



UNIVERSITI TEKNOLOGI MALAYSIA  
**FAKULTI SAINS**  
Faculty Of Science

Buku Panduan Akademik | **2009/2010**  
Academic Guide Book

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Fakulti berhak membuat pindaan apabila perlu tanpa sebarang  
pengumuman terlebih dahulu.

Buku Panduan Akademik ini ialah untuk rujukan pelajar kemasukan Sesi 2009/2010  
dan akan digunakan sehingga tamat pengajian.

Sinopsis bagi mata pelajaran yang ditawarkan oleh Fakulti ditulis dalam  
Bahasa Inggeris sahaja, memandangkan pengajaran dikendalikan dalam bahasa tersebut.

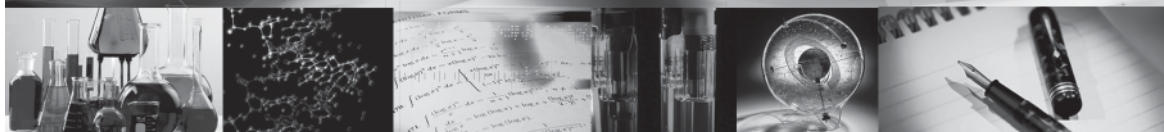
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The Faculty reserves the right to make the appropriate changes  
without any prior notification.*

*This guide book is a reference for students initially  
enrolled in the 2009/2010 session and will be used until graduation.  
Synopses of subjects offered by the faculty are written in English only  
based on the fact that teaching will be conducted in the language.*

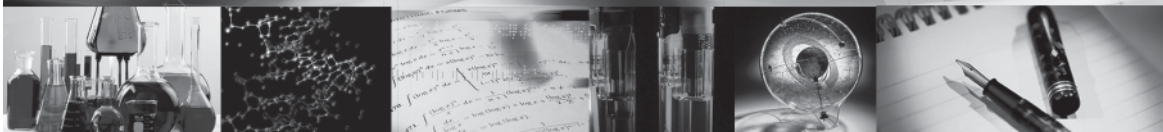
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# KATA ALUAN DEKAN DEAN'S MESSAGE



UNIVERSITI TEKNOLOGI MALAYSIA

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## KATA ALUAN DEKAN

Assalamualaikum warahmatullahi wabarakatuh dan Salam Sejahtera

Syukur ke hadrat Allah swt kerana dengan izinNya Buku Panduan Fakulti Sains telah dapat diterbitkan dengan jayanya.

Pada kesempatan ini saya ingin mengucapkan setinggi-tinggi tahniah dan syabas kepada para pelajar yang telah berjaya terpilih untuk mengikuti pengajian yang ditawarkan oleh Fakulti Sains khususnya dan UTM amnya.

Buku Panduan ini memuatkan maklumat ringkas mengenai Fakulti, kurikulum dan sinopsis yang digunakan untuk pelajar kemasukan sesi 2009/2010 sehingga tamat pengajian. Pelajar kemasukan Semester I sesi 2005/2006 merupakan kumpulan pertama pelajar yang mengikuti kurikulum baru tiga tahun pengajian. Buku ini juga menerangkan program dan kursus yang ditawarkan di Fakulti Sains, sistem semester dan pengendalian program ini.

Diharapkan agar Buku Panduan ini dapat memberi maklumat yang diperlukan, khususnya oleh pelajar, mengenai pengurusan Fakulti, pengendalian program dan kursus yang ditawarkan. Buku ini dapat dijadikan panduan untuk pelajar merancang pembelajaran di samping menjadi rujukan untuk lebih memahami struktur kursus/program yang dikendalikan oleh Fakulti Sains. Selain itu, Buku Panduan ini menjelaskan mengenai penasihat akademik supaya pelajar dan penasihat dapat mengetahui peranan masing-masing dengan lebih berkesan.

Bagi pihak Fakulti, saya mengambil kesempatan ini untuk merakamkan ucapan terima kasih kepada semua pihak yang terlibat dalam menghasilkan Buku Panduan ini.

Terima kasih. Wassalam.

PROFESOR DR. MADZLAN BIN AZIZ  
Dekan  
Fakulti Sains



## DEAN'S MESSAGE

Assalamualaikum warahmatullahi wabarakatuh And Greetings to All

I am grateful to Allah The Almighty for with His consent that this Guide Book is successfully published.

I would like to take this opportunity to congratulate and welcome all students who have been successfully selected to study in the Faculty of Science, UTM.

This Guide Book contains brief information about the Faculty as well as the curriculum and synopses that will be used by students initially enrolled in the 2009/2010 session until graduation. Students enrolled in Semester I of the 2005/2006 session are the first batch that would be following a new three-year curriculum. This book also describes the programmes and courses offered by the Faculty of Science, the semester system and the programmes conducted.

I hope this book will provide the students with relevant information on the administration of the Faculty, the running of the programmes and courses offered. This book should be used as a guide for students to plan their study as well as a reference to understand the course structure offered by the faculty. This guide also describes the Academic Advisory System to enable students and their academic advisors understand the system and play their respective roles effectively.

On behalf of the Faculty, I would like to convey my appreciation to all parties involved in the publication of this Guide Book.

Thank you. Wassalam.

PROFESSOR DR. MADZLAN BIN AZIZ  
Dean  
Faculty of Science





PASUKAN PENGURUSAN  
FAKULTI SAINS  
*FACULTY OF SCIENCE  
MANAGEMENT TEAM*



UNIVERSITI TEKNOLOGI MALAYSIA

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**Assoc. Prof. Dr Nor Haniza Sarmin**

B.Sc (Hons), M.A., Ph.D (Birmingham)

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**Assoc. Prof. Dr. Azli bin Sulaiman**

Dip.Sc.Ed, B.Sc.Ed (Hons)(UTM), M.Sc, Ph.D (Loughborough).

Timbalan Pendaftar/*Deputy Registrar*

**Mr. Muhamad Afandi bin Hamzah**

B.A.(Hons) (UM).

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**Mr. Ramli bin Ibrahim**

B. Sc. (Political Sc.) USM

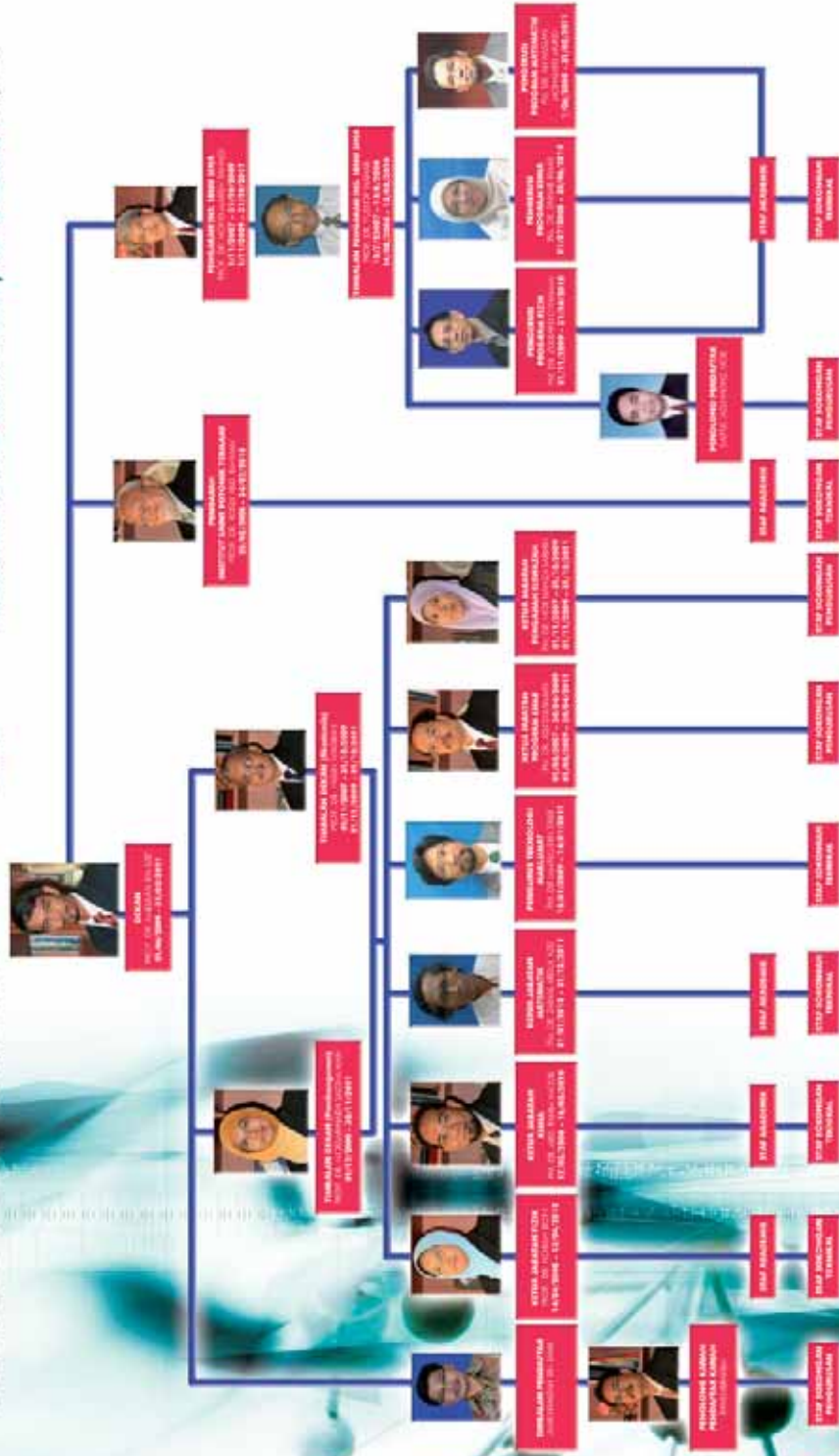


# CARTA ORGANISASI FAKULTI SAINS



UNIVERSITI TEKNOLOGI MALAYSIA

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LATAR BELAKANG  
UNIVERSITI TEKNOLOGI  
MALAYSIA  
*BACKGROUND OF UNIVERSITI  
TEKNOLOGI MALAYSIA*



UNIVERSITI TEKNOLOGI MALAYSIA

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## LATAR BELAKANG

Universiti Teknologi Malaysia (UTM) telah ditubuhkan pada 14 Mac, 1972 dengan nama Institut Teknologi Kebangsaan (ITK). Pada 1 April, 1975 nama itu ditukar kepada Universiti Teknologi Malaysia. Walaupun ia dianggap sebuah universiti yang baru pada ketika itu, namun sebagai sebuah pusat pengajian teknikal ia telah lama bertapak sejak 1925 lagi dengan nama Sekolah Teknik Kuala Lumpur. Sekolah tersebut melatih Juruteknik bagi Jabatan Kerja Raya dan hanya dibuka kepada kakitangan jabatan kerajaan yang lain pada tahun 1930.

Pada tahun 1946 kerajaan telah menaiktaraf Sekolah Teknik itu kepada sebuah Maktab Teknik. Bagaimanapun, pembinaan bangunan Maktab Teknik hanya dapat dimulakan pada 1951 di Jalan Gurney, Kuala Lumpur dan siap pada tahun 1955.

Pada tahun 1960 Maktab Teknik mengorak langkah mengendalikan kursus kejuruteraan di peringkat iktisas. Pelajar yang mengikuti kursus ini mengambil peperiksaan iktisas yang dianjurkan oleh 'Institution of Civil Engineers, Institution of Mechanical Engineers' dan 'Institution of Electrical Engineers', United Kingdom.

Kursus peringkat ijazah mula ditawarkan pada tahun 1969 apabila Maktab Teknik di perakukan sebagai sebuah Institut Teknik bertaraf universiti oleh Jawatankuasa Perancangan Pelajaran Tinggi. Pada 14 Mac 1972, Duli Yang Maha Mulia Yang DiPertuan Agong mengisytiharkan penubuhan Institut Teknologi Kebangsaan yang kemudiannya dinamakan sebagai Universiti Teknologi Malaysia. Universiti ini diperaku sebagai sebuah universiti bidang teknologi yang menggunakan Bahasa Malaysia sebagai bahasa penghantar.

Pada masa ini, kampus induk UTM terletak di kawasan tanah seluas 1,120 hektar di Skudai, Johor. Ia berkedudukan lebih kurang 18 km dari Bandaraya Johor Bahru. Kampus cawangan terletak di Jalan Semarak, Kuala Lumpur. Perpindahan dari kampus asal Jalan Semarak, Kuala Lumpur ke kampus induk, Skudai, dimulakan pada tahun 1985 dan dijalankan secara berperingkat. Kini, 12 buah fakulti beroperasi di Kampus Skudai, iaitu:

- a. Fakulti Sains
- b. Fakulti Kejuruteraan Awam
- c. Fakulti Kejuruteraan Mekanikal
- d. Fakulti Kejuruteraan dan Sains Geoinformasi
- e. Fakulti Alam Bina
- f. Fakulti Pengurusan dan Pembangunan Sumber Manusia
- g. Fakulti Pendidikan
- h. Fakulti Kejuruteraan Elektrik
- i. Fakulti Sains Komputer dan Sistem Maklumat
- j. Fakulti Kejuruteraan Kimia dan Kejuruteraan Sumber Asli
- k. Fakulti Biosains dan Biokejuruteraan
- l. Fakulti Kejuruteraan Bioperubatan dan Sains Kesihatan





## BACKGROUND

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

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

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

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

Currently, UTM's main campus is located on a 1,1200 hectares of land in Skudai, Johor. It is situated about 18 km from Johor Bahru City centre. The Branch Campus is located at Jalan Semarak, Kuala Lumpur. The move from the original campus at Jalan Semarak, Kuala Lumpur to the main campus in Skudai began in 1985, and proceeded in stages. At present, the Skudai Campus houses 12 faculties, as follows:

- a. The Faculty of Science
- b. The Faculty of Civil Engineering
- c. The Faculty of Mechanical Engineering
- d. The Faculty of Geoinformation Science and Engineering
- e. The Faculty of Built Environment
- f. The Faculty of Administration and Human Resource Development
- g. The Faculty of Education
- h. The Faculty of Electrical Engineering
- i. The Faculty of Computer Science and Information Systems
- j. The Faculty of Chemical Engineering and Natural Resources Engineering
- k. The Faculty of Bioscience and Bioengineering
- l. The Faculty of Biomedical and Health Science



**FALSAFAH, VISI, MISI  
& COGANKATA UNIVERSITI  
PHILOSOPHY, VISION, MISSION  
& MOTTO OF THE  
UNIVERSITY**



**UNIVERSITI TEKNOLOGI MALAYSIA**

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### **FALSAFAH**

Hukum Allah adalah dasar kepada Sains dan Teknologi. Maka Universiti Teknologi Malaysia berusaha secara menyeluruh dan bersepadu memperkembangkan kecemerlangan Sains dan Teknologi untuk kesejahteraan dan kemakmuran sejagat sesuai dengan kehendakNya.

### **VISI**

Diiktiraf sebagai pusat kecemerlangan akademik dan teknologi bertaraf dunia.

### **MISI**

Menjadi peneraju dalam pembangunan modal insan dan teknologi inovatif demi pengkayaan khazanah negara.

### **COGANKATA UNIVERSITI**

KERANA TUHAN UNTUK MANUSIA



### **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.

### **MISION**

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





SEJARAH PERKEMBANGAN  
FAKULTI SAINS  
*CHRONOLOGY OF THE FACULTY  
SCIENCE'S DEVELOPMENT*



UNIVERSITI TEKNOLOGI MALAYSIA

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## SEJARAH PERKEMBANGAN FAKULTI SAINS

### Tahun

### Peristiwa

- 1972
- Pusat Perkhidmatan Sains mengendali pengajaran Fizik, Kimia dan Matematik untuk Fakulti Kejuruteraan, Institut Teknologi kebangsaaan (ITK).
  - Pusat Pengajian Sains dan Kemanusiaan ditubuhkan - merangkumi 4 Jabatan (Fizik, Kimia, Matematik, Sains Kemanusiaan)
  - Kursus Diploma Sains dan Pendidikan dimulakan dengan kerjasama Kementerian Pendidikan.
- 1973
- Pemisahan Pusat Pengajian Sains dari Pusat Pengajian Sains dan Kemanusiaan.
  - Pusat pengajian baru ditubuhkan dengan nama Pusat Pengajian Sains (PPS) yang mengandungi 3 Jabatan (Fizik, Kimia, Matematik).
  - Pensyarah kontrak dilantik di bawah kerjasama Institut Teknologi Bandung (ITB) dan Universitas Gadjja Mada (GAMA) dengan ITK.
  - PPS mengendalikan sepenuhnya Kursus Diploma Sains serta Pendidikan
- 1978
- Kursus Diploma Sains serta Pendidikan diubah kepada Kursus Integrasi Sains serta Pendidikan (ISP).
- 1979
- Pengambilan kumpulan pertama pelajar Sarjana Muda Sains serta Pendidikan (SSP).
- 1980
- Jabatan Sains Komputer ditubuh dan diletakkan di bawah PPS.
- 1981
- Pusat Pengajian Sains (PPS) dinaiktaraf ke Fakulti Sains (FS).
- 1982
- Jabatan Pendidikan dan Jabatan Pendidikan Sains Teknikal (dari Pusat Pengajian Kemanusiaan) dipindahkan ke Fakulti Sains.
- 1983
- Kursus Sarjana Muda Sains Komputer dimulakan di Fakulti Sains.
- 1984
- Jabatan Sains Komputer dipisahkan dari Fakulti Sains kerana penubuhan Fakulti Sains Komputer.



