel, H.W., and de Jager, E.M. (eds.). *Proceedings of the International Symposium KdV '95,* 1995.
6. Filippov, A. *The Versatile Soliton*. Birhauser, Boston, 2000.
7. Infeld, E. and Rowlands, G. *Nonlinear Waves, Solitons and Chaos*, Cambridge University Press, 2000.

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.

References:

1. Paterson, A.R.*A First Course in Fluid Dynamics*. Cambridge, UK, 1983.
2. Acheson. D.J. *Elementary Fluid Dynamics*.Oxford,UK, 1992.
3. Ligget, J.A. *Fluid Mechanics.* Mc Graw-Hill: New York, 1994.
4. Street, R.L. et al. *Elementary Fluid Mechanics.* John Wiley and Sons: New York, 1996.
5. Anderson, J.D, Jr. *Computational Fluid Dynamics*. McGraw Hill: New York, 1995.
6. White, F.M. *Fluid Mechanics*. McGraw Hill: New York, 2003.
7. Robert, J.R. *Heat Transfer Tools*. McGraw Hill: New York, 2002.
8. Chung, T.J. *Computational Fluid Dynamics*. Cambridge University Press, UK, 2002.

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.

References:

1. Asmar, N.H., *Applied Complex Analysis with Partial Differential Equations*. Prentice Hall, New Jersey, 2002.
2. Henrici, P., *Applied and Computational Complex Analysis*. Volume 1, John Wiley & Sons, New York, 1974.
3. Jeffrey, A., *Complex Analysis and Applications*. 2nd ed., Chapman and Hall/CRC, Boca Raton, 2006.
4. Kwok, Y.K., *Applied Complex Variables for Scientists and Engineers*. Cambridge University Press, 2002.
5. Robertson, J.S., *Engineering Mathematics with Mathematica*. McGraw-Hill, 1995.

6. Saff, E.B. & Snider, A.D. *Fundamentals of Complex Analysis for Mathematics, Science and Engineering.* 3rd ed., Prentice Hall, 2003.
7. Wunsch, A.D. *Complex Variables with Applications.* 3rd ed.,Addison-Wesley, 2005.

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.

1. Awrejcewicz, J. and Krys'ko, V., *Introduction to asymptotic methods*, CRC Press, 2006.
2. Bender,C. and Orszag, S., *Advanced Mathematical Methods for Scientists and Engineers*, Springer, 1999.
3. Bleinstein, N. and Handelman, R.A., *Asymptotic Expansion of Integrals*, Holt, Reinhard & Winston, 1975.
4. deBruijn, N. G., *Asymptotic Methods in Analysis, Dover*, 1981.
5. King, A.C., Billingham, J. and Otto, S.R., *Differential Equations: Linear, Nonlinear Ordinary, Partial,* Cambridge University Press, 2003.

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.

References:

1. King, A.C., Billingham, J. and Otto, S.R. *Differential Equations; Linear, Nonlinear, Ordinary, Partial.* Cambridge University Press, 2003.
2. Kevokian, J. and Cole, J.D. *Perturbation Methods in Applied Mathematics*. Springer-Verlag, 1980.

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.

References:

1. Fraleigh, J.B., *A First Course in Abstract Algebra*, 7^{th}*Ed*. Addison Wesley, 2003.
2. Gallian, J.A., *Contemporary Abstract Algebra, 3^{rd} Ed.* Heath, 1994
3. Gilbert, J. and Gilbert, L., *Elements of Modern Algebra*, 6^{th}*Ed*. Belmont, California: Thomson Brooks/Cole, 2005
4. Gilbert, W.J. and Nicholson, W.K., *Modern Algebra with Applications*, 3^{rd} *Ed.* New Jersey: John Wiley & Sons, 2004.

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.