## CHRONOLOGY OF THE FACULTY OF SCIENCE'S DEVELOPMENT

Year	Event
1972	<ul style="list-style-type: none"><li>- The Science Service Unit conducted the teaching of Physics, Chemistry and Mathematics for the Engineering Faculties of Institut Teknologi Kebangsaan (ITK).</li><li>- The Centre for Science and Humanities Studies, consisting of four departments (Physics, Chemistry, Mathematics and Humanities) was established.</li><li>- A Diploma of Science with Education course was initiated in cooperation with the Ministry of Education.</li></ul>
1973	<ul style="list-style-type: none"><li>- A new Centre of Science Studies (PPS), which consisted of 3 Departments (Physics, Chemistry, Mathematics) was formed due to the split of the Centre for Science and Humanities Studies.</li><li>- Short-term contract lecturers were hired under the cooperation involving Institut Teknologi Bandung (ITB) and Universitas Gadjja Mada (GAMA) with ITK.</li><li>- PPS was given full autonomy on the running of the Diploma of Science with Education course.</li></ul>
1978	<ul style="list-style-type: none"><li>- The Diploma of Science with Education course was renamed as Integrated Science with Education course (ISP).</li></ul>
1979	<ul style="list-style-type: none"><li>- Enrolment of the first batch of undergraduate students for the Bachelor of Science with Education program (SSP).</li></ul>
1980	<ul style="list-style-type: none"><li>- The Department of Computer Science was established and placed under PPS.</li></ul>
1981	<ul style="list-style-type: none"><li>- The Centre for Science Studies (PPS) was upgraded and renamed as Faculty of Science (FS).</li></ul>
1982	<ul style="list-style-type: none"><li>- The Education Department and the Department of technical Science were transferred from the Centre of Humanities Studies into the Faculty of Science.</li></ul>
1983	<ul style="list-style-type: none"><li>- The Bachelor of Science Programme in Computer Science was initiated.</li></ul>
1984	<ul style="list-style-type: none"><li>- The Department of Computer Science separated from The Faculty of Science to form an independent Faculty.</li></ul>



## SEJARAH PERKEMBANGAN FAKULTI SAINS

Tahun	Peristiwa
1986	<ul style="list-style-type: none"><li>- Permulaan Kursus Diploma Pendidikan guru Maktab Rendah Sains MARA (MRSM).</li><li>- Permulaan Kursus Sarjana Muda Teknologi dan Pendidikan (Awam/Elektrik/Jentera)</li></ul>
1987	<ul style="list-style-type: none"><li>- Kursus Ijazah Sarjana Muda Sains Industri (SSI) dimulakan. Program ditawarkan: Kimia Industri, Fizik Industri dan Matematik Industri.</li><li>- Pengambilan pelajar SSP dihentikan.</li></ul>
1988	<ul style="list-style-type: none"><li>- Perpindahan Fakulti Sains ke Skudai.</li><li>- Unit Perkhidmatan Sains (UPS) ditubuhkan di Kampus Jalan Semarak.</li><li>- Kursus Ijazah Sarjana Muda Sains Komputer serta Pendidikan (SPK), dan Kursus Diploma Pendidikan dimulakan.</li></ul>
1989	<ul style="list-style-type: none"><li>- Permulaan Program Ijazah Lanjutan dalam bidang Kimia, Fizik dan Matematik.</li></ul>
1992	<ul style="list-style-type: none"><li>- Permulaan Kursus Ijazah Sarjana Muda Teknologi serta Pendidikan (Kemahiran Hidup).</li></ul>
1994	<ul style="list-style-type: none"><li>- Penstrukturan semula Fakulti Sains. Tiga Jabatan (Kimia, Fizik, Matematik) ditadbir di bawah Fakulti Sains. Jabatan Pendidikan dan Jabatan Pendidikan Sains Teknikal dimansuhkan berikutan penubuhan Fakulti Pendidikan.</li></ul>
1997	<ul style="list-style-type: none"><li>- Fakulti Sains menawarkan Program Sarjana Muda Sains Industri (Biologi).</li></ul>
1998	<ul style="list-style-type: none"><li>- Fakulti Sains menawarkan Program Sarjana Muda Sains Industri (Fizik Bahan).</li></ul>
1999	<ul style="list-style-type: none"><li>- Fakulti Sains menawarkan Program Sarjana Muda Sains Industri (Fizik Kesihatan).</li></ul>
2000	<ul style="list-style-type: none"><li>- Jabatan Biologi ditubuhkan, menambah jumlah bilangan Jabatan di Fakulti Sains kepada empat.</li></ul>
2002	<ul style="list-style-type: none"><li>- Fakulti Sains memulakan program khas dikenali sebagai Program Saintis Cemerlang (Bidang Fizik, kimia dan matematik)</li></ul>
2003	<ul style="list-style-type: none"><li>- Pengambilan pelajar sarjana muda dihadkan kepada lepasan Sijil Matrikulasi, lepasan STPM dan Diploma sahaja.</li></ul>
2005	<ul style="list-style-type: none"><li>- Fakulti Sains menawarkan Program Sarjana Muda Sains Tulen (Biologi, Kimia, Fizik dan Matematik).</li></ul>



## CHRONOLOGY OF THE FACULTY OF SCIENCE'S DEVELOPMENT

Year	Event
1986	<ul style="list-style-type: none"><li>- A Diploma of Education course for MARA Junior Science College (MRSM) teachers was conducted.</li><li>- The Bachelor of Science course in Technology with Education (Civil, Electrical, Mechanical) was established.</li></ul>
1987	<ul style="list-style-type: none"><li>- The Bachelor of Industrial Science (SSI) course was initiated. The programmes offered were Industrial Chemistry, Industrial Physics and Industrial Mathematics.</li><li>- The enrolment of SSP students was terminated.</li></ul>
1988	<ul style="list-style-type: none"><li>- The Faculty of Science moved to Skudai.</li><li>- The Science Service Unit was established at the Jalan Semarak Campus.</li><li>- The Bachelor of Science and Computer with Education course (SPK) was initiated, followed by the Diploma in Education.</li></ul>
1989	<ul style="list-style-type: none"><li>- The Faculty officially started its postgraduate program.</li></ul>
1992	<ul style="list-style-type: none"><li>- The Faculty started the Bachelor of Science in Technology with Education (Living Skills) course.</li></ul>
1994	<ul style="list-style-type: none"><li>- The Department of Education and the Department of Science and Technical Education were dissolved following the establishment of the Faculty of Education. Three departments remained in the Faculty of Science: The Departments of Chemistry, Physics and Mathematics.</li></ul>
1997	<ul style="list-style-type: none"><li>- The Faculty offered the Bachelor of Industrial Science (Biology) programme.</li></ul>
1998	<ul style="list-style-type: none"><li>- The Faculty offered the Bachelor of Industrial Science (Material Physics) programme.</li></ul>
1999	<ul style="list-style-type: none"><li>- The Faculty offered the Bachelor of Industrial Science (Health Physics) programme.</li></ul>
2000	<ul style="list-style-type: none"><li>- The Biology Department was established in the Faculty, bringing the number of departments up to four.</li></ul>
2002	<ul style="list-style-type: none"><li>- The Faculty of Science began offering a special programme known as the Excellent Scientists Programme (Pure physics, chemistry and mathematics)</li></ul>
2003	<ul style="list-style-type: none"><li>- The enrollment of students for the Undergraduate Programme was limited to only post-Matriculation, post-Malaysia Higher School Certificate (STPM) and diploma holders or the equivalent.</li></ul>
2005	<ul style="list-style-type: none"><li>- The Faculty began offering Undergraduate Degree Programmes in Pure Sciences (Biology, Chemistry, Physics and Mathematics)</li></ul>





**VISI, MISI, COGANKATA  
& OBJEKTIF FAKULTI**  
*VISION, MISSION, MOTTO &  
OBJECTIVE OF THE FACULTY*



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### **VISI FAKULTI**

Menjadi fakulti terkemuka dunia dalam perkembangan sains dan matematik

### **MISI FAKULTI**

Menjadi peneraju dalam pembangunan modal insan dan teknologi menerusi penajaan dan penyebaran ilmu sains dan matematik melalui pengajaran dan pembelajaran berkualiti, penyelidikan inovatif, penerbitan kesarjanaan bagi kesejahteraan manusia dan alam sekitar

### **COGANKATA**

**Q-LEAP** bersama kami  
(beLajar, tEroka, gunA dan PPraktik)

### **OBJEKTIF**

- Menyediakan program akademik berkualiti dalam sains dan matematik bagi memenuhi keperluan pendidikan tempatan dan global
- Memudahkan penyebaran ilmu sains dan matematik melalui pengajaran dan pembelajaran yang inovatif dan efektif
- Menghasilkan graduan yang kompeten dan versatil berpandukan nilai moral dan etika yang tinggi
- Menjalankan penyelidikan dan pembangunan terkehadapan dan transformatif dalam biologi, kimia, fizik dan matematik
- Melaksanakan penyelidikan antara bidang dan penyelidikan kerjasama
- Menyediakan persekitaran kondusif bagi pertukaran pengetahuan, pandangan dan idea inovatif.
- Menyumbang kepada kemajuan ilmu melalui penerbitan kesarjanaan
- Menjalinkan perkongsian pintar dan jaringan global berdasarkan sains
- Menyumbang kepada penajaan kekayaan negara melalui penyelidikan dan inovasi
- Menyumbang kepada peningkatan kualiti hidup, pengawalan alam sekitar dan pemuliharaan sumber asli



### **VISION OF THE FACULTY**

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

### **MISSION OF THE FACULTY**

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

### **MOTTO**

**Q - LEAP** with us

(Learn, Explore, Apply and Practise)

### **OBJECTIVES OF THE FACULTY**

- To provide quality academic programmes in science and mathematics to meet both local and global educational 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 networking.
- 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.



# STRUKTUR ORGANISASI *STRUCTURE OF ORGANISATION*



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## STRUKTUR ORGANISASI

Fakulti Sains diketuai oleh Dekan, dibantu oleh dua Timbalan Dekan, lima Ketua Jabatan, dua Pengarah Institut, Pengurus Teknologi Maklumat, Timbalan Pendaftar dan Penolong Pendaftar.

Struktur organisasi Fakulti Sains dapat dilihat pada Carta Organisasi Fakulti Sains yang ditunjukkan.

Pada masa ini fakulti mengandungi lima buah jabatan iaitu:-

- i Jabatan Fizik
- ii Jabatan Kimia
- iii Jabatan Matematik
- iv Jabatan Program Luar
- v Jabatan Pengajian Siswazah

Fakulti juga mempunyai dua buah pusat kecemerlangan iaitu Institut Kajian Sains Fundamental Ibnu Sina atau ringkasnya Institut Ibnu Sina (IIS), yang menumpukan penyelidikan dalam bidang sains fundamental dan Institut Sains Fotonik Termaju yang memfokuskan penyelidikan dalam laser dan serabut optik.

Fakulti Sains merupakan fakulti yang terbesar di UTM dari segi bilangan staf. Kini terdapat seramai 204 orang staf akademik yang berkelayakan tinggi dan berpengalaman serta dibantu oleh 91 orang staf sokongan yang tekun lagi berdedikasi.

Dari segi kemudahan dan peralatan, fakulti mempunyai 4 buah makmal komputer yang diuruskan oleh Jabatan Matematik, Jabatan Fizik mempunyai 32 makmal/bengkel yang digunakan untuk tujuan pengajaran dan penyelidikan, manakala Jabatan Kimia pula mempunyai 15 makmal pengajaran dan projek.





## STRUCTURE OF ORGANISATION

The Faculty of Science is headed by a Dean and is assisted by two Deputy Deans, five Heads of Departments, two Director of Institute, an Information Technology Administrator, a Deputy Registrar and an Assistant Registrar.

The structure of the Faculty's organization is illustrated in the Faculty's Organization Chart as shown.

Currently, the faculty consists of five departments as follows: –

- i Department of Physics
- ii Department of Chemistry
- iii Department of Mathematics
- iv Department of External Programme
- v Department of Postgraduate Studies

The Faculty has two centres of excellence known as the Ibnu Sina Institute for Fundamental Science Studies or IIS that focuses on research in fundamental sciences and Advanced Photonics Science Institute that focuses on Photonics research.

The Faculty of Science is the largest faculty in UTM in terms of number of staff. Currently, the Faculty has 204 highly qualified and experienced academic staffs and assisted by 91 dedicated hardworking supporting staffs.

In terms of facilities and equipment, the faculty has 4 computer laboratories under the management of the Department of Mathematics, 32 research and teaching laboratories/workshops under the Department of Physics, and 15 teaching and project laboratories under the Department of Chemistry.



**BISNES, PENYATA PELUANG,  
KOMPETENSI TERAS FAKULTI DAN  
PIAGAM PELANGGAN FAKULTI  
*BUSINESS, STATEMENT OF  
OPPURTUNITY, FACULTY'S CORE  
COMPETENCY AND FACULTY'S  
CLIENTS CHARTER***



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## **BISNES**

Melaksanakan pengajaran dan pembelajaran, penyelidikan, perundingan dan aktiviti penerbitan dalam sains dan matematik.

## **PENYATAAN PELUANG**

1. Menggunakan kepakaran staf bagi merealisasikan budaya kecemerlangan intelek untuk menarik pelajar berkualiti tinggi.
2. Memaksimumkan kerjasama-pintar dan jaringan profesional dengan sektor awam dan swasta untuk mempertingkatkan penyelidikan, latihan pelajar, dan graduan yang memenuhi kehendak pasaran.
3. Mengoptimumkan penggunaan peralatan terkini untuk menjalankan program, aktiviti penyelidikan, perundingan dan program pembangunan profesional Fakulti.
4. Menjalankan program akademik mengikut keperluan pasaran untuk menghasilkan graduan berkualiti dan memuaskan majikan.
5. Menyokong panduan kepimpinan bervisi, idea inovatif dan transformatif untuk mencapai kecemerlangan pengurusan seterusnya meningkatkan tahap kedudukan akademik Fakulti.

## **KOMPETENSI TERAS FAKULTI**

1. Menjalankan pengajaran dan pembelajaran berkualiti dalam bidang sains dan matematik melalui teknik yang kreatif dan inovatif.
2. Merekabentuk program dalam bidang sains dan matematik sejajar dengan tren dan keperluan tempatan dan global.
3. Menjalankan penyelidikan terkehadapan dalam bidang sains dan matematik.
4. Penglibatan dalam penyelidikan kolaboratif dan antara-disiplin.
5. Menghasilkan penerbitan ilmiah secara konsisten.
6. Menyumbangkan khidmat perundingan dan nasihat saintifik.

## **PIAGAM PELANGGAN FAKULTI**

Fakulti Sains bertekad untuk:

1. Merekabentuk program akademik berkualiti yang berpandukan pasaran, bersesuaian dengan keperluan negara dan berupaya untuk menerapkan nilai beretika kepada pelajar.
2. Menunaikan tugas akademik dengan penuh tanggungjawab dan dedikasi menurut piawai, syarat dan peraturan seperti yang dinyatakan oleh Universiti.
3. Bersikap adil dan saksama dalam menilai prestasi akademik pelajar.
4. Menyediakan makmal serba lengkap dengan peralatan yang sentiasa dipelihara serta keadaan yang sesuai bagi melakukan kerja dan penyelidikan.
5. Memberikan bimbingan profesional, pengawasan dan pengurusan yang efisien bagi kerja makmal dan penyelidikan.
6. Menyediakan latihan dan perundingan ke arah memperbaiki kemahiran dan profesionalisme.
7. Mengamalkan sikap mesra, terbuka dan prihatin, sentiasa bersedia untuk memberi bantuan yang sesuai dengan teras 'business' Fakulti.
8. Memberikan layanan dalam tempoh lima (5) minit daripada masa ketibaan pelanggan di kaunter servis Fakulti.
9. Memastikan suasana kerja yang selamat dan sihat di Fakulti.



## **BUSINESS**

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

## **STATEMENT OF OPPORTUNITY**

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

## **FACULTY'S CORE COMPETENCY**

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

## **FACULTY'S CLIENTS CHARTER**

Faculty of Science is committed to:

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





**MATLAMAT PENDIDIKAN, OBJEKTIF  
KURSUS, SYARAT KEMASUKAN,  
STRUKTUR KURSUS DAN  
PENGENDALIAN KURSUS SECARA AM  
EDUCATION AIM, COURSE OBJECTIVE,  
ENTRANCE REQUIREMENTS, COURSE  
STRUCTURE AND GENERAL  
RUNNING OF COURSES**



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## MATLAMAT PENDIDIKAN

Matlamat pendidikan Fakulti Sains ialah melahirkan graduan yang mempunyai ciri berikut:

1. Berfikir secara kritikal dan analitikal.
2. Mencari ilmu dan berkeyakinan diri, berupaya berkongsi dan menggunakan pengetahuan secara profesional dan beretika.
3. Menggunakan pemikiran intelek untuk menganalisis, membuat cadangan dan membuat keputusan secara kreatif.
4. Menggunakan dan mengadaptasi pengetahuan bidang sains untuk tuntutan pekerjaan, industri dan masyarakat.
5. Berkomunikasi secara efektif.
6. Menunjukkan sikap warganegara bertanggungjawab.

Fakulti Sains menawarkan dua kursus di peringkat Sarjana Muda iaitu kursus Sarjana Muda Sains Industri dan kursus Sarjana Muda Sains Tulen. Kedua-dua kursus ini memerlukan tiga tahun pengajian dengan kredit lulus antara 96-102 kredit bergantung kepada bidang pengkhususan. Setelah menamatkan semua kredit yang diperlukan pelajar akan dianugerahkan Ijazah Sarjana Muda Sains. Kursus Sarjana Muda Sains Industri mempunyai lima bidang pengkhususan iaitu Fizik Bahan, Fizik Industri, Fizik Kesihatan, Kimia Industri dan Matematik Industri. Kursus Sarjana Muda Sains Tulen mempunyai tiga bidang pengkhususan iaitu Fizik, Kimia dan Matematik.

Bidang dan kod pengkhususan adalah seperti berikut:

i.	Fizik	-	SSZ
ii.	Fizik Bahan	-	SSD
iii.	Fizik Industri	-	SSF
iv.	Fizik Kesihatan	-	SSH
v.	Kimia	-	SSA
vi.	Kimia Industri	-	SSC
vii.	Matematik	-	SSE
viii.	Matematik Industri	-	SSM

## OBJEKTIF KURSUS

Objektif utama kursus Sarjana Muda Sains adalah untuk melahirkan ahli sains dan teknologi di peringkat ijazah sarjana muda yang mahir, cekap dan berketerampilan bagi memenuhi keperluan perindustrian, penyelidikan dan pembangunan di sektor awam dan swasta.



## EDUCATIONAL AIM

The educational aims of the Faculty of Science is to provide graduates with the following abilities and characteristics:

1. Think critically and analytically.
2. Knowledge seeking and self confident, able to share and use knowledge professionally and ethically.
3. Able to use intellectual thinking in analyzing, creatively making suggestions and decisions.
4. Able to use and make adaptations of scientific knowledge to occupational, industrial and peer requirements.
5. Communicate effectively.
6. A responsible citizen of the country.

The Faculty offers two courses at the Bachelor of Science level, which comprise of the Bachelor of Industrial Science and the Bachelor of Pure Science courses. Both of these courses are 3-year programmes requiring passing credits of between 96-102 credit hours depending on the major fields. Upon completion of all the required credits, students will be awarded the Bachelor of Science Degree. The Bachelor of Industrial Science course comprises five majors, namely Industrial Chemistry, Industrial Physics, Material Physics, Health Physics and Industrial Mathematics. Alternatively, the Bachelor of Pure Science course consists of three majors, namely Chemistry, Physics and Mathematics.

The major fields and their respective codes are as follows:

- Physics - SSZ
- Material Physics - SSD
- Industrial Physics - SSF
- Health Physics - SSH
- Chemistry - SSA
- Industrial Chemistry - SSC
- Mathematics - SSE
- Industrial Mathematics - SSM

## COURSE OBJECTIVE

The main objective of the Bachelor of Science course is to produce competent, efficient and skilled scientists and technologists at the undergraduate level, in order to fulfill the needs of industries, research and development for the public and private sectors.



## SYARAT KEMASUKAN

Kemasukan calon untuk program peringkat ijazah pertama adalah berdasarkan kelulusan peperiksaan Sijil Tinggi Pelajaran Malaysia atau yang setaraf dengannya. Perincian syarat kemasukan boleh dirujuk dalam buku Prospektus UTM. Calon dengan kelayakan akademik peringkat diploma dan lain-lain yang diiktiraf boleh dipertimbangkan untuk diberi pengecualian kredit.

## STRUKTUR KURSUS

Kurikulum Sarjana Muda Sains digubal untuk memberikan gabungan kursus teras dan elektif yang bersesuaian dan terkini. Kurikulumnya dirancang untuk memperkukuh asas sains dan matematik pada peringkat awal pengajian. Untuk memenuhi hasrat ini, pelajar yang mengikuti kursus Sarjana Muda Sains perlu mengambil dua kursus teras Fakulti pada Semester I, Tahun 1 disamping kursus teras program dan Kursus Umum Universiti.

Pelajar yang memilih kursus Sarjana Muda Sains Industri dikehendaki menjalani Latihan Industri selama sepuluh minggu. Latihan Industri tidak wajib bagi pelajar kursus Sarjana Muda Sains Tulen. Selain itu, pelajar Sarjana Muda Sains Industri, bergantung kepada bidang pengkhususan, perlu mengambil tiga subjek pengurusan. Sebaliknya, pelajar Sarjana Muda Sains Tulen perlu mengambil tiga kursus Sains atau Matematik sebagai ganti kursus pengurusan.

Taburan kredit bagi kursus Sains Industri diberikan dalam jadual berikut:

Kursus	Taburan Kredit				
	SSD	SSF	SSH	SSC	SSM
Teras Fakulti	6	6	6	6	6
Teras Program	75	68	79	61	61
Elektif	10	8	6	12	12
Pengurusan	-	9	-	9	9
Umum Universiti	8	8	8	8	8
Bahasa Inggeris	6	6	6	6	6
Ko-Kurikulum	2	2	2	2	2
Jumlah Keseluruhan Kredit	107	107	107	104	104
Jumlah Kredit Kira	102	102	102	99	99



## ENTRANCE REQUIREMENTS

Entrance into the undergraduate programme is based on the candidate's success in the 'Sijil Tinggi Persekolahan Malaysia' (STPM), or the 'Sijil Matrikulasi Kementerian Pelajaran Malaysia', or the equivalent. Refer to UTM's prospectus for details of the entrance requirements. Candidates with a certified diploma and other certified qualifications may be considered for credit transfer.

## COURSE STRUCTURE

The Bachelor of Science curriculum was designed to provide relevant and up-to-date combinations of core and elective subjects. The curriculum was devised with the intention to strengthen the fundamentals of science and mathematics in the earlier stage of the course. To achieve this, all students in the Bachelor of Science Programme must take two Faculty Core Subjects in Semester I of Year 1, in addition to Programme Core Subjects and General University Subjects.

Students who opt for the Bachelor of Industrial Science courses must undergo a 10-week Industrial Training. This is not compulsory for students opting for the Bachelor of Pure Science courses. The Bachelor of Industrial Science students, depending on their majors, are required to take three management subjects. Alternatively, the Bachelor of Pure Science students must replace the three management subjects with three science or mathematic subjects.

The distribution of credits for the Industrial Science course is given in the following table:

Subject	Distribution of Credits				
	SSD	SSF	SSH	SSC	SSM
Faculty core	6	6	6	6	6
Programme core	75	68	79	61	61
Electives	10	8	6	12	12
Management	-	9	-	9	9
General University	8	8	8	8	8
English	6	6	6	6	6
Co-Curriculum	2	2	2	2	2
Overall Total Credit	107	107	107	104	104
Total Credit Count	102	102	102	99	99





Sebagai perbandingan, jadual di bawah memberikan taburan kredit bagi kursus Sains Tulen.

Kursus	Taburan Kredit		
	SSZ	SSA	SSE
Teras Fakulti	6	6	6
Teras Program	71	67	64
Elektif	6	9	12
Pengurusan	-	-	-
Umum Universiti	8	8	8
Bahasa Inggeris	6	6	6
Ko-Kurikulum	2	2	2
Jumlah Keseluruhan Kredit	99	98	98
Jumlah Kredit Kira	99	98	98

#### PENGENDALIAN KURSUS SECARA AM

Kursus peringkat sarjana muda dikendalikan mengikut sistem semester dan pengambilan pelajar baru dibuat pada semester I sesuatu tahun akademik. Jangka masa minima pengajian bagi kursus ialah 3 tahun (6 semester). Umumnya kursus dikendalikan secara perkuliahan, tutorial dan amali.

Pelajar diwajibkan mengambil kursus umum universiti yang terdiri daripada kursus Pengajian Islam, Tamadun Islam dan Asia, Pengajian Kenegaraan Malaysia, Bahasa Inggeris dan Ko-Kurikulum.

Selain itu, pelajar tahun akhir perlu menjalankan kajian penyelidikan atau projek dalam bidang yang berkaitan. Mereka dikehendaki menghantar tesis berasaskan kepada kajian penyelidikan atau projek yang dijalankan

Pelajar yang memilih kursus Sains Industri diwajibkan menjalani latihan industri selama sepuluh minggu sama ada di sektor swasta atau badan kerajaan pada semester pendek Tahun 2. Latihan Industri bertujuan untuk melengkapkan bakal graduan dengan pengetahuan praktikal di samping mendedahkan mereka kepada suasana bekerja di industri.

Semua kursus yang ditawarkan oleh Fakulti mempunyai kredit kecuali kursus tertentu yang mempunyai kelulusan Senat Universiti. Amnya, satu jam kredit adalah bersamaan dengan empat-belas jam kuliah per semester atau tiga puluh jam kerja-kerja amali/projek per semester.





In comparison, the following table shows the distribution of credits for the Pure Science course.

Subject	Distribution of Credits		
	SSZ	SSA	SSE
Faculty core	6	6	6
Programme core	71	67	64
Electives	6	9	12
Management	-	-	-
General University	8	8	8
English	6	6	6
Co-Curriculum	2	2	2
Overall Total Credit	99	98	98
Total Credit Count	99	98	98

#### GENERAL RUNNING OF COURSES

Undergraduate courses are run according to the semester system and new-student intake is done in semester I of a particular academic year. The minimum duration of all the courses is three years (6 semesters). Generally the courses are carried out through the media of lectures, tutorials and laboratory practicals.

It is compulsory for students to take the general university subjects, which consist of Islamic Studies, Islamic and Asian Civilization, Malaysian Nationhood Studies, English and Co-Curriculum.

In addition, a final year student is required to undertake a research project or project design in a course-related field. The student is required to submit a dissertation on the project

It is compulsory for industrial science students to undergo a 10-week industrial training in a private or public sector during the short semester at the end of Year 2. The purpose of Industrial Training is to equip graduates with practical technical knowledge besides exposing them to industrial working environment.

All the subjects, offered by the faculty, with the exception of selected subjects approved by the University's Senate, carry credit values. In general, one credit hour is equivalent to fourteen hours of lecture or thirty hours of laboratory work/project.



# SPEKIFIKASI PROGRAM SSZ PROGRAMME SPECIFICATIONS SSZ



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1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Programme Name	Bachelor of Science in Physics			
4. Final Award	Bachelor of Science (Physics)			
5. Programme Code	TS15 (SSZ)			
6. Professional or Statutory Body of Accreditation	Kementerian Pendidikan Tinggi			
7. Language(s) of Instruction	Bahasa Melayu and English			
8. Mode of Study (Conventional, distance learning, etc)	Conventional			
9. Mode of operation (Franchise, self-govern, etc)	Self-governing			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Minimum : 3 yrs Maximum : 5 yrs			
Type of Semester	No. of Semesters		No. of weeks per semester	
	Full Time	Part Time	Full Time	Part Time
Normal	6		17	
12. Entry Requirement	Fulfill the university requirement and the following program requirement 1. Matriculation with minimum B in physics and a minimum of C in mathematics and chemistry or 2. STPM with minimum B in Physics, and a minimum of C in Mathematics and Chemistry or 3. Diploma in sciences or engineering with minimum CPA of 2.50 from recognized institutions.			

### 13. Programme Objectives

- (i) Graduates those are able to acquire knowledge and skills in Physics to conduct contemporary research and development.
- (ii) Graduates those are able to apply their knowledge and skills in planning, analysis, design and supervision of work in fundamental physics.
- (iii) Graduates those are able to solve problems logically, analytically and creatively with confidence.
- (iv) Graduates those are able to lead and contribute towards development of the nation.
- (v) Graduates those are able to work in society with diverse background to achieve common goals.
- (vi) Graduates those are able to communicate effectively and work in a team to achieve excellence.
- (vii) Graduates those are able to appreciate entrepreneurship and foresee opportunities towards job-creation for the nation.



#### 14. Programme Learning Outcomes

##### (a) Technical Knowledge and Competencies

PO1	Acquire the knowledge and understanding of fundamental principles of physics	Lectures, tutorials, seminars, laboratory work, directed reading, active learning	Examinations, laboratory reports, presentations, written assignments, problem-based exercises, project reports
PO2	Ability to apply knowledge in the techniques, skills, and scientific tools related to fundamental physics	Lectures, tutorials, computer hands-on sessions, laboratory work, and industrial training	Examinations, laboratory reports, presentations, written assignments, problem-based exercises, project reports, simulation exercises
PO3	Ability to analyze, interpret, develop and conduct experiments and to design projects related to fundamental physics	Supervised projects, lectures, tutorials, laboratory works, directed reading, simulation exercises, computer-based exercises, problem-based learning	Final Year Project reports, examinations, laboratory reports, presentations, written assignments

##### (b) Generic Skills

PO4	Ability to identify, analyze, formulate and solve fundamental physics related problems	Supervised projects, lectures, tutorials, laboratory works, directed reading, simulation exercises, computer-based exercises, problem-based learning	Final Year Project reports, examinations, laboratory reports, presentations, written assignments
PO5	Ability to communicate effectively and with confidence in relevant occasions	Project supervision, lectures, tutorials, laboratory works, individual assignment	Final Year Project reports, examinations, laboratory reports, presentations, written assignments



PO6	Ability to function effectively and with responsibility as team member to achieve common goals and adapt to changing situations and priorities	Final year project, laboratory work, group assignment	Laboratory reports, final year project reports and logbooks. Peer evaluation
PO7	Ability to perpetually seek and acquire contemporary knowledge	Final year projects, individual assignments	Final year project reports, written assignments
PO8	Ability to function effectively and with responsibility as a leader in a team to achieve common goals.	Projects, tutorials, group assignments, laboratory work	Oral presentations, reports
PO9	Ability to practice ethical values and integrity in scientific and social interactions, think positively and possessing self-esteem	Tutorials, final year project	Written assignments, essays, final year project reports
PO10	Awareness of business and entrepreneurship opportunities	Lectures, laboratory works, group assignments, final year project	Laboratory reports, final year project reports and logbooks

15. Classification of Subjects				
No.	Classification	Credit Hours	Percentage	Standard (QA)
i.	Basic Sciences and Mathematics	13	13%	10 – 30%
ii.	Program Core	62	63%	60-70%
iii.	Program Electives	6	6%	5 – 30%
iv.	Compulsory University Subjects	18	18%	5 – 10%
	a. Humanity	8	8%	
	b. English Language	6		
	c. Co-curriculum	2		
	d. Entrepreneurship	2		
	Total	99	100	100%





For science program please fill up the following classification.  
(Other please refer to the Statutory Body Guidelines)

A	Physics Subjects		
	(a) Lecture	65	75.8%
	(b) Laboratory/ Workshop/Field	4	
	(c) Industrial Training	-	
	(d) Final Year Project	6	
	Total Credit Hours for Part A	75	
B	Related Subjects		
	(a) Mathematics	6	24.2%
	(b) Humanities/Ethics	6	
	(c) Co-Curriculum	2	
	(d) English	6	
	(e) Electives	2	
	(f) Entrepreneurship	2	
	Total Credit Hours for Part B	24	
	Total Credit Hours for Parts A and B	99	100%

<b>16. Total credit hours to graduate</b>	99 credit hours
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**17. Programme structures and features, curriculum and award requirements**  
The course is offered on full-time mode and is based on a 2-Semester Academic Session with several subjects being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester.

Award requirements:  
To graduate, students should:

- Attain a total of no less than 99 credit hours with minimum CPA of 2.0.
- Pass the undergraduate Final Year Project.