References:
1. Fraleigh, John B.*A First Course in Abstract Algebra*. Addison-Wesly, 2000.
2. Rotman, Joseph J. *An Introduction to the Theory of Groups,* 3rd*Ed*. Wm.C.Brown, 1988.
3. Ledermann, Walter. *Introduction to Group Theory.* Longman, 1973.

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.

References:
1. Snaith, V.P. *Groups, Rings and Galois Theory.*World Scientific Computing, 2001.
2. Cox, D.A. *Galois Theory.*New Jersey: John Wiley and Sons, 2004.
3. Rotman, J. *Galois Theory*. Springer Verlag-New York, 1998.
4. Fraleigh, J.B. *A First Course in Abstract Algebra,7th Ed.* Addison- Wesley, 2003.

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.

References:
1. MacDuffee, C. C. *The Theory of Matrices*. Chelsea Pub. Co.New York, 1946.
2. Noble, B.and Daniel, J. W. *Applied Linear Algebra*. Prentice-Hall Inc., New Jersey, 1977.
3. Lancaster, P. *Theory of Matrices*. Academic Press, New York, 1965.

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.

References:
1. Mendelson, B. *Introduction to Topology*. Allyn & Bacon Inc., 1962.
2. Dugundji, J. *Topology*, Allyn & Bacon Inc., 1966.
3. Brown, R. *Elements of Modern Topology*. McGraw Hill, Maidenhead, 1968.
4. Munkres, J. R. *Topology: A First Course*. Prentice Hall, New Jersey, 1974.
5. Abraham, R. and Marsden, J. E. *Foundations of Mechanics*. Addison-wesley Pub. Co., Massachusetts, 1985.
6. Janish, K. *Topology*. Springer Verlag, New York, 1990

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.

References:

1. Jain, M. K. *Numerical Solution of Diferential Equations*. Wiley Eastern Limited, New Delhi, 1984.
2. Iserles, A.*A First Course in the Numerical Analysis of Differential Equations.*University press, Cambridge, 1986.
3. Butcher, J. C. *The Numerical Analysis of Ordinary Differential Equations: Runge-Kutta and General Linear Methods.*John Wiley & Sons, Chichester, 1987.
4. Lambert, J. D. *Computational Methods in Ordinary Differential Equations*.Wiley, New York, 1974.

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.

References:

1. Trefethen, L.N and David Bau III 1997 Numerical Linear Algebra, SIAM.
2. Demmel, J 1997 Applied Numerical Linear Algebra, SIAM.
3. Bolub, G and C. F. van Loan 1996 Matrix Computations, 3rd Ed, Johns Hopkins.

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.

References:

1. Smith, G. D. *Numerical Solution of Partial Differential Equations: Finite Difference Methods*. Clarendon Press,1985.
2. Mitchell, A. R. *Computational Methods in Partial Differential Equations*. John Wiley & Sons, 1977.
3. Evans, G., Blackledge, J. and Yardley, P. *Numerical Methods for Partial Differential Equations*. Springer-Verlag, 2000.

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

References:
1. Ottosen, N. and Petersson, H. *Introduction to Finite Element Method.* Prentice-Hall, 1992.
2. Reddy, J.N. *An Introduction to the Finite Element Method*. McGraw-Hill, 1993.

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.

References:
1. Lewis T.G. and El Rewini, H. *Distributed and Parallel Computing*. Manning Publication, 1998.
2. Kumar,V., Grama, A., Gupta, A. and Karypis, G. *Introduction to Parallel Computing: Design and Analysis of Algorithms*. Benjamin Cumming, 1994.
3. Quinn, M. J. *Parallel Computing Theory and Practice*. McGraw Hill, 1994.
4. Geist, A., Beguelin, A., Dongarra,J., Jiang, W., Manchek, R. and Sunderam, V. *PVM: Parallel Virtual Machine, A Users' Guide and Tutorial for Networked Parallel Computing.* Cambridge: MIT Press,1994.

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.