**YEAR 1 (Semester 1)**

SSP 1103	Physics I	3
SSP 1133	Physics II	3
SSP 1811	Physics Practical I	1
SSH 1013	Intermediate	3
SSH 1113	Mathematics	3
ULT 1022	Statistic 1 Islamic and Asian Civilizations	2
<b>Total Credit Hours</b>		<b>15</b>

**(Semester 2)**

SSP 1123	Thermodynamics	3
SSP 1223	Modern Physics	3
SSP 1323	Basic Electronics	3
SSP 1513	Optical Physics	3
SSP 1821	Physics Practical II	1
UHB 1412	English for Academic	2
UHS 1152	Communication Ethnic Relations	2
<b>Total Credit Hours</b>		<b>17</b>



### YEAR 2 (Semester 3)

SSP 2122	Computational Physics	2
SSP 2213	Nuclear Physics	3
SSP 2323	Advanced Electronics	3
SSP 2613	Mathematical Physics	3
SSP 2811	Physics Practical III	1
SSU 2612	History of Nobel Laureate	2
UQ 2--1	Co- curriculum I	1
<b>Electives (Choose 2 credits)</b>		
ULT 2122	Islamic Institutions	2
ULT 2132	Islam and Current Issues	2
<b>Total Credit Hours</b>		<b>17</b>

### (Semester 4)

SSP 2413	Solid State Physics	3
SSP 2623	Electromagnetism	3
SSP 2633	Classical Mechanics	3
SSP 2821	Physics Practical IV	1
SSU 2623	Research Methodology and Material Retrieval	3
UHB 2422	Advanced English for Academic Communication	2
UHS 2122	Critical and Creative Thinking	2
<b>Total Credit Hours</b>		<b>17</b>

### YEAR 3 (Semester 5)

SSP 3513	Applied Optics	3
SSP 3612	General Relativity	2
SSP 3613	Quantum Mechanics	3
SSU 3922	Undergraduate Project I	2
UHB 3__2	English for Technical Writing	2
UQ_ 3__1	Co-curriculum II	1
<b>Electives (Choose 2 credits)</b>		
SSP 3332	Signal Processing	2
SSP 3422	Magnetism	2
SSP 3532	Photonics	2
SSP 3312	Computer Interfacing	2
<b>Total Credit Hours</b>		<b>15</b>

### (Semester 6)

SSP 3622	Elementary Particles	2
SSP 3623	Thermal and Statistical Physics	3
SSP 3633	Astrophysics	3
SSU 3924	Undergraduate Project II	4
UHS 3102	Entrepreneurship and Enterprise Development	2
<b>Electives (Choose 4 credits)</b>		
SSP 3472	Superconductivity	2
SSP 3482	Microscopic Techniques	2
SSP 3552	Optoelectronics	2
SSP 3632	Advanced Quantum Mechanics	2
SSP 3642	Condensed Matter Physics	2
<b>Total Credit Hours</b>		<b>18</b>



18. Mapping of Programme Learning Outcome to Subjects											
Learning Outcomes											
Subjects offered	Fundamental Physics knowledge	Application of physics knowledge	Analyzing & experimentation skills	Problems Solving	Communicating effectively	Team working and Adaptability	Life long learning	Leadership	Ethics, Integrity and Self esteem	Entrepreneurship awareness	
Subjects	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	
Core Subjects											
S SP 1103	Physics I	a	a	a	1	2	2	2	2	2	
S SP 1133	Physics II	a	a	a	1	2	2	2	1	2	
SSP 1811	Physics Laboratory I	a	a	a	2	2	1	2	2	2	
SSH 1013	Intermediate Mathematics	a	a	-	-	-	1	-	-	-	
SSH 1113	Statistics 1	a	a	a	1	-	-	-	-	-	
SSP 1123	Thermodynamics	a	a	b	2	1	1	2	2	2	
SSP 1223	Modern Physics	a	a	b	2	2	1	2	2	2	
SSP 1323	Basic Electronics	a	a	b	2	2	1	2	2	2	
SSP 1513	Optical Physics	a	a	b	1	1	2	2	2	2	
SSP 1821	Physics Laboratory II	a	a	a	2	2	1	2	2	2	
SSP 2122	Computational Physics	a	a	b	2	2	1	2	2	2	
SSP 2213	Nuclear Physics	a	a	b	2	2	1	2	2	2	
SSP 2323	Advanced Electronics	a	a	b	1	2	2	1	2	2	
SSP 2613	Mathematical Physics	a	a	c	1	2	1	2	2	2	
SSP 2811	Physics Laboratory III	a	a	a	2	1	1	2	2	2	
SSU 2612	History of Nobel Laureates	a	c	c	2	2	1	2	1	2	
SSP 2413	Solid State Physics	a	a	b	1	1	2	2	2	2	
SSP 2623	Electromagnetism	a	a	b	2	2	2	1	2	2	
SSP 2633	Classical Mechanics	a	a	c	1	1	2	2	2	2	
SSP 2821	Physics Laboratory IV	a	a	a	2	1	1	2	2	2	
SSU 2623	Research Methodology and Information Acquisition	a	a	a	2	1	1	2	2	2	
SSP 3513	Applied Optics	a	a	c	1	1	2	2	2	2	
SSP 3612	General Relativity	a	a	c	1	1	2	2	2	2	
SSP 3613	Quantum Mechanics	a	a	b	2	2	2	1	2	2	
SSU 3922	Undergraduate Final Year Project I	a	a	a	1	1	2	1	2	1	
SSP 3622	Elementary Particles	a	a	b	1	2	2	1	2	2	



Subjects offered		Fundamental Physics knowledge	Application of physics knowledge	Analyzing & experimentation skills	Problems Solving	Communicating effectively	Team working and Adaptability	Life long learning	Leadership	Ethics, Integrity and Self esteem	Entrepreneurship awareness
Subjects		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
<b>Core Subjects</b>											
SSP 3623	Thermal Physics and Statistics	a	a	b	2	1	1	2	2		
SSP 3552	Optoelectronics	a	a	b	1	2	2	1	2	2	
SSP 3633	Astrophysics	a	a	c	2	1	1	2	2	2	
SSU 3924	Undergraduate Final Year Project II	a	a	a	1	1	2	1	2	1	
<b>Elective Subjects</b>											
SSP 3332	Signal Processing	a	a	b	2	2	1	2	2	2	
SSP 3422	Magnetism	a	a	b	1	2	2	2	1	2	
SSP 3532	Photonics	a	a	b	1	2	2	1	2	2	
SSP 3312	Computer Interfacing	a	a	b	1	2	1	2	2	2	
SSP 3472	Superconductivity	a	a	b	1	2	2	2	1	2	
SSP 3482	Microscopic Techniques	a	a	b	1	2	2	2	1	2	
SSP 3552	Optoelectronics	a	a	b	1	2	2	1	2	2	
SSP 3632	Advance Quantum Mechanics	a	a	b	2	2	2	1	2	2	
SSP 3642	Condensed Matter Physics	a	a	b	1	2	2	2	2	2	
<b>University Subjects</b>											
ULT 1022	Islamic and Asian Civilizations (TITAS)	c			2	2		2	2	2	2
UHB1412	English for Academic Communications	a	a	c	2	1	2	2	1		1
UHS1152	Ethnic Relation	c			2						
UQ_ 2xx1	Co-curriculum	c			1	2		1	1	2	1
UHB2422	Advanced English for Academic Communications	a	a	b	2	1	2	2	1		1
UHS 2xx2	Nationhood Electives	c			2						1
UHB 3xx2	Compulsory English Elective	a	c		2	1	2	2	1		1
UQ_ 3xx1	Co-curriculum II	c			1	2		1	1	2	
ULT 2122	Islamic Institutions										
ULT 2132	Islam and Current Issues	c			2	2		2	2	2	2
UHS3102	Entrepreneurship and Enterprise Development	c									1



**Key:**

Physics Knowledge and Competencies: **a** = major contribution to outcome; **b** = moderate contribution to outcome; **c** = minor contribution to outcome

Generic Skills: **1** = Substantial (with assessment); **2** = not substantial (introduce)

**19. Our Uniqueness**

This programme stressed on the research skill of the grandaunts.

**20. Career Prospects and Career Path**

Graduates of the program can work as

- Research officer – Research Institute, university and industries
- Science Officer -- Research Institute, university and industries
- Physic Teacher – Schools and colleges
- Quality control officer -- Industries

**21. Cross Campus Programme**

Students are given the opportunity to enroll few courses in participating universities and the grades and credits (up to 1/3 of the total credits of the curriculum) are transferable. At the moment, there are four participating universities i.e. Universiti Teknologi Malaysia, Universiti Sains Malaysia, Universiti Malaya and Universiti Malaysia Sarawak.

**22. UTM Degree ++ Programme**

Students are given a chance to enroll in certificate program offered by Centers of Excellence in the university during their semester breaks. For example, Certificate of Attendance in *Communicate with Confidence*, *Good Resume Writing*, *Personal Grooming etc*

**23. Facilities available**

**A: Laboratories**

1. Modern Physics Laboratory
2. Wave & Optics Laboratory
3. Basic & Advanced Electronic Laboratories
4. Optoelectronics Devices Laboratory
5. Nuclear Physics Laboratory
6. Radiation Dosimetry Laboratory
7. Laser Technology & Research Laboratories
8. Fiber Optics Technology Laboratory
9. Thin Film & Low Temperature Laboratory
10. Vacuum Laboratory
11. Material Science & Material Analysis Laboratories
12. Computer & Microcomputer Laboratory
13. Photonics Training & Research Laboratories
14. Optical Crystal Research Laboratory
15. Electronic & Mechanical Workshops

**B: Major Equipments**

1. AFM – Atomic Force Microscopic
2. Tensile Machine
3. Corrosion Machine
4. Crystal Growth equipment
5. CNC Machine
6. Nd : YAG Laser
7. Ti : Sapphire Laser



#### 24. Support for Students and their learning

- a) Two weeks of induction programme for orientation and introductory study skills
- b) Student Handbook and Module Guides
- c) Staff student ratios for teaching of 16:1
- d) Extensive library and other learning resources and facilities.
- e) All students are allocated academic advisor whose role is to assist them with personal problems and advise on programme of study.

#### 25. Methods for Evaluating and Improving the Quality and standards of teaching and learning Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards

1. Students performance in terms of:
  - KS/KB
  - CPA
  - Graduating students performance
  - GOT
  - Completion rate
  - Analysis of course performance
2. Employability
  - Exit survey
  - Alumni survey
  - Market survey
3. Lecturer's performance
  - Teaching evaluation by students (online)
  - Competency check-list for staff (CV).
  - Annual staff appraisal (SKT)
4. Curriculum review
  - Faculty academic committee
  - Industrial training survey
  - PSM survey
  - External examiner reports
  - CO achievement survey by students
  - Students e-Portfolio
  - Generic skills evaluation (Performance Criteria Report)
5. Delivery system
  - Academic Quality Assurance Committee
  - CSI
  - SSI
  - AKNC audit report
  - MOA standard





## 26. Regulation of Assessment

### a) Summary of marks, grades and their evaluation points

Marks	Grade	Evaluation Point
90-100	A+	4.00
80-89	A	4.00
75-79	A-	3.67
70-74	B+	3.33
65-69	B	3.00
60-64	B-	2.67
55-59	C+	2.33
50-54	C	2.00
45-49	C-	1.67
40-44	D+	1.33
35-39	D	1.00
30-34	D-	0.67
00-29	E	0.00

### b) Role of External Examiners (Visiting Examiners)

Visiting Examiners are appointed by the Faculty Academic Committee to

- review and evaluate programme curriculum,
- review and evaluate assessment procedure and methods,
- make necessary recommendations to the Academic Committee.

## 27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by	
	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10			
Lecturer Course Assessment	x	x	x	x	x	x	x	x	x	x	x	Twice/ year	Department
Student Course Evaluation	x	x	x	x								Twice/ year	Department
Graduating Student Survey	x	x	x	x	x	x	x	x	x	x	x	Once/ year	Department
Learning Portfolio	x	x	x	x								Once/ year	Department
Final Year Project Grade	x	x	x	x								Once/ year	Department
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/ year	Department
Employer Survey				x	x	x	x	x	x	x	x	Once/ year	Department
Program Performance Report	x	x	x	x								Once/ year	Department



# SPEKIFIKASI PROGRAM SSF PROGRAMME SPECIFICATIONS SSF



UNIVERSITI TEKNOLOGI MALAYSIA

Buku Panduan Akademik Fakulti Sains **09/10**  
Academic Guide Book Faculty Of Science **09/10**





1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Program Name	Bachelor of Science in Industrial Physics			
4. Final Award	Bachelor of Science (Industrial Physics)			
5. Program Code	TS33 (SSF)			
6. Professional or Statutory Body of Accreditation	Kementerian Pendidikan Tinggi Malaysia			
7. Language(s) of Instruction	Bahasa Melayu and English			
8. Mode of Study (Conventional, distance learning, etc)	Conventional			
9. Mode of operation (Franchise, self-govern, etc)	Self-governing			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Minimum : 3 yrs Maximum : 5 yrs			
Type of Semester	No. of Semesters		No. of weeks per semester	
	Full Time	Part Time	Full Time	Part Time
Normal	6		17	
Short	1		10	
12. Entry Requirement	Fulfill the University and the Pogram Requirements as the following: 1. Matriculation with a minimum B- in Physics and a minimum of C in both Chemistry and Mathematics or 2. STPM with a minimum B- in Physics, and a pass in both Mathematics and Chemistry or 3. Diploma in Sciences or Engineering with a minimum CPA of 2.50 from a recognized institution.			

### 13. Programme Objectives

The program was developed with the objectives to produce graduates with the following attributes:

- (i) Graduates who are capable of applying their scientific knowledge and skill in planning, analyzing, designing and supervising work related to Industrial Physics.
- (ii) Graduates with the ability to acquire knowledge and skill in field related to industrial Physics to support industry, and involve in research and development.
- (iii) Graduates with basic skills and know-how to solve industrial problems creatively and with confidence.
- (iv) Graduates with the ability to acquire new knowledge in frontier of the industrial development and innovation.
- (v) Graduates who are able to think scientifically, communicate effectively, and work in a team.
- (vi) Graduates with leadership potential.
- (vii) Graduates who are able to appreciate entrepreneurship and foresee opportunities towards job-creation



#### 14. Programme Learning Outcomes

##### (a) Technical Knowledge and Competencies

PO1	Acquire the sound knowledge of sciences and understanding of fundamental principles of physics	Lectures, tutorials, seminars, laboratory work, directed reading, active learning	Examinations, laboratory reports, presentations, written assignments, problem-based exercises, project reports
PO2	Ability to apply physics theory, instrumentation and computational knowledge to solve scientific problems for industrial needs	Lectures, tutorials, computer hands-on sessions, laboratory work, and industrial training	Examinations, laboratory reports, presentations, written assignments, problem-based exercises, project reports, simulation exercises
PO3	Ability to analyze, interpret data, design and develop experimental systems to solve industrial problems	Supervised projects, lectures, tutorials, laboratory works, directed reading, simulation exercises, computer-based exercises, problem-based	Final Year Project reports, examinations, laboratory reports, presentations, written assignments

##### (b) Generic Skills

PO4	Ability to identify, analyze, formulate and solve fundamental physics related problems	Lectures, tutorials, quizzes, tests, laboratory works, directed reading, simulation exercises, computer-based exercises	Final Year Project reports, examinations, laboratory reports, presentations, written assignments
PO5	Ability to convey and articulate ideas and knowledge effectively in writing and verbally with confidence.	Project supervision, lectures, tutorials, laboratory works, individual assignment	Final Year Project reports, laboratory reports, presentations, written assignments



PO6	Ability to function effectively as individual and as part of a team and undertaking different team roles. Ability to adapt and response to changing situations	Industrial Training, Final year project, laboratory works, tutorials, group assignments	Industrial report and log book, final year project report, peer evaluations
PO7	Ability to seek relevant information from various sources	Final year projects, individual assignments	Final year project reports, written assignments
PO8	Ability to lead in a team to achieve common goals	Industrial training, Final year project, laboratory work, group assignment	Laboratory reports, final year project reports and log books. Peer evaluations
PO9	Ability to practice high ethical values and integrity in scientific and social interactions, think positively and possessing self-esteem	Tutorials, final year project	Written assignments, essays, final year project reports
PO10	Posses the awareness of business and entrepreneurship opportunity	Lectures, laboratory works, group assignments, final year project	Laboratory reports, final year project reports and logbooks

#### 15. Classification of Subjects

No.	Classification	Credit Hours	Percentage %	Standard (QA) %
i.	Basic Sciences and Mathematics	13	12.1	10 - 30
ii.	Program Core	70	65.4	60 - 70
iii.	Program Electives	6	5.6	3 - 30
iv.	Compulsory University Subjects	18	15	5 - 10
	a. Humanity	8	7.5	
	b. Language			
	c. Co-curriculum			
	d. Entrepreneurship			
	Total	107	100	100





For science program please fill up the following classification.  
(Other please refer to the Statutory Body Guidelines)

A	Physics Subjects		
	(a) Lecture	68	77.6%
	(b) Laboratory/ Workshop	4 6	
	(c) Final Year Project	5	
	(d) Industrial training		
	Total Credit Hours for Part A	83	
B	Related Subjects		
	(a) Mathematics	6	22.4%
	(b) Humanities/Ethics	8	
	(c) Co-Curriculum	2	
	(d) English	6	
	(e) Entrepreneurship	2	
	Total Credit Hours for Part B	24	
iii	Total Credit Hours for Parts A and B	107	100%

16. Total credit hours to graduate	107 credit hours
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**17. Programme structures and features, curriculum and award requirements**

The course is offered on full-time mode and is based on a 2-Semester Academic Session with several subjects being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester.

Award requirements:

To graduate, students should:

- Attain a total of no less than 107 credit hours with minimum CPA of 2.0.
- Pass the industrial Training
- Complete and pass the undergraduate Final Year Project.

**YEAR 1 (Semester 1)**

SSP 1013	Physics I	3
SSP 1113	Physics II	3
SSP 1811	Physics Practical I	1
SSH 1103	Intermediate	3
SSH 1133	Mathematics	3
ULT 1022	Statistics 1 Islamic and Asian Civilizations (TITAS)	2
Total Credit Hours		15

**(Semester 2)**

SSP 1123	Thermodynamics	3
SSP 1223	Modern Physics	3
SSP 1323	Basic Electronics	3
SSP 1513	Optical Physics	3
SSP 1821	Physics Practical II	1
UHB1412	English for Academic Communications	2
UHS1152	Ethnic Relations	2
Total Credit Hours		17



### YEAR 2 (Semester 3)

SSP 2122	Computational Physics	2
SSP 2213	Nuclear Physics	3
SSP 2323	Advanced Electronics	3
SSP 2613	Mathematical Physics	3
SSP 2811	Physics Laboratory III	1
SHD 1513	Principles of Management	3
UQ 2--1	Co- curriculum	1
<b>Electives (Choose 2 credits)</b>		
ULT 2122	Islamic Institutions	2
ULT 2132	Islam and Current Issues	2
<b>Total Credit Hours</b>		<b>18</b>

### (Semester 4)

SSP2343	Instrumentation and	3
SSP2413	Measurements	3
SSP2623	Solid State Physics	3
SSP2821	Electromagnetism	1
SHF1113	Physics Practical IV	3
	Principles of Marketing	
UHB2422	Advanced English for Academic Communications	2
UHS 2--2	Nationhood Electives	2
<b>Total Credit Hours</b>		<b>17</b>

### Short Semester

SSU 2915	Industrial Training	5
<b>Total Credit Hours</b>		<b>15</b>

### YEAR 3 (Semester 5)

SSP 3312	Computer Interfacing	2
SSP 3413	Semiconductor Physics	3
SSP 3613	Quantum Mechanics	3
SSU 3922	Undergraduate Project I	2
UHB 3_ _2	English for Technical Writing	2
UQ_ 3_ _1	Co- curriculum II	1
<b>Electives (Choose 4 credits)</b>		
SSP 3322	Electronic Circuits Simulation	2
SSP 3332	Signal Processing	2
SSP 3342	Non-Destructive Testing I	2
SSP 3422	Magnetism	2
SSP 3512	Laser Technology	2
SSP 3522	Fiber Optics Sensors	2
SSP 3532	Photonics	2
<b>Total Credit Hours</b>		<b>17</b>

### (Semester 6)

SSP 3313	Industrial Electronics	3
SSP 3442	Undergraduate Project II	2
SSU 3924	Quality Control	4
SHD 1523	Organizational Behaviors	3
UHS 3102	Entrepreneurship and Enterprise Development	2
<b>Electives (Choose 4 credits)</b>		
SSP 3352	Process Control	2
SSP 3362	Communication Electronics	2
SSP 3372	Electronics Testing and Maintenance	2
SSP 3382	Non-Destructive Testing	2
SSP 3462	Methods II	2
SSP 3542	Metallurgy	2
SSP 3552	Fiber Optics Technology Optoelectronics	2
<b>Total Credit Hours</b>		<b>18</b>



### 18. Mapping of Programme Learning Outcome to Subjects

Subjects offered		Learning Outcomes									
		Fundamental Physics knowledge	Application of physics knowledge	Analyzing & experimental skill	Problem Solving	Communicating	Team working	Life long learning	Leadership	Ethics, Integrity and Self esteem	Entrepreneurship awareness
Subjects		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Core Subjects											
SSP 1103	Physics I	a	a	a	1	2	2	2	2	2	-
SSP 1133	Physics II	a	a	a	1	2	2	2	1	2	-
SSP 1811	Physics Practical I	a	a	a	2	2	1	2	2	2	-
SSH 1013	Intermediate Mathematics	a	a	-	-	1	-	-	-	-	-
SSH 1113	Statistics 1	a	a	a	1	-	-	-	-	-	-
SSP 1123	Thermodynamics	a	a	b	2	1	1	2	2	2	-
SSP 1223	Modern Physics	a	a	b	2	2	1	2	2	2	-
SSP 1323	Basic Electronics	a	a	b	2	2	1	2	2	2	-
SSP 1513	Optical Physics	a	a	b	1	1	2	2	2	2	-
SSP 1821	Physics Practical II	a	a	a	2	2	1	2	2	2	-
SSP 2122	Computational Physics	a	a	b	2	2	1	2	2	2	-
SSP 2213	Nuclear Physics	a	a	b	2	2	1	2	2	2	-
SSP 2323	Advanced Electronics	a	a	b	1	2	2	1	2	2	-
S SP 2613	Mathematical Physics	a	a	c	1	2	1	2	2	2	-
SSP 2811	Physics Practical III	a	a	a	2	1	1	2	2	2	-
SSP 2343	Instrumentations and Measurements	a	a	b	2	2	2	1	2	2	-
SSP 2413	Solid State Physics	a	a	b	1	1	2	2	2	2	-
SSP 2623	Electromagnetism	a	a	b	2	2	2	1	2	2	-
SSP 2811	Physics Practical IV	a	a	a	2	1	1	2	2	2	-
SHF 1113	Principles of Marketing	a	a								
SSU 2915	Industrial Training	b	a	a	1	1	2	1	2	1	-
SSP 3312	Computer Interfacing	a	a	b	1	2	1	2	2	2	-
SSP 3413	Semiconductor Physics	a	a	b	1	2	1	2	2	2	-
SSP 3613	Quantum Mechanics	a	a	b	2	2	2	1	2	2	-
SSU 3922	Undergraduate Final Year Project I	a	a	a	1	1	2	1	2	1	-
SSP 3313	Industrial Electronics	a	a	b	2	2	1	2	2	2	-
SSP 3442	Quality Control	a	a	b	1	1	2	2	2	2	-
SSU 3924	Undergraduate Final Year Project II	a	a	a	1	1	2	1	2	1	-



Subjects offered		Fundamental Physics knowledge	Application of physics knowledge	Analyzing & experimental skill	Problem Solving	Communicating	Team working	Life long learning	Leadership	Ethics, Integrity and Self esteem	Entrepreneurship awareness
Subjects		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
<b>Core Subjects</b>											
SHD1523	Organizational Behavior										
<b>Elective Subjects</b>											
SSP 3322	Electronics Circuit Simulation	a	a	b	1	2	2	2	2	2	-
SSP 3332	Signal Processing	a	a	b	2	2	1	2	2	2	-
SSP 3342	Nondestructive Testing 1	a	a	b	1	2	2	1	2	2	2
SSP 3422	Magnetism	a	a	b	1	2	2	2	1	2	-
SSP 3512	Laser Technology	a	a	b	2	2	1	1	2	2	
SSP 3522	Fiber Optics Sensors	a	a	b	1	2	2	1	2	2	
SSP 3532	Photonics	a	a	b	1	2	2	1	2	2	
SSP 3352	Process Control	a	a	b	1	1	2	2	2	2	
SSP 3362	Communication Electronics	a	a	b	1	2	2	2	2	2	
SSP 3372	Electronics Testing and Maintenance	a	a	b	1	2	1	2	2	2	2
SSP 3382	Nondestructive Testing 2	a	a	b	2	1	2	1	2	2	2
SSP 3452	Metallurgy	a	a	b	1	1	2	2	2	2	
SSP 3542	Fiber Optics Technology	a	a	b	1	2	2	1	2	2	
SSP 3552	Optoelectronics	a	a	b	1	2	2	1	2	2	-
SSP 3632	Advance Quantum Mechanics	a	a	b	2	2	2	1	2	2	-
<b>University Subjects</b>											
ULT 1022	Islamic and Asian Civilizations (TITAS)	c			2	2		2	2	2	2
UHB1412	English for Academic Communications	a	a	c	2	1	2	2	1		2
UHS1152	Ethnic Relation	c			2						
UQ_ 2xx1	Co-curriculum	c			1	2		1	1	2	1
UHB2422	Advanced English for Academic Communications	a	a	b	2	1	2	2	1		1
UHS 2xx2	Nationhood Electives	c			2						
UHB 3xx2	Compulsory English Elective	a	c		2	1	2	2	1		1
UQ_ 3xx1	Co-curriculum II	c			1	2		1	1	2	1
ULT 2122	Islamic Institutions										
ULT 2132	Islam and Current Issues	c			2	2		2	2	2	1
UHS3102	Entrepreneurship and Enterprise Development	c									1



**Key:**

Physics Knowledge and Competencies: **a** = major contribution to outcome; **b** = moderate contribution to outcome; **c** = minor contribution to outcome

Generic Skills: **1** = Substantial (with assessment); **2** = not substantial (introduce)

**19. Our Uniqueness**

**20. Career Prospects and Career Path**

Bachelor of Science in Industrial Physics, prepare the graduates to carry out research and development tasks in the industry or the government laboratories; as scientific, research or quality control personnel or to teaching sciences and physics in particular in colleges and high schools.

1. Quality Assurance and Control Engineers at Manufacturing Industries.
2. Nondestructive Assurance Inspectors.
3. Researchers at National Research Institutes (MINT, SIRIM, AMREC, Telekom Malaysia Research Institute, Public University)
4. Sales and Marketing Engineers

**21. Cross Campus Programme**

Students are given the opportunity to enroll a few courses in participating universities and the grades and credits (up to 1/3 of the total credits of the curriculum) are transferable. Currently, there are four participating universities i.e. Universiti Teknologi Malaysia, Universiti Sains Malaysia, Universiti Malaya and Universiti Malaysia Sarawak.

**22. UTM Degree ++ Programme**

Students are given an opportunity to enroll in certificate program offered by the Centres of Excellence in the University, with most courses offered by the School of Professional and Continuing Education (SPACE) during their semester breaks. For example, AutoCAD offered by SPACE or Certificate in Modular Construction in the Construction Industry offered by Construction Technology and Management Centre.

**23. Facilities available**

Laboratory Facilities:

1. Modern Physics Laboratory
2. Wave & Optics Laboratory
3. Basic & Advanced Electronic Laboratories
4. Optoelectronics Devices Laboratory
5. Nuclear Physics Laboratory
6. Radiation Dosimetry Laboratory
7. Laser Technology & Research Laboratories
8. Fiber Optics Technology Laboratory
9. Thin Film & Low Temperature Laboratory
10. Vacuum Laboratory
11. Material Science & Material Analysis Laboratories
12. Computer & Microcomputer Laboratory
13. Photonics Training & Research Laboratories
14. Advanced Materials Research Laboratory
15. Nondestructive Testing Lab

Major Equipments:

1. Crystal growth Equipments
2. Photoluminescence Spectrophotometer
3. High precision polishing machine
4. Hyper-pure Ge detector
5. High temperature Furnaces
6. DTA systems
7. Laser systems





#### 24. Support for Students and their learning

- a) Two weeks of induction programme for orientation and introductory study skills
- b) Student Handbook and Module Guides
- c) Staff student ratios for teaching of 16:1
- d) Extensive library and other learning resources and facilities.
- e) All students are allocated academic advisor whose role is to assist them with personal problems and advise on programme of study.

#### 25. Methods for Evaluating and Improving the Quality and standards of teaching and learning Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards

1. Students performance in terms of:
  - KS/KB
  - CPA
  - Graduating students performance
  - Graduate on time, GOT
  - Completion rate
  - Analysis of course performance
2. Employability
  - Exit survey
  - Alumni survey
  - Market survey
3. Lecturer's performance
  - Teaching evaluation by students (OMR)
  - Competency check-list for staff (CV).
  - Annual staff appraisal (SKT)
4. Curriculum review
  - Faculty academic committee
  - PSM survey
  - External examiner reports
  - CO achievement survey by students
  - Students e-Portfolio
  - Generic skills evaluation (Performance Criteria Report)
5. Delivery system
  - Academic Quality Assurance Committee
  - CSI
  - SSI
  - AKNC audit report
  - MQA standard





## 26. Regulation of Assessment

### a) Summary of marks, grades and their evaluation points

Marks	Grade	Evaluation Point
90-100	A+	4.00
80-89	A	4.00
75-79	A-	3.67
70-74	B+	3.33
65-69	B	3.00
60-64	B-	2.67
55-59	C+	2.33
50-54	C	2.00
45-49	C-	1.67
40-44	D+	1.33
35-39	D	1.00
30-34	D-	0.67
00-29	E	0.00

### b) Role of External Examiners (Visiting Examiners)

Visiting Examiners are appointed by the Faculty Academic Committee to

- review and evaluate programme curriculum,
- review and evaluate assessment procedure and methods,
- make necessary recommendations to the Academic Committee.

## 27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by	
	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10			
e- Portfolio	x	x	x	x	x	x	x	x	x	x	x	Continuous	Student
Course outcome survey	x	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Course outcome report	x	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Final Year Project survey	x	x	x	x	x		x		x			End of sem	Faculty
PO survey by final year students	x	x	x	x	x	x	x	x	x	x	x	End of sem	Faculty
Industrial training survey			x	x	x	x	x	x	x			End of session	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept
Employer Survey	x	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept



# SPEKIFIKASI PROGRAM SSD PROGRAMME SPECIFICATIONS SSD



UNIVERSITI TEKNOLOGI MALAYSIA

Buku Panduan Akademik Fakulti Sains **09/10**  
Academic Guide Book Faculty Of Science **09/10**





1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Program Name	Bachelor of Science in Material Physics			
4. Final Award	Bachelor of Science (Material Physics)			
5. Program Code	TS28 (SSD)			
6. Professional or Statutory Body of Accreditation	Kementerian Pendidikan Tinggi			
7. Language(s) of Instruction	Bahasa Melayu and English			
8. Mode of Study (Conventional, distance learning, etc)	Conventional			
9. Mode of operation (Franchise, self-govern, etc)	Self-governing			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Minimum : 3 yrs Maximum : 5 yrs			
Type of Semester	No. of Semesters		No. of weeks per semester	
	Full Time	Part Time	Full Time	Part Time
Normal	6		17	
Short	1		10	
12. Entry Requirement	Fulfill the university requirement and the following program requirement: 1. Matriculation with a minimum of B- in Physics, and a minimum of C in Mathematics and Chemistry or 2. STPM with minimum B- in Physics, and a minimum of C in Mathematics and Chemistry or 3. Diploma in Science or Engineering with minimum CPA of 2.70 from recognized institutions.			

### 13. Programme Objectives

- (i) Graduates that are able to apply their knowledge and skills in planning, analysis, design and supervision of work in fundamental physics discipline.
- (ii) Graduates with up to date material characterization, skills and evaluation techniques in which material physics is relevant.
- (iii) Graduates that are able to continuously upgrade their knowledge, acquiring new functional material and related technology to propose and solve current problems creatively in material related industry.
- (iv) Graduates that are able to think scientifically, communicate effectively, responsible, and work in a team with leadership potential
- (v) Graduates that possess entrepreneurship skills and foresee towards job-creation for the nation.



#### 14. Programme Learning Outcomes

##### (a) Technical Knowledge and Competencies

PO1	Acquire the knowledge and understanding of fundamental principles of physics	Lectures, tutorials, seminars, laboratory work, directed reading, student participation.	Examinations, laboratory reports, presentations, written assignments, problem-based exercises, project reports
PO2	Ability to apply the material characterization techniques and skills to solve material related problems	Lectures, tutorials, computer hands-on sessions, laboratory work, and industrial training	Examinations, laboratory reports, presentations, written assignments, problem-based exercises, project reports, simulation exercises
PO3	Ability to analyze, develop and conduct experiments, and to design projects related to material characterization technique.	Supervised projects, lectures, tutorials, laboratory works, directed reading, simulation exercises, computer-based exercises, problem-based	Final Year Project reports, examinations, laboratory reports, presentations, written assignments

##### (b) Generic Skills

PO4	Be able to identify, analyze and interpret data to evaluate, formulate and solve related problems and decision making creatively.	Lectures, tutorials, laboratory works, individual or group assignments,	Examinations, test, quiz, laboratory reports, individual or group presentations, written assignments
PO5	Ability to communicate and express ideas clearly and effectively through writing and verbally.	Project supervision, lectures, tutorials, laboratory works, individual assignment	Final Year Project reports, examinations, laboratory reports, presentations, written assignments



PO6	Ability to work collaboratively as part of a team, interact and respect the ideas of others	Projects, tutorials, group assignments, laboratory work	Oral presentations, reports
PO7	Ability to acquire relevant information continuously from various sources	Final year projects, individual assignments	Final year project reports, written assignments
PO8	Ability to lead with responsibility and initiate changes for improvement	Final year project, laboratory work, group assignment	Laboratory reports, final year project reports and logbooks. Peer evaluation
PO9	Ability to practice high ethical values and integrity in scientific and social interactions, think positively and possessing self-esteem	Lectures, tutorials, final year project	Written assignments, essays, final year project reports
PO10	Possess awareness of business opportunity and entrepreneurship	Final year project, industrial training	Written assignments, final year project reports. Industrial training reports.