References:
1. Delves, L.M. and Walsh, J. *Numerical Solutions of Integral Equations*. Clarendon Press, Oxford, 1974.
2. Baker, C.T.H. *The Numerical Treatment of Integral Equations*. Oxford University Press, Oxford, 1977.
3. Corduneanu, C. *Integral Equations and Applications*.Cambridge University Press, Cambridge England, 1991.
4. Hochstadt, *Integral Equations*. Wiley, New York, 1989.
5. Kondo, J.*Integral Equations*. Clarendon Press, Oxford, England, 1992.
6. Pipkin, A.C.*A Course on Integral Equations*. Springer- Verlag, New York, 1991.
7. Porter,D. and Stirling, D.S.G. *Integral Equations: A Practical Treatment, from Spectral Theory to Applications*, Cambridge University Press, Cambridge, England, 1990.
8. Tricomi, F.G.*Integral Equations*. Dover, New York, 1985

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.

References:
1. Freund, J.E. *Mathematical Statistics*. Prentice Hall, Inc., 1992.
2. Hoel, P.G. *Introduction to Mathematical Statistics*. John Wiley & Sons, 1984.
3. Hogg, R.V., McKean, J. W. and Craig, A.G. *Introduction to Mathematical Statistics.* 6th ed. Pearson Prentice Hall, 2005.
4. Hogg, R.V. and Tanis, E.A. *Probability and Statistical Inference*. McMillan Publishing Co. Inc. 1978.
5. Larsen, J.L. and Marx, M.L. *An Introduction to Mathematical Statistics and Its Applications*, *4th ed*. Prentice Hall International, Inc., 2006.

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.

References:
1. Feller,W., *An Introduction to Probability Theory and Its Application*. John Wiley & Sons, 1968.
2. Robert B.Ash., *Real Analysis and Probability*. Academic Press, 1972.
3. Yates, R.D. & Goodman, D.J., *Probability and Stochastic Processes*. John Wiley, 2005.

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.

References:
1. Ross, S.M. *Stochastic Processes*. New York: John Wiley & Sons, 1983.
2. Yates, R.D. and Goodman, D.J. *Probability and Stochastic Processes*, *2nd Ed.* 2005.
3. Heyman, D.P. and Sobel, M.J. *Stochastic Models in Operation Research Vol.1*. 1982.
4. Papoulis, A. *Probability, Random Variables and Stochastic Processes, 4th Ed.* New York:Mc Graw Hill, 2002.

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.

References:
1. Dobson, A.J. *An introduction to Generalized Linear Models*. Chapman and Hall, 2002.
2. Mc Cullaugh, P. and Nelder, J.A. *Generalized Linear Models*. John Wiley & Sons, 1989.
3. Smith, D. *Applied Regression Analysis*. Wiley Interscience 1998.

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.

References:

1. Montgomery, D.C. , Jennings, C.L. & Kulachi, M. *Introduction to Time Series Analysis and Forecasting.* Wiley Interscience, 2007.
2. Brockwell P.J. and Davis, R.A. *Introduction to Time Series Analysis and Forecasting*. Springer. 1996.
3. Wei, W.W.S. *Time Series Analysis Univariate and Multivariate Methods*. Pearson, 2006.
4. Box, G.E.P., Jenkins, G.M and Reinsel, G.C. *Time Series Analysis Forecasting and Control.* Prentice Hall International Edition,1994.
5. Gaynor P.E. and Kirkpatrick, R.C..*Introduction to Time-series Modeling and Forecasting in Business and Economics.* McGraw-Hill, Inc,1994.

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.

References:

1. Johnson, R. A. and Wichern, D.W. *Applied Multivariate Statistical Analysis*. *5th ed*. Prentice Hall, 2002.
2. Tabachnick, B.G. and Fidell, L.S. *Using Multivariate Statistics. 5th ed.* Pearson, 2007.
3. Krzanowski, W.J. *Principles of Multivariate Analysis. A User's Perspective.* Oxford Science Publications, 1990.