15. Classification of Subjects				
No.	Classification	Credit Hours	Percentage %	Standard (QA) %
i.	Basic Sciences and Mathematics	13	12.1%	10 - 30%
ii.	Program Core	66	61.7%	60 - 70%
iii.	Program Electives	10	9.3%	5 - 30%
iv.	Compulsory University Subjects	18	16.9 %	5 - 10%
	a. Humanity	8	7.5%	
	b. English Language	6		
	c. Co-curriculum	2		
	d. Entrepreneurship	2		
	Total	107	100.0%	100%





For science program please fill up the following classification.  
(Others please refer to the Statutory Body Guidelines)

A	Physics Subjects		
	(a) Lecture	68	77.6%
	(b) Laboratory/Workshop/Field	4	
	(c) Industrial training	5	
	(d) Final Year Project	6	
	Total Credit Hours for Part A	83	
B	Related Subjects		
	(a) Mathematics	6	22.4%
	(b) Humanities/Ethics	8	
	(c) Co-Curriculum	2	
	(d) English	6	
	(e) Entrepreneurship	2	
	Total Credit Hours for Part B	24	
iii	Total Credit Hours for Parts A and B	107	100%

16. Total credit hours to graduate	107 credit hours
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### 17. Programme structures and features, curriculum and award requirements

The course is offered on full-time mode and is based on a 2-Semester Academic Session with several subjects being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester.

Award requirements:

To graduate, students should:

- Attain a total of **107** credit hours with minimum CPA of 2.0.
- Pass the undergraduate Final Year Project.
- Pass the industrial training programmed.

#### YEAR 1 (Semester 1)

SSP 1103	Physics I	3
SSP 1133	Physics II	3
SSP 1811	Physics Practical I	1
SSH 1013	Intermediate Mathematics	3
SSH 1113	Statistic 1	3
ULT 1022	Islamic and Asian Civilizations	2
Total Credit Hours		15

#### (Semester 2)

SSP 1123	Thermodynamics	3
SSP 1223	Modern Physics	3
SSP 1323	Basic Electronics	3
SSP 1513	Optical Physics	3
SSP 1821	Physics Practical II	1
UHB1412	English for Academic Communications	2
UHS1152	Ethnic Relations	2
Total Credit Hours		17



### YEAR 2 (Semester 3)

SSP 2122	Computational Physics	2
SSP 2213	Nuclear Physics	3
SSP 2323	Advanced Electronics	3
SSP 2412	Material Science	2
SSP 2613	Mathematical Physics	3
SSP 2811	Physics Laboratory III	1
UQ_2_1	Co- curriculum I	1
<b>Electives (Choose 2 credits)</b>		
ULT 2132	Islam and Current Issues	2
ULT 2122	Islamic Institutions	2
Total Credit Hours		17

### (Semester 4)

SSP 2413	Solid State Physics	3
SSP 2423	Spectroscopy Techniques & Material Analysis	3
SSP 2433	Thin Film Technology	3
SSP 2623	Electromagnetism	3
SSP 2831	Material Physics Practical	1
UHB 2422	Advanced English for Academic Communication	2
UHS 2_2	Nationhood elective	2
Total Credit Hours		17

### Short Semester

SSU 2915	Industrial Training	5
Total Credit Hours		5

### YEAR 3 (Semester 5)

SSP 3413	Semiconductor Physics	3
SSP 3423	Amorphous and Ceramic	3
SSP 3613	Materials	3
SSU 3922	Quantum Mechanics	2
UHB 3_2	Undergraduate Project I	2
UQ_3_1	Compulsory English Elective Co-curriculum II	1
<b>Electives (Choose 4 credits)</b>		
SSP 3412	X-ray Crystallography	2
SSP 3422	Magnetism	2
SSP 3432	Science of Material Corrosion	2
SSP 3512	Laser Technology	2
Total Credit Hours		18

### (Semester 6)

SSP 3442	Quality Control	2
SSP 3452	Metallurgy	2
SSP 3462	Polymeric Materials	2
SSU 3924	Undergraduate Project II	4
UHS 3102	Entrepreneurship and Enterprise Development	2
<b>Electives (Choose 6 credits)</b>		
SSP 3472	Superconductivity	2
SSP 3482	Microscopic Techniques	2
SSP 3542	Fibre Optic Technology	2
SSP 3552	Optoelectronics	2
Total Credit Hours		18



### 18. Mapping of Programme Learning Outcome to Subjects

Subjects offered		Learning Outcomes									
		Fundamental Physics knowledge	Application of physics knowledge and skill	Analyzing & experimental skill	Problem Solving	Communicating	Team working	Life long learning	Leadership	Ethics, Integrity and Self esteem	Entrepreneurship awareness
Subjects		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Core Subjects											
SSP 1103	Physics I	a	a	a	1	2	2	2	2	2	
SSP 1133	Physics II	a	a	a	1	2	2	2	1	2	
SSP 1811	Physics Practical I	a	a	a	2	2	1	2	2	2	
SSH 1013	Intermediate Mathematics	a	a	-	-	-	1	-	-	-	
SSH 1113	Statistics 1	a	a	a	1	-	-	-	-	-	
SSP 1123	Thermodynamics	a	a	b	2	1	1	2	2	2	
SSP 1223	Modern Physics	a	a	b	2	2	1	2	2	2	
SSP 1323	Basic Electronics	a	a	b	2	2	1	2	2	2	
SSP 1513	Optical Physics	a	a	b	1	1	2	2	2	2	
SSP 1821	Physics Practical II	a	a	b	2	2	1	2	2	2	
SSP 2122	Computational Physics	a	a	a	2	2	1	2	2	2	
SSP 2213	Nuclear Physics	a	a	b	2	2	1	2	2	2	
SSP 2323	Advanced Electronics	a	a	b	1	2	2	1	2	2	
SSP 2412	Material Science	a	a	b	1	1	2	2	2	2	
SSP 2613	Mathematical Physics	a	a	c	1	2	1	2	2	2	
SSP 2811	Physics Practical III	a	a	a	2	1	1	2	2	2	
SSP 2413	Solid State Physics	a	a	b	1	1	2	2	2	2	
SSP 2423	Spectroscopy Technique & Material Analysis	a	a	b	1	2	2	1	2	2	
SSP 2433	Thin Film Technology	a	a	b	1	1	2	2	2	2	
SSP 2623	Electromagnetism	a	a	b	1	2	2	1	2	2	
SSP 2831	Material Physics Practical	a	a	a	2	1	1	2	2	2	
SSU 2915	Industrial Training	b	a	a	1	1	2	1	2	1	
SSP 3413	Semiconductor Physics	a	a	b	1	2	1	2	2	2	
SSP 3423	Amorphous and Ceramic Materials	a	a	b	1	2	2	1	2	2	
SSP 3613	Quantum Mechanics	a	a	b	2	2	2	1	2	2	
SSU 3922	Undergraduate Final Year Project I	a	a	a	1	1	2	1	2	1	
SSP 3442	Quality Control	a	a	b	1	1	2	2	2	2	
SSP 3452	Metallurgy	a	a	b	1	1	2	2	2	2	



Subjects offered		Fundamental Physics knowledge	Application of physics knowledge and skill	Analyzing & experimental skill	Problem Solving	Communicating	Team working	Life long learning	Leadership	Ethics, Integrity and Self esteem	Entrepreneurship awareness
Subjects		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
<b>Core Subjects</b>											
SSP 3462	Polymeric Materials	a	a	b	1	2	2	1	2	2	
SSU 3924	Undergraduate Final Year Project II	a	a	a	1	1	2	1	2	1	
<b>Elective Subjects</b>											
SSP 3412	X-ray Crystallography	a	a	b	1	2	1	2	2	2	
SSP 3422	Magnetism	a	a	b	1	2	2	2	1	2	
SSP 3432	Science of Material Corrosion	a	a	b	1	1	2	2	2	2	
SSP 3512	Laser Technology	a	a	b	1	2	2	1	2	2	
SSP 3472	Superconductivity	a	a	b	1	2	2	2	1	2	
SSP 3482	Microscopic Techniques	a	a	b	1	2	2	2	1	2	
SSP 3542	Fibre Optic Technology	a	a	b	1	2	2	1	2	2	
SSP 3552	Optoelectronics	a	a	b	1	2	2	1	2	2	
<b>University Subjects</b>											
ULT 1022	Islamic and Asian Civilizations (TITAS)	c			2	2		2	2	2	2
UHB1412	English for Academic Communications	a	a	c	2	1	2	2	1		1
UHS1152	Ethnic Relation	c			2						
UO_ 2xx1	Co-curriculum	c			1	2		1	1	2	1
UHB2422	Advanced English for Academic Communications	a	a	b	2	1	2	2	1		1
UHS 2xx2	Nationhood Electives	c			2				1		1
UHB 3xx2	Compulsory English Elective	a	c		2	1	2	2			1
UO_ 3xx1	Co-curriculum II	c			1	2		1	1	2	2
ULT 2122	Islamic Institutions										
ULT 2132	Islam and Current Issues	c			2	2		2	2	2	1
UHS3102	Entrepreneurship and Enterprise Development	c									

**Key:**

Physics Knowledge and Competencies: **a** = major contribution to outcome; **b** = moderate contribution to outcome; **c** = minor contribution to outcome

Generic Skills: **1** = Substantial (with assessment); **2** = not substantial (introduce)



### 19. Our Uniqueness

- i. Special program that emphasize on the latest material characterization, skills and evaluation techniques.
- ii. The program that is conducted by a diversity of expertise.
- iii. The program that provides with the state of the art laboratories
- iv. The program that utilize the high end equipment facilities

### 20. Career Prospects and Career Path

With a Bachelor of Science in Material Physics, the graduates will be able to work as:

- Device Engineer in electronics industries.
- Optical engineer in glass and crystal based industries.
- Material Control Officer in textile or polymer based industries.
- Clean Room Engineer in semiconductor or wafer production industries.
- Material Purchase Engineer in automotive or construction based industries.
- Quality Assurance Engineer/Officer in electronics and semiconductor industries.
- Research and Development officer in material related industries.

### 21. Cross Campus Programme

Students are given the opportunity to enroll few courses in participating universities and the grades and credits (up to 1/3 of the total credits of the curriculum) are transferable. At the moment, there are four participating universities i.e. Universiti Teknologi Malaysia, Universiti Sains Malaysia, Universiti Malaya and Universiti Malaysia Sarawak.

### 22. UTM Degree ++ Programme

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### 23. Facilities available

List of laboratories

1. Modern Physics Laboratory
2. Wave & Optics Laboratory
3. Basic & Advanced Electronic Laboratories
4. Optoelectronics Devices Laboratory
5. Nuclear Physics Laboratory
6. Radiation Dosimetry Laboratory
7. Laser Technology & Research Laboratories
8. Fiber Optics Technology Laboratory
9. Thin Film & Low Temperature Laboratory
10. Vacuum Laboratory
11. Material Science & Material Analysis Laboratories
12. Computer & Microcomputer Laboratory
13. Photonics Training & Research Laboratories
14. Advanced Optical Crystal Research Laboratory
15. Electronic & Mechanical Workshops

List of Capital Instruments

1. X-ray diffractometer (XRD)
2. Automated Control Crystal growth CZ machine.
3. Infrared Spectrophotometer
4. UV-VIS Spectrometer
5. CNC Machine Equipment
6. Photoluminescence Spectrophotometer
7. High Precision Grinding and Polishing Machine
8. Ellipsometer
9. High Temperature Furnaces
10. Differential Thermal Analyser (DTA)
11. Vickers Hardness Equipment
12. General Mechanical Testing Machine
13. Hyperpure Germanium Detector

List of Workshop

1. Mechanical Workshop
2. Computer Workshop
3. Electronic Workshop





#### 24. Support for Students and their learning

- a) Two weeks induction program for orientation and introductory study skills
- b) Student Handbook and Module Guides
- c) Staff-student ratio for teaching of 1:12
- d) Extensive library and other learning resources and facilities.
- e) All students are allocated academic advisor whose role is to assist them with personal problems and advise on program of study.

#### 25. Methods for Evaluating and Improving the Quality and standards of teaching and learning Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards

1. Students performance in terms of:
  - KS/KB
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  - Completion rate
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  - Exit survey
  - Alumni survey
  - Market survey
3. Lecturer's performance
  - Teaching evaluation by students (OMR)
  - Competency check-list for staff (CV)
  - Annual staff appraisal (SKT)
4. Curriculum review
  - Faculty academic committee
  - Industrial training survey
  - PSM survey
  - External examiner reports
  - CO achievement survey by students
  - Students e-Portfolio
  - Generic skills evaluation (Performance Criteria Report)
5. Delivery system
  - Academic Quality Assurance Committee
  - CSI
  - SSI
  - AKNC audit report
  - MQA standard





## 26. Regulation of Assessment

### a) Summary of marks, grades and their evaluation points

Marks	Grade	Evaluation Point
90-100	A+	4.00
80-89	A	4.00
75-79	A-	3.67
70-74	B+	3.33
65-69	B	3.00
60-64	B-	2.67
55-59	C+	2.33
50-54	C	2.00
45-49	C-	1.67
40-44	D+	1.33
35-39	D	1.00
30-34	D-	0.67
00-29	E	0.00

### b) Role of External Examiners (Visiting Examiners)

Visiting Examiners are appointed by the Faculty Academic Committee to

- review and evaluate programme curriculum,
- review and evaluate assessment procedure and methods,
- make necessary recommendations to the Academic Committee.

## 27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by	
	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10			
e- Portfolio	x	x	x	x	x	x	x	x	x	x	x	Continuous	Student
Course outcome survey	x	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Course outcome report	x	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Final Year Project survey	x	x	x	x	x		x		x			End of sem	Faculty
PO survey by final year students	x	x	x	x	x	x	x	x	x	x	x	End of sem	Faculty
Industrial training survey			x	x	x	x	x	x	x			End of session	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept
Employer Survey	x	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept



# SPESIFIKASI PROGRAM SSH PROGRAMME SPECIFICATIONS SSH



UNIVERSITI TEKNOLOGI MALAYSIA

Buku Panduan Akademik Fakulti Sains **09/10**

Academic Guide Book Faculty Of Science **09/10**





1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Program Name	Bachelor of Science in Health Physics			
4. Final Award	Bachelor of Science (Health Physics)			
5. Program Code	TS29 (SSH)			
6. Professional or Statutory Body of Accreditation	Kementerian Pendidikan Tinggi			
7. Language(s) of Instruction	Bahasa Melayu and English			
8. Mode of Study (Conventional, distance learning, etc)	Conventional			
9. Mode of operation (Franchise, self-govern, etc)	Self-governing			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Minimum: 3 yrs Maximum: 5 yrs			
Type of Semester	No. of Semesters		No. of weeks per semester	
	Full Time	Part Time	Full Time	Part Time
Normal	6		17	
Short	1		10	
12. Entry Requirement	Fulfill the university requirement and the following program requirement: 1. Matriculation with minimum B- in Physics and minimum of C in Mathematics and Chemistry or 2. STPM with minimum of B- in Physics, and minimum of C in Mathematics and Chemistry or 3. Diploma in Science or Engineering with minimum CPA of 2.70 from recognized institutions			

### 13. Programme Objectives

- (i) Graduates that are able to apply their knowledge and skills in planning, analysis, design and supervision of work related to Health Physics discipline.
- (ii) Graduates that are able to acquire knowledge and skills in Health Physics to support industry, research and development.
- (iii) Graduates that are scientifically competent in solving problems logically, analytically and creatively.
- (iv) Graduates that possess leadership that are able to contribute towards development of the nation.
- (v) Graduates that are able to work in society with diverse background to achieve common goals.
- (vi) Graduates that are able to communicate effectively and work in a team to achieve excellence.
- (vii) Graduates that possess entrepreneurship skills and are able to venture towards job-creation for the nation.



#### 14. Programme Learning Outcomes

##### (a) Technical Knowledge and Competencies

PO1	Well versed in science and health physics knowledge	Lectures, tutorials, seminars, laboratory work, directed reading, active learning	Examinations, laboratory reports, presentations, assignments, problem-based exercises
PO2	Ability to apply knowledge in the techniques, skills and scientific tools related to Health Physics discipline	Lectures, tutorials, computer hands-on sessions, laboratory work, and industrial training	Examinations, laboratory reports, presentations, assignments, problem-based exercises, simulation exercises, industrial training reports
PO3	Ability to analyze, interpret, develop and conduct experiments and to design projects, taking into consideration the potential future applications and thus towards enhancing skills related to entrepreneurship and use of information technology.	Supervised projects, lectures, tutorials, laboratory works, directed reading, simulation exercises, computer-based exercises, problem-based learning	Final Year Project reports, examinations, laboratory reports, presentations, written assignments

##### (b) Generic Skills

PO4	Ability to identify, formulate and solve Health Physics related problems including their economic impacts and thus towards enhancing skills related to problem solving and decision making.	Supervised projects, lectures, tutorials, laboratory works	Final Year Project reports, examinations, laboratory reports, presentations, written assignments
PO5	Ability to communicate effectively and with confidence	Final year projects, tutorials, group assignments, laboratory work, seminars	Oral presentations, reports



PO6	Ability to function effectively as an individual in a team to achieve common goals and ability to respond and adapt to changing situations and priorities	Industrial training, final year project, laboratory work, group assignment	Industrial training report and logbook, laboratory report, final year project report and logbook. Peer evaluation
PO7	Ability to perpetually seek and acquire contemporary knowledge	Final year projects, individual assignments, tutorials	Final year project reports, written assignments
PO8	Ability to lead in a team to achieve common goals	Industrial training, final year project, laboratory work, group assignment	Industrial training report and logbook, laboratory report, final year project report and logbook. Peer evaluation
PO9	Ability to apply high ethical standards in scientific practice and social interactions for sustainable development	Final year projects, Laboratory works, Industrial training	Written assignments, laboratory reports, essays, Final year project reports, Industrial training report
PO10	Awareness of business and entrepreneurship opportunities	Lectures, tutorials, industrial training, final year project	Written assignments, essays, final year project reports, Industrial training reports

#### 15. Classification of Subjects

No.	Classification	Credit Hours	Percentage %	Standard (QA) %
i.	Basic Sciences and Mathematics	13	12.9%	10 - 30%
ii.	Program Core	70	65.4%	60 - 70%
iii.	Program Electives	6	5.6%	5 - 30%
iv.	Compulsory University Subjects	18		
	a. Humanity	8	16.8 %	
	b. English Language	6	7.5%	5 - 10%
	c. Co-curriculum	2		
	d. Entrepreneurship	2		
	Total	107	100.0%	100%





For science program please fill up the following classification.  
(Others please refer to the Statutory Body Guidelines)

A	Physics Subjects		
	(a) Lecture	68	77.6%
	(b) Laboratory/Workshop/Field	4	
	(c) Industrial training	5	
	(d) Final Year Project	6	
	Total Credit Hours for Part A	83	
B	Related Subjects		
	(a) Mathematics	6	22.4%
	(b) Humanities/Ethics	8	
	(c) Co-Curriculum	2	
	(d) English	6	
	(e) Entrepreneurship	2	
	Total Credit Hours for Part B	24	
iii	Total Credit Hours for Parts A and B	<b>107</b>	100%

<b>16. Total credit hours to graduate</b>	<b>107 credit hours</b>
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**17. Programme structures and features, curriculum and award requirements**

The course is offered on full-time mode and is based on a 2-Semester Academic Session with several subjects being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester.

Award requirements:

To graduate, students should:

- Attain a total of no less than 107 credit hours with minimum CPA of 2.0.
- Pass Industrial Training (equivalent to 5 credit hours).
- Pass the undergraduate Final Year Project.

**YEAR 1 (Semester 1)**

SSP 1103	Physics I	3
SSP 1133	Physics II	3
SSP 1811	Physics Practical I	1
SSH 1013	Intermediate Mathematics	3
SSH 1113	Statistic 1	3
ULT 1022	Islamic and Asian Civilizations	2
<b>Total Credit Hours</b>		<b>15</b>

**(Semester 2)**

SSP 1123	Thermodynamics	3
SSP 1223	Modern Physics	3
SSP 1323	Basic Electronics	3
SSP 1513	Optical Physics	3
SSP 1821	Physics Practical II	1
UHS1152	Ethnic Relations English for Academic	2
UHB 1412	Communication	2
<b>Total Credit Hours</b>		<b>17</b>



### YEAR 2 (Semester 3)

SSP2122	Computational Physics	2
SSP2213	Nuclear Physics	3
SSP2323	Advanced Electronics	3
SSP2613	Mathematical Physics	2
SSP2811	Physics Practical III	3
SSG2903	Physiology and Human	1
UQ_2__1	Anatomy Co-curriculum I	1
<b>Electives (2 credits)</b>		
ULT 2132	Islam and Current Issues	2
ULT 2122	Islamic Institutions	2
Total Credit Hours		17

### (Semester 4)

SSP2223	Radiation Protection	3
SSP2233	Radiobiology	3
SSP2243	Radiation Physics	3
SSP2623	Electromagnetism	3
SSP2841	Health Physics Practical	1
UHB2422	Advanced English for Academic Communication	2
UHS2__2	Electives on Nationhood subjects	2
Total Credit Hours		17

### Short Semester

SSU 2915	Industrial Training	5
Total Credit Hours		5

### YEAR 3 (Semester 5)

SSP 3213	Radiation Detection and	3
SSP 3223	Dosimetry	3
SSP 3312	Radiological Protection	2
SSP 3613	Computer Interfacing	3
SSU 3922	Quantum Mechanics	2
UHB 3__2	Undergraduate Project I Compulsory English Elective	2
UQ_3__1	Co-curriculum II	1
<b>Electives (Choose 2 credits)</b>		
SSP 3232	Biophysics	2
SSP 3242	Medical Imaging	2
SSP 3332	Signal Processing	2
SSP 3342	Non-Destructive Testing I	2
Total Credit Hours		18

### (Semester 6)

SSP 2343	Instrumentation and Measurement	3
SSP 3252	Occupational Health	2
SSP 3262	Neutron and Reactor Physics	2
SSP 3924	Undergraduate Project II	4
UHS 3102	Entrepreneurship and Enterprise Development	2
<b>Electives (Choose 4 credits)</b>		
SSP 3212	Nuclear Techniques	2
SSP 3222	Laser in Medicine	2
SSP 3272	Radiotherapy	2
SSP 3282	Nuclear Medicine	2
SSP 3372	Electronics Testing and Maintenance	2
Total Credit Hours		17



### 18. Mapping of Programme Learning Outcome to Subjects

		Learning Outcomes									
Subjects offered		Fundamental Physics	Application of physics	Ability to analyze & perform	Ability to formulate & solve related	Communicating effectively	Team working and Adaptability	Lifelong learning	Leadership	Ethics, Integrity and self-esteem	Entrepreneurship
Subjects		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Core Subjects											
SSP 1103	Physics I	a	a	a	1	2	2	2	2	2	
SSP 1133	Physics II	a	a	a	1	2	2	2	1	2	
SSP 1811	Physics Practical I	a	a	a	2	2	1	2	2	2	
SSH 1013	Intermediate Mathematics	a	a	-	-	-	1	-	-	-	
SSH 1113	Statistics 1	a	a	a	1	-	-	-	-	-	
SSP 1123	Thermodynamics	a	a	b	2	1	1	2	2	2	
SSP 1223	Modern Physics	a	a	b	2	2	1	2	2	2	
SSP 1323	Basic Electronics	a	a	b	2	2	1	2	2	2	
SSP 1513	Optical Physics	a	a	b	1	1	2	2	2	2	
SSP 1821	Physics Practical II	a	a	a	2	2	1	2	2	2	
SSP 2122	Computational Physics	a	a	b	2	2	1	2	2	2	
SSP 2213	Nuclear Physics	a	a	b	2	2	1	2	2	2	
SSP 2323	Advanced Electronics	a	a	b	1	2	2	1	2	2	
SSP 2613	Mathematical Physics	a	a	c	1	2	1	2	2	2	
SSP 2811	Physics Practical III	a	a	a	2	1	1	2	2	2	
SSG2903	Physiology and Human Anatomy	a	a	b	1	2	2	-	-	-	
SSP2223	Radiation Protection	a	a	b	-	1	-	1	-	-	
SSP2233	Radiobiology	a	a	b	2	-	-	1	-	-	
SSP2243	Radiation Physics	a	a	b	1	-	-	1	-	-	
SSP2623	Electromagnetism	a	a	b	2	2	2	1	2	2	
SSP2821	Health Physics Practical	a	a	a	1	1	1	1	2	1	
SSP 3213	Radiation Detection and Dosimetry	a	a	a	1	-	1	-	-	2	
SSP3223	Radiological Protection	a	a	b	-	1	-	-	-	-	
SSP 3312	Computer Interfacing	a	a	b	1	2	1	2	2	2	
SSP 3613	Quantum Mechanics	a	a	b	2	2	2	1	2	2	
SSU 3922	Undergraduate Project I	a	a	a	1	1	2	1	2	1	
SSP 2343	Instrumentation and Measurement	a	a	b	2	2	2	1	2	2	
SSP 3242	Occupational Health	a	a	b	-	2	-	-	1	1	



Subjects offered		Fundamental Physics	Application of physics	Ability to analyze & perform	Ability to formulate & solve related	Communicating effectively	Team working and Adaptability	Lifelong learning	Leadership	Ethics, Integrity and selfesteem	Entrepreneurship
Subjects		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
<b>Core Subjects</b>											
SSP 3262	Neutron and Reactor Physics	a	a	b	1	-	1	2	-	-	
SSU 3924	Undergraduate Project II	a	a	a	1	1	2	1	2	1	
SSU 2915	Industrial Training	b	a	a	1	1	2	1	2	1	
<b>Elective Subjects</b>											
SSP 3232	Biophysics	a	a	b	1	1	-	-	-	-	
SSP 3252	Medical Imaging	a	a	b	1	=	1	2	-	-	
SSP 3332	Signal Processing	a	a	b	2	2	1	2	2	2	
SSP 3342	Non Destructive Testing Method I	a	a	b	1	2	2	1	2	2	2
SSP 3212	Nuclear Techniques	a	a	b	2	1	1	2	-	-	
SSP 3222	Laser in Medicine	a	a	b	2	1	2	1	2	2	
SSP 3272	Radiotherapy	a	a	b	-	1	-	1	-	-	
SSP 3282	Nuclear Medicine	a	a	b	-	1	-	1	-	-	
SSP 3372	Electronic Testing and Maintenance	a	a	b	1	2	1	2	2	2	2
<b>University Subjects</b>											
ULT 1022	Islamic and Asian Civilizations (TITAS)	c			2	2		2	2	2	2
UHB1412	English for Academic Communications	a	a	c	2	1	2	2	1		1
UHS1152	Ethnic Relation	c			2						
UQ_ 2xx1	Co-curriculum	c			1	2		1	1	2	1
UHB2422	Advanced English for Academic Communications	a	a	b	2	1	2	2	1		1
UHS 2xx2	Nationhood Electives	c			2						
UHB 3xx2	Compulsory English Elective	a	c		2	1	2	2	1		1
UQ_ 3xx1	Co-curriculum II	c			1	2		1	1	2	1
ULT 2122	Islamic Institutions										
ULT 2132	Islam and Current Issues	c			2	2		2	2	2	2
UHS3102	Entrepreneurship and Enterprise Development	c									1

**Key:**

Physics Knowledge and Competencies: **a** = major contribution to outcome; **b** = moderate contribution to outcome; **c** = minor contribution to outcome

Generic Skills: **1** = Substantial (with assessment); **2** = not substantial (introduce)



### 19. Our Uniqueness

1. Health Physics program online with the need in medical application.
2. Concern the health for public.

### 20. Career Prospects and Career Path

Graduates of the program can work as

- Health Physics/Medical Physics Officers in hospitals, health services, and industries related to medical services and manufacture of medical products and instruments
- Radiation Protection Officer/Personnel in institutions using radioactive materials and irradiation apparatus
- Researchers in scientific and medical establishments

### 21. Cross Campus Programme

Students are given the opportunity to enroll few courses in participating universities and the grades and credits (up to 1/3 of the total credits of the curriculum) are transferable. At the moment, there are four participating universities i.e. Universiti Teknologi Malaysia, Universiti Sains Malaysia, Universiti Malaya and Universiti Malaysia Sarawak.

### 22. UTM Degree ++ Programme

Students are given a chance to enroll in certificate program offered by Centers of Excellence in the university during their semester breaks. For example, Certificate of Attendance in Communicate with Confidence, Good Resume Writing, Personal Grooming etc

### 23. Facilities available

List of laboratories:

1. Modern Physics Laboratory
2. Wave & Optics Laboratory
3. Basic & Advanced Electronic Laboratories
4. Optoelectronics Devices Laboratory
5. Nuclear Physics Laboratory
6. Radiation Dosimetry Laboratory
7. Laser Technology & Research Laboratories
8. Fiber Optics Technology Laboratory
9. Thin Film & Low Temperature Laboratory
10. Vacuum Laboratory
11. Material Science & Material Analysis Laboratories
12. Computer & Microcomputer Laboratory
13. Photonics Training & Research Laboratories
14. Advanced Optical Crystal Research Laboratory
15. Electronic & Mechanical Workshops

List of capital instrument:

1. High Power Solid State Laser System
2. HPGe detector
3. Crystal Growth Equipment
4. CNC Machine
5. High Precision Polishing Machine
6. Ellipsometer/ Photoluminescence





#### 24. Support for Students and their learning

- a) Two weeks induction program for orientation and introductory study skills
- b) Student Handbook and Module Guides
- c) Staff-student ratio for teaching of 1:12
- d) Extensive library and other learning resources and facilities.
- e) All students are allocated academic advisor whose role is to assist them with personal problems and advise on program of study.

#### 25. Methods for Evaluating and Improving the Quality and standards of teaching and learning Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards

1. Students performance in terms of:
  - KS/KB
  - CPA
  - Graduating students performance
  - GOT
  - Completion rate
  - Analysis of course performance
2. Employability
  - Exit survey
  - Alumni survey
  - Market survey
3. Lecturer's performance
  - Teaching evaluation by students (OMR)
  - Competency check-list for staff (CV)
  - Annual staff appraisal (SKT)
4. Curriculum review
  - Faculty academic committee
  - Industrial training survey
  - PSM survey
  - External examiner reports
  - CO achievement survey by students
  - Students e-Portfolio
  - Generic skills evaluation (Performance Criteria Report)
5. Delivery system
  - Academic Quality Assurance Committee
  - CSI
  - SSI
  - AKNC audit report
  - MQA standard





## 26. Regulation of Assessment

### a) Summary of marks, grades and their evaluation points

Marks	Grade	Evaluation Point
90-100	A+	4.00
80-89	A	4.00
75-79	A-	3.67
70-74	B+	3.33
65-69	B	3.00
60-64	B-	2.67
55-59	C+	2.33
50-54	C	2.00
45-49	C-	1.67
40-44	D+	1.33
35-39	D	1.00
30-34	D-	0.67
00-29	E	0.00

### b) Role of External Examiners (Visiting Examiners)

Visiting Examiners are appointed by the Faculty Academic Committee to

- review and evaluate programme curriculum
- review and evaluate assessment procedure and methods
- make necessary recommendations to the Academic Committee

## 27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by	
	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10			
e- Portfolio	x	x	x	x	x	x	x	x	x	x	x	Continuous	Student
Course outcome survey	x	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Course outcome report	x	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Final Year Project survey	x	x	x	x	x		x		x			End of sem	Faculty
PO survey by final year students	x	x	x	x	x	x	x	x	x	x	x	End of sem	Faculty
Industrial training survey			x	x	x	x	x	x	x			End of session	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept
Employer Survey	x	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept



# SPEKIFIKASI PROGRAM SSA PROGRAMME SPECIFICATIONS SSA



UNIVERSITI TEKNOLOGI MALAYSIA

Buku Panduan Akademik Fakulti Sains **09/10**

Academic Guide Book Faculty Of Science **09/10**





1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Program Name	Bachelor of Science in Chemistry			
4. Final Award	Bachelor of Science (Chemistry)			
5. Program Code	TS16 (SSA)			
6. Professional or Statutory Body of Accreditation	Kementerian Pengajian Tinggi			
7. Language(s) of Instruction	Bahasa Malaysia and English			
8. Mode of Study (Conventional, distance learning, etc)	Conventional			
9. Mode of operation (Franchise, self-govern, etc)	Self-govern			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Minimum : 3 yrs Maximum : 5 yrs			
Type of Semester	No. of Semesters		No. of weeks per semester	
	Full Time	Part Time	Full Time	Part Time
Normal	6		17	
Short	1		10	
12. Entry Requirement	Fulfill the university requirement and the following program requirement: • Matriculation Certificate with minimum B in Chemistry AND a minimum of C in any two from Mathematics, Physics and Biology. Or • STPM with minimum B in Chemistry and a minimum of C in any two from Mathematics, Physics and Biology. Or • Diploma in Science or Engineering with minimum CPA of 2.50 from recognized institutions.			

### 13. Programme Objectives

- (i) To produce graduates who have a rigorous education in the fundamental areas of chemistry: organic, physical, inorganic, and analytical.
- (ii) To produce graduates who are able to perform and understand chemical research.
- (iii) To produce graduates who are responsive and adaptive to changing situation and with high desire to continuously acquire new knowledge and skills.
- (iv) To produce graduates who are professional, with high intellectual skills and competence in solving problems related to chemistry or an allied field in which sound knowledge of chemistry is important.