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.

References:

1. Joshi, M.C. and Moudgalya K.M..*Optimization Theory and Practice.* Alpha Science International LTD. Harrow, UK, 2004.
2. Lange, K. *Optimization.* Springer, New York, 2004.
3. Fletcher, R. *Practical Methods of Optimization.* John Wiley & Sons Ltd. Chichester, England,1987.
4. Jeter, M.W. *Mathematical programming: An Introduction to Optimization.* Marcel Dekker, Inc. New York,1986.
5. Venkataraman, P. *Applied Optimization with MATLAB Programming.* John Wiley & Sons, Inc. New York, 2002.
6. Conn, A. R., Scheinberg, K., and Vicente, L.N. (2009). *Introduction to Derivative Free Optimization.* Society for Industrial and Applied Mathematics. Philadelphia, PA.
7. Diwekar, U. (2008). *Introduction to Applied Optimization.* 2nd Ed. Springer, New York, NY.

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.

References:

1. Reeves, C.R. *Modern Heuristic Techniques for Combinatorial Problems*. John Wiley & Sons, Inc., 1993.
2. Rardin, R.L. *Optimization in Operations Research.* Prentice Hall, Inc.,1998.
3. Moustakas, C.E. *Heurictic Research: Design, Methodology and Applications.* Newbury Park: Sage Publications, 1990.
4. Glover, F. *Tabu Search.* Kluwer Academic Publishers, 1997.
5. Kirkpatrick, S. *et al*. *Optimization by Simulated Annealing.*1983*.*
6. Coley, D.A. *AnIntroduction t oGenetic Algorithms ForScientist and Engineers.* World Scientific PublishingCo.Pte. Ltd., 1999.
7. Mitchell, M. *An Introduction to Genetic Algorithms.* A Bradford Book, 1996.
8. Van Laarhoven, P.J. and Harts, E.H. *Simulated Annealing : Theory and Applications (Mathematics andIts Application).* 1st Edition, Springer, 1987.
9. Glover, F. and Laguna, M.*Tabu Search.* Kluwer Academic Publishers, 1997.
10. Hagan, M.T., Demuth, H.B., andBeale, M. *Neural Network Design.* PWS Publishing Company, 1996.
11. Fausett, L. *Fundamental of Neural Networks : Architectures, Algorithms, and Applications.* PrenticeHall, Inc, 1994.

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.

References:

1. Thomas Ferguson. *Game Theory*. UCLA 2008.
2. Martin Osborne, Ariel Rubenstein. *A Course in Game Theory*, MIT Press, 1995.
3. Joel Watson, Strategy: *An Introduction to Game Theory*, 2ndEd,Norton, 2007.
4. Avinash K. Dixit, David H. Reiley Jr. and Susan Skeath Avinash K. Dixit, David H. Reiley Jr. and Susan Skeath, *Games of Strategy*,3rd Ed, Norton, 2009

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.

References:

1. Course Notes is in the e-learning webpage http://elearning.utm.my
2. Chopra, S. and Meindl, P. *Supply Chain Management: Strategy, Planning and Operations*. Prentice-Hall, 2001.
3. Eppen et al. *Introductory Management Science – Decision Modeling with Spreadsheets*. Prentice-Hall, 1998.
4. David Simchi-Levi et al., *Designing and Managing the Supply Chain: Concepts, Strategies, and Test Studies*, Second edition, McGraw-Hill, 2003.

5. Terry P. Harrison, et al. ed. *The Practice of Supply Chain Management: Where Theory and Application Converge*, Kluwer Academic Publishers, 2003.
6. Edward A. Silver et al., *Inventory Management and Production Planning and Scheduling,* Third edition, John Wiley & Sons, 1998.

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.

References:
Relevant literature sources, journals, etc.