#### 14. Programme Learning Outcomes

##### (a) Technical Knowledge and Competencies

Program Learning Outcomes	Intended Learning Outcomes	Teaching and Learning Methods	Assessment
(PO) PO1	Ability to acquire and apply knowledge and understanding of the chemical principles, terminology, nomenclatures, conventions and units, and basic mathematics	Lectures, tutorials, laboratory works, directed reading, group discussion and problem solving assignments	Examinations, tests, quizzes, assignments, and laboratory reports.
PO2	Ability to demonstrate thorough knowledge, understanding and skills in application of scientific methodology to undertake and report on experimental investigation.	Lectures, laboratory practical, assigned reading, group discussion and problem solving assignments  Hands-on instrumentations, chemistry software skills and research project	Examinations, tests, quizzes, assignments, and laboratory reports,  Oral presentations, group projects, and computer simulation.
PO3	Possess high awareness of major issues and development of chemical research and competent in initiating, developing, and pursuing a scientific research.	Lectures, laboratory practical, assigned reading, group discussion and problem solving assignments  Hands-on instrumentations, chemistry software skills and research project  Research proposal, experimental works, project presentation and report.	Examinations, tests, quizzes, assignments, and laboratory reports,  Oral presentations, group projects, computer simulation.  Proposal, presentation and project report
<b>(b) Generic Skills</b>			
PO4	Ability to learn independently and demonstrate knowledge and understanding of chemical principles, theories and evaluate current research.	Independent research projects, group research projects	Independent research project report.



PO5	Ability to present technical, scientific and chemical information and arguments clearly and correctly, in writing and orally to a range of audiences	Group projects, independent research, individual assignments, tutorials	Oral presentations, written assignments, laboratory reports, research project report.
PO6	Ability to portray good interpersonal skills with high ability to work collaboratively as part of a team undertaking a range of different team roles	Tutorials, laboratory works, group assignments	Laboratory reports and group presentation
PO7	Ability to seek new knowledge, skills and manage relevant information from various sources	Tutorials, research projects, laboratory works	Laboratory reports, research project report
PO8	Ability to demonstrate leadership, to take action and to get others involved	Group assignments and presentations	Group assignment reports and presentations
PO9	Ability to act with integrity and good ethics in their profession and their obligation to society	Examination, individual assignment and individual research projects	Reports and seminar presentation
PO10	Ability to demonstrate knowledge and skills in analyzing and identifying business opportunities.	Final year projects, laboratory works, industrial training.	Written assignments, laboratory reports, essays, final year project reports.

#### 15. Classification of Subjects

No.	Classification	Credit Hours	Percentage %	Standard (QA) %
i.	Basic Sciences and Mathematics	14	14.3 %	10 - 30%
ii.	Program Core	59	60.2 %	60 - 70%
iii.	Program Electives	9	9.2 %	5 - 30%
iv.	Compulsory University Subjects	18		
	a. Humanity	8	8.2 %	
	b. English Language	6		5 - 10%
	c. Co-curriculum	2		
	d. Entrepreneurship	2		
	Total	98	100 %	100%





For science program please fill up the following classification. (Others please refer to the Statutory Body Guidelines)			
A	Chemistry subjects	Credit Hours	Percentage %
	- Lecture	64	75.5%
	- Laboratory/Workshop/Field	4	
	- Final Year Project	6	
	Total credit hours for Part A	74	
B	Related Subjects		
	a. Mathematics	6	24.5%
	b. Humanities/Ethics	8	
	c. Co-Curriculum	2	
	d. English	6	
	e. Entrepreneurship	2	
	Total credit hours for Part B	24	
	<b>Total</b>	<b>98</b>	<b>100%</b>

<b>16. Total credit hours to graduate</b>	<b>98 credit hours</b>
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**17. Programme structures and features, curriculum and award requirements**

This program is offered on full-time mode and is based on a 2-Semester Academic Session with several subjects being delivered and assessed in each semester. Assessment is based on final examination and coursework conducted throughout the semester.

Award requirements:

To graduate, students should:

- Attain a total of 98 credit hours with minimum CPA of 2.00.
- Pass the undergraduate Final Year Project.

**YEAR 1 (Semester 1)**

SSC 1703	Inorganic Chemistry	3
SSC 1851	Practical Inorganic Chemistry I	1
SSC 1603	Organic Chemistry – Functional Groups	3
SSC 1831	Practical Organic Chemistry I	1
SSH 1013	Intermediate Mathematics	3
SSH 1113	Statistics I	3
ULT 1022	Islamic and Asian Civilization	1
<b>Total</b>		<b>15</b>

**(Semester 2)**

SSC 1312	Laboratory Management and Safety	2
SSC 1613	Organic Chemistry - Biomolecule	3
SSC 1861	Practical Organic Chemistry II	1
SSC 1403	Physical Chemistry	3
SSC 1841	Practical Physical Chemistry I	1
UHB1412	English for Academic Communications	2
UHS1152	Ethnic Relations	2
<b>Total</b>		<b>14</b>



### YEAR 2 (Semester 3)

SSC 2203	Fundamental Analytical Chemistry	3
SSC 2831	Practical Analytical Chemistry I	1
SSC 2413	Physical Chemistry II	3
SSC 2463	Quantum Chemistry and Spectroscopy	3
SSU 2612	History of Noble Prize Winners	2
UQ_ 2xx1	Co-curriculum I	1
<b>ULT Electives (2 credits)</b>		<b>2</b>
ULT 2122	Islamic Institutions	
ULT 2132	Islam and Current Issues	
<b>Total</b>		<b>15</b>

### (Semester 4)

SSC 2213	Instrumentation in Analytical Chemistry	3
SSC 2871	Practical Analytical Chemistry II	1
SSC 2443	Chemical Reaction Processes	3
SSC 2713	Coordination Chemistry	3
SSC 2851	Practical Inorganic Chemistry II	1
SSU2623	Research Methodology and Information Retrieval	3
UHB2422	Advanced English for Academic Communications	2
UHS2122	Critical and Creative Thinking	2
<b>Total</b>		<b>18</b>

### YEAR 3 (Semester 5)

SSC 3533	Application of Computer in Chemistry	3
SSC 3653	Organic Synthesis	3
SSU 3922	Undergraduate Project I	3
UHB 3xx2	English for Technical Writing	2
UQ_ 3xx1	Co-curriculum II	1
<b>Electives (6 credits)</b>		<b>6</b>
SSC 3243	Separation Methods	
SSC 3643	Application of Spectroscopy	
SSC 3493	Surface and Colloid Chemistry	
SSC 3723	Organometallic Chemistry	
SSP 3613	Quantum Mechanics	
<b>Total</b>		<b>18</b>

### (Semester 6)

SSC 3333	Chemistry of Macromolecules	3
SSC 3473	Solid State Chemistry	3
SSC 3683	Biotechnology	3
SSU 3924	Undergraduate Project II	4
UHS 3102	Entrepreneurship and Enterprise Development	2
<b>Electives (3 credits)</b>		<b>3</b>
SSC 3263	Thermal Analysis	
SSC 3543	Computer Modelling and Simulation in Chemistry	
SSC 3663	Natural Product Chemistry	
SSH 1523	Linear Algebra	
SSH 1743	Differential Equation	
<b>Total</b>		<b>18</b>

Total Credit = 98

Counted Credit = 98



### 18. Mapping of Programme Learning Outcome to Subjects

		Learning Outcomes									
Subjects offered		Fundamental Knowledge	Chemical techniques	Application	Critical Thinking	Communicating Skills	Teamworking	Lifelong Learning	Leadership	Ethics & Integrity	Entrepreneurship
Subjects		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Core Subjects											
SSC1703	Inorganic Chemistry	a	b	c	1	1					
SSC1851	Practical Inorganic Chemistry I	c	b	a	1	1					
SSC1603	Organic Chemistry – Functional Groups	a	b	c	1		1				
SSC1831	Practical Organic Chemistry I	c	b	a	1		1				
SSH1013	Intermediate Mathematics	a	a			1					
SSH1113	Statistics I	a	a	a	1						
SSC1312	Laboratory Management and Safety	a	b		1	1	2				
SSC1613	Organic Chemistry - Biomolecule	a	b	c	1	1					
SSC1861	Practical Organic Chemistry II	c	b	a	1	1					
SSC1403	Physical Chemistry	a	b	c	1	1					
SSC1841	Practical Physical Chemistry I	c	b	a	1	1					
SSC2203	Fundamental Analytical Chemistry	a	b	c	1	1					
SSC2831	Practical Analytical Chemistry I	c	b	a	1	1	1				
SSC2413	Physical Chemistry II	a	b	c	1		1				
SSC2463	Quantum Chemistry and Spectroscopy	a	b	c	1	1					
SSU2612	History of Noble Prize Winners	a				1	1			1	
SSC2213	Instrumentation in Analytical Chemistry	a	b	c	1			1			
SSC2871	Practical Analytical Chemistry II	c	b	a	1	1	1				
SSC2443	Chemical Reaction Processes	a	b	c	1		1				
SSC 2713	Coordination Chemistry	a	b	c	1	1	1				
SSC 2851	Practical Inorganic Chemistry II	c	b	a	1	1	1				
SSU 2623	Research Methodology and Information Retrieval	a			1	1	1				



Subjects offered		Fundamental Knowledge	Chemical techniques	Application	Critical Thinking	Communicating Skills	Teamworking	Lifelong Learning	Leadership	Ethics & Integrity	Entrepreneurship
Subjects		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
<b>Core Subjects</b>											
SSC 3533	Application of Computer in Chemistry	a	b	c	1						
SSC 3653	Organic Synthesis	a	b	c	1						
SSU 3922	Undergraduate Project I	a	a	a	1				1	1	
SSC 3333	Chemistry of Macromolecules	a	b	a	1	1	1				
SSC 3473	Solid State Chemistry	a	b	c	1				1		
SSC 3683	Biotechnology	a	b	c	1			1			
SSU 3924	Undergraduate Project II	a	a	a	1	1		1		1	
<b>Elective Subjects</b>											
SSC 3243	Separation Methods	a	b	c	1			1			
SSC 3643	Application of Spectroscopy	a	b	c	1		1				
SSC 3493	Surface and Colloid Chemistry	a	b	c	1		1				
SSC 3723	Organometallic Chemistry	a	b	c	1		1				
SSP 3613	Quantum Mechanics	a	b	c	1		1				
SSC 3263	Thermal Analysis	a	c	a	1	1	1				
SSC 3543	Computer Modelling and Simulation in Chemistry	a	b	c	1			1			
SSC 3663	Natural Product Chemistry	a	b	c	1			1			
SSH 1523	Linear Algebra	a	b	b	1		1				
SSH 1743	Differential Equation	a	b	b							
<b>University Subjects</b>											
ULT 1022	Islamic and Asian Civilization	c			2	2		2	2	2	2
UHB1412	English for Academic Communications	a	a	c	2	1	2	2	1		1
UHS1152	Ethnic Relations	c			2						
UQ_2xx1	Co-curriculum I	c			1	2		1	1	2	1
UHB2422	Advanced English for Academic Communications	a	a	b	2	1	2	2	1		1
UHS2122	Critical and Creative Thinking										
UHB 3xx2	English for Technical Writing										
UQ_3xx1	Co-curriculum II	c			1	2		1	1	2	1
UHS3102	Entrepreneurship and Enterprise Development	c									1



**Key:**

- Technical Skills : a = major contribution to outcome (Final Exam/Test/Quiz)  
b = moderate contribution to outcome (Assignment only)  
c = minor contribution to outcome
- Generic Skills : 1 = Substantial (with assessment)  
2 = not substantial (introduce)

**19. Our Uniqueness**

- Special program designed to produce excellent young and talented scientists.
- Diverse and experienced lecturers.
- State of the arts facilities and teaching laboratories.

**20. Career Prospects and Career Path**

Graduates of the program can work as

- Chemists or scientists in private and government research institutions such as MARDI, PORIM, RRI, PRSS, AMREC, SIRIM and MINT
- Lecturers or researchers in higher learning institutions, following further their degree qualifications at Masters of PhD levels;
- Officers in agencies or industries in which sound knowledge of chemistry and high levels of generic skills are required.

**21. Cross Campus Programme**

Students are given opportunity to enroll few courses in participating universities and the grades and credits (up to 1/3 of the total credits of the curriculum) are transferable. At the moment, there are four participating universities i.e. Universiti Teknologi Malaysia, Universiti Sains Malaysia, Universiti Malaya, and Universiti Malaysia Sarawak.

**22. UTM Degree ++ Programme**

Students are given a chance to enroll in certificate programs offered by Centres of Excellence in the university during their semester breaks. For example, Certificate of Attendance in Communicate with Confidence, Good Resume Writing, Personal Grooming etc.

**23. Facilities available**

List of laboratories:

- |   |  |
|---|--|
| i. Inorganic Chemistry Laboratory 1 & 2 | 9. High Performance Liquid Chromatograph |
| ii. Physical Chemistry Laboratory 1 & 2 | 10. Gas Chromatograph                    |
| iii. Organic Chemistry Laboratory 1 & 2 | 11. Liquid Chromatograph                 |
| iv. Analytical Laboratory 1, 2, & 3     | 12. Atomic Absorption Spectrometer       |
| v. Project Laboratories                 | 13. Ion Chromatograph                    |
| vi. Macromolecule Laboratory            | 14. Capillary Electrophoresis Unit       |
| vii. Biotechnology Laboratory           | 15. BET Surface Analyser                 |
| viii. Students Computer Room            | 16. Differential Scanning Calorimeter    |
| ix. Resource Centre                     | 17. Voltammetric Systems                 |

List of Capital Instruments

- |  |  |
|--|--|
| 4. Nuclear Magnetic Resonance Spectrometer     | 18. Fluorescence Spectrometer            |
| 5. Gas Chromatography-Mass Spectrometer System | 19. Surface Adsorption/Desorption System |
| 6. Fourier Transform Infrared Spectrometers    | 20. Total Organic Carbon Analyser        |
| 7. Gel Permeation Chromatograph                | 21. Flame Photometer                     |
| 8. UV-Visible Spectrometers                    | 22. Electron Spin Resonance Spectrometer |
|  | 23. X-Ray Diffraction Spectrometer       |
|  | 24. Inductively Coupled Plasma           |





#### 24. Support for Students and Their Learning

##### Personal support

- Academic Advisor
- Counseling

##### Infrastructure support

- Internet access
- e-learning
- Digital library
- Health care and Recreational

##### Financial support

- Some financial support via Research Grants
- Perbadanan Tabung Pendidikan Tinggi Negara (PTPTN)
- MARA

#### 25. Methods for Evaluating and Improving the Quality and Standards of Teaching and Learning Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards

##### 1. Students performance in terms of:

- KS/KB
- CPA
- Graduating students performance
- GOT
- Completion rate
- Analysis of course performance

##### 2. Employability

- Exit survey
- Alumni survey
- Market survey

##### 3. Lecturer's performance

- Teaching evaluation by students (OMR)
- Competency check-list for staff (CV)
- Annual staff appraisal (SKT)

##### 4. Curriculum review

- Faculty academic committee
- Industrial training survey
- PSM survey
- External examiner reports
- CO achievement survey by students
- Students e-Portfolio
- Generic skills evaluation (Performance Criteria Report)

##### 5. Delivery system

- Academic Quality Assurance Committee
- CSI
- SSI
- AKNC audit report
- MQA standard





## 26. Regulation of Assessment

### a. Summary of grades, marks and their interpretation

Marks	Grade	Evaluation Point
90-100	A+	4.00
80-89	A	4.00
75-79	A-	3.67
70-74	B+	3.33
65-69	B	3.00
60-64	B-	2.67
55-59	C+	2.33
50-54	C	2.00
45-49	C-	1.67
40-44	D+	1.33
35-39	D	1.00
30-34	D-	0.67
00-29	E	0.00

### b) Role of External Examiners (Visiting Examiners)

Visiting Examiners are appointed by the Faculty Academic Committee to

- review and evaluate programme curriculum
- review and evaluate assessment procedure and methods
- make necessary recommendations to the Academic Committee

## 27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by
	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10		
e- Portfolio	x	x	x	x	x	x	x	x	x	x	Continuous	Student
Course outcome survey	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Course outcome report	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Final Year Project survey	x	x	x	x	x		x		x		End of sem	Faculty
PO survey by final year students	x	x	x	x	x	x	x	x	x	x	End of sem	Faculty
Industrial training survey			x	x	x	x	x	x	x		End of session	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept
Employer Survey	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept



# SPEKIFIKASI PROGRAM SSC PROGRAMME SPECIFICATIONS SSC



UNIVERSITI TEKNOLOGI MALAYSIA

Buku Panduan Akademik Fakulti Sains **09/10**  
Academic Guide Book Faculty Of Science **09/10**





1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Program Name	Bachelor of Science in Industrial Chemistry			
4. Final Award	Bachelor of Science (Industrial Chemistry)			
5. Program Code	TS07 (SSC)			
6. Professional or Statutory Body of Accreditation	Kementerian Pengajian Tinggi			
7. Language(s) of Instruction	Bahasa Melayu and English			
8. Mode of Study (Conventional, distance learning, etc)	Conventional			
9. Mode of operation (Franchise, self-govern, etc)	Self-govern			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Minimum : 3 yrs Maximum : 5 yrs			
Type of Semester	No. of Semesters		No. of weeks per semester	
	Full Time	Part Time	Full Time	Part Time
Normal	6		17	
Short (Industrial Training)	1		10	
12. Entry Requirement	Fulfill University requirements and the following program requirements i) Matriculation Certificate with minimum of B- in Chemistry and a minimum of C in any two from Mathematics, Physics and Biology. or ii) STPM with minimum of B- in Chemistry and a minimum of C in any two from Mathematics, Physics and Biology. or iii) Diploma in Science or Engineering with minimum