DISSERTATION CODES FOR FULL TIME STUDENTS

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

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

Guidelines for Dissertation codes:

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

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SYNOPSES OF COURSES (ENGINEERING MATHEMATICS)

ENGINEERING MATHEMATICS
SYNOPSIS OF MATHEMATICS 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.

References:

1. Reddy, J.N., *An Introduction to Nonlinear Finite Element Analysis*,Oxford University Press, 2004.
2. G.R. Liu, Quek,S.S.,*Finite Element Method: A Practical Course,* Butterworth-Heinemann, 2003
3. Strang, G. and Fix, G. J.,*An Analysis of theFinite Element Method*,Prentice-Hall, Eaglewood Cliffs, 1973.

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.

References:

1. King, A.C., Billingham, J. and Otto,S.R., *Differential Equations; Linear, Nonlinear, Ordinary, Partial.* Cambridge University Press, 2003.
2. Kevokian, J. and Cole, J.D., *Perturbation Methods in Applied Mathematics.* Springer-Verlag , 1980.

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.

References:

1. Bender, C. M. and Orszag, S. A., *Advanced Mathematical Methods for Scientists and Engineers,* McGraw-Hill, 1978.
2. Carlson, B. C., *Special Functions of Applied Mathematics,* Academic Press, 1977.
3. Jeffrey, A., *Advanced Engineering Mathematics,* Harcourt/Academic Press, 2003.
4. Asmar, N.H., *Applied Complex Analysis with Partial Differential Equation*s, Prentice-Hall, 2002.
5. Duffy, D.G., *Transform Methods for Solving Partial Differential Equations,* Chapman & Hall/ CRC, 2004.
6. Debnath, L., *Integral Transform and Their Applications,*CRC Press, 1995.
7. Davies, B.,*Integral Transforms and Their Applications: 3rd Edition.* Springer, 2002. Andrew, L.C., *Special Functions of Mathematics for Engineers: 2nd Edition.* Mc-Graw Hill, 1985

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.

References:

1. Dobson, A.J., *An Introduction to Generalized Linear Models*, Chapman and Hall, 2002.
2. Pawitan, Y.,*In All Likelihood: Statistical Modelling and Inference Using Likelihood*, Oxford Science Publications, 2001.
3. Kutner, M.H., Nachtsheim, C.J. and Neter, J.,*Applied Linear Regression Models*,McGraw Hill, 2004.
4. Montgomery, D.C. , *Design and Analysis of Experiments,* John Wiley & Sons, 2005.
5. McCullagh, P. and Nelder, J. A., *Generalized Linear Models*, Chapman & Hall, 1989.

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.

References:

1. Bhatnagar, P.L.,*Nonlinear Waves In One-Dimensional Dispersive Systems*,Oxford University Press, Oxford, 1979.
2. Toda, M.,*Nonlinear Waves And Solitons*, Kluwer Academic Publishers, Dordrecht, 1989.
3. Dodd, V, Eilbeck, J.C. , Gibbon, J.D. and Morris,H.C.,*Solitons And Nonlinear Wave Equations,*Academic Press, London, 1982.
4. Drazin, P.G.,*Solitons,* Cambridge University Press, Cambridge, 1985.
5. M. Hazewinkel, H.W. Capel and E.M. de Jager,*Proceedings of the International Symposium KdV '95,* 1995.
6. Filippov, A., *The Versatile Soliton,* Birhauser, Boston, 2000.
7. Infeld, E. and Rowlands, G., *Nonlinear Waves, Solitons and Chaos,* Cambridge University Press, 2000.

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.

References:

1. Paterson, A.R., *A First Course in Fluid Dynamics*, Cambridge, UK, 1983
2. Acheson.D.J.,*Elementary Fluid Dynamics,*Oxford,UK, 1992
3. Ligget, J.A., *Fluid Mechanics,* Mc Graw-Hill: New York, 1994
4. Street, R.L. et al.,*Elementary Fluid Mechanics,* John Wiley and Sons: New York, 1996
5. Anderson, J.D, Jr., *Computational Fluid Dynamics*, McGraw Hill: New York, 1995.
6. White, F.M., *Fluid Mechanics,* McGraw Hill: New York, 2003.
7. Robert, J.R., *Heat Transfer Tools,* McGraw Hill: New York, 2002.
8. Chung, T.J., *Computational Fluid Dynamics,* Cambridge University Press, UK, 2002.

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.

References:

Relevant literature sources, journals, etc.

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;

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SYNOPSES OF COURSES (PHYSICS)

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.

References:

1. Griffiths, D. J., Introduction to Quantum Mechanics, Pearson, Upper Sadle River, 2005.
2. Gasiorowicz, S., Quantum Physics 2nd ed, John Wiley and Sons, 1995.

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.

References:

1. Coughan, G.D. and Dodd, J.E., *The Ideas of Particle Physics*, Cambridge Univ.Press, 1991.
2. Kane, G., *Modern Elementary Particle Physics*, Addison Wesley, 1993.
3. Kane, G, *The Particle Garden*, Addison Wesley, 1995.
4. Krane, K.S., *Introductory Nuclear Physics*, John Wiley, 1988.

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.

References:

1. Relevant literature sources, journals, etc.

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..

References:

1. Classical Electrodynamics by J.D. Jackson (3rd Edition).
2. Engineering Electromagnetics by W.H. Hayt Jr.
3. Electromagnetic Field Theory by B. Thide.

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.

References:

1. Kingler, L.E., Frey, A.R., Coppens, A.B and Sanders, *Fundamentals of Acoustics*, John Wiley & Sons, 1982
2. Rohn, T., Elbaum, C., and Chick, B.B., *Ultrasonic Methods in Solid State Physics,* Academic Press, 1969.
3. Krautkreamer, J, and Krautkreamer, H,*Ultrasonic Testing of Material*, Springer Verlag, 1981
4. Silk, M. G., *Ultrasonics Transducers*, Wiley, 1981.
5. Scruby, C.B., Drain, L.E.,*Laser Generated Ultrasound,* 1990.
6. Bhatia, A.B, *Ultrasonic Attenuations*, 1974.

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

References:

1. Modul Spectroscopy Physics
2. Banwell, C.N., *Fundamental of Molecular Spectroscopy*, Mc-Graw Hill, 4th Edition, 1994
3. Harris, R.K., *Nuclear Magnetic Resonance Spectroscopy*, Longman Scientific and Technical,1986.
4. Kemp, W., *NMR in Chemistry* - A Multinuclear Introduction, Mac Millan, London, 1986.
5. William W. Paudler, *Nuclear Magnetic Resonance: General, Concepts and Application*, John Wiley & Son, 1987.
6. Hollas, J.M.,*Modern Spectroscopy*, 3rd Edition, John Wiley, 1996.
7. Brown, J. M., *Molecular Spectroscopy*, *Oxford University Press*, 1998.
8. Skoog, D.A., Holler, F.J., Nieman, V., *Harcourt Brace Principles of Instrumental Analysis*, College Publishers, 1998
9. Slichter, C.P., *Principles of Magnetic Resonance*, Springer-Verlag, 3rd. edition 1990.
10. Eckert, H., *Progress in NMR Spectroscopy*, 24, 1992.
11. Mehring, M.,*High Resolution NMR in Solids*, Springer-Verlag, 1983.
12. Dupree,R.*, Line Broadening in Solids*, in Nuclear Magnetic Resonance in Modern Technology, G. E. Maciel (ed.), Kluwer Academic Publishers, 87-103, 1994.
13. Akitt, J.W. , NMR *and Chemistry: An Introduction to Modern NMR Spectroscopy*, Chapman & Hall (1992).

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.

References:

1. Neamen, D.A., *Semiconductor Physics and Devices: Basic Principles,* 3rd Edition, Mc Graw Hill, 2003.
2. Smith, R. A., *Semiconductors*, 3rdEdition, Cambridge University Press, 1978.
3. Streetman, B.G., and Banerjee, S., *Solid State Electronic Devices*, 5th Edition, Prentice Hall, 2000.
4. Morigaki, K., *Physics of Amorphous Semiconductors*, World Scientific, 1999.
5. Brodsky, M.H., *Amorphous Semiconductors*, Topics in Applied Physics Vol. 36, Ed., 2nd Edition, Springer-Verlag, 1985.

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).

References:

1. Streetment, B. G. and Banergee S , *Solid State Electronic device* 5th ed., Prentice Hall, Inc USA 2000.
2. Shur, M., *Physical of Semiconductor Device*, Prentice Hall, Inc USA, 1990.
3. Navon, D. H. and Mifflin, H., *Electronic Material and Device*, Boston USA 1975.
4. Sze, S.M *, Physics of Semiconductor Devices, 2 ed., Willey- Interscience Publication 1981*

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.

References:

1. Samsudi Sakrani, *Kuliah: Thin Film Technology*, Jabatan Fizik, UTM, 2000
2. Ohring M., *The Material Science of Thin Films,* Academic Press, San Diego, 1992
3. Heavens O.S., *Thin Film Physics*, Metheun & Co. ltd., London, 1969.
4. Eckertova L., *Physics of Thin Films*, Plenum Press, 2nd Edition, New York, 1986.
5. Chopra K.L., *Thin film Phenomena*, McGraw-Hill, New York, 1969.
6. Chopra K.L. and Kaur I., *Thin Film Device Applications*, Plenum Press, London, 1983.
7. Maissel L.I. and Glang R., *Handbook of Thin Film Technology*, McGraw-Hill, 1970.
8. Francombe, M.H. and Vossen, J.L. (Eds.). *Physics of Thin Films, Vol. 16: Thin Films for Emerging. Applications.* 1992.
9. MacLeod H.A., *Thin Film Optical Filters*, Adam Hilger Ltd., 1969

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.

References:

1. Md Rahim Sahar, Non-Crystalline Solid
2. H. Rawson; Properties and application of glass; ElsĤvier 1980.
3. A. Paul; Chemistry of glasses, Chapman and Hall, 1982
4. R. Zallen; The properties of amorphous solids, John Wiley & Sons, 1983

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.

References:

1. Md Rahim Sahar, Phase transformation.
2. D.A.Porter, K.E. Easterling; Phase transformation in metals and Alloys, Van Nostrand Reibhold CO Ltd.

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

References:

1. Kasap, S.O., Optoelectronics and Photonics: Principles and Practices, Prentice-Hall, International,2001.
2. Uiga, E., *Optoelectronics*, Prentice-Hall ,nternational, 1995.
3. Wilson, J. & Hawkes J. F. B., *Optoelectronics: An Introduction*, Prentice-Hall International, 1983.
4. Articles from Laser Focus World.

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.

References:

1. Relevant literature sources, journals, etc.

CNC Machine

Single crystal growth machine

Bragg Grating Fabrication Unit

Gas Sensor

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FACULTY OF SCIENCE ACADEMIC STAFF

THE FACULTY OF SCIENCE ACADEMIC STAFF

The following is the list of academic staff of the Faculty of Science and their areas and sub-areas of specialisation. Please note that generally only a Graduate Faculty member is allowed to supervise post-graduate students. A Graduate Faculty member is an academic staff who has a Doctoral Degree or an academic staff who holds an academic post of at least Associate Professor.

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Related Websites

School of Postgraduate Studies, http:/www.sps.utm.my
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While every effort has been made to ensure accuracy of the information available at the time this handbook was prepared, the Faculty of Science reserves the right to make changes at any time without prior notice.

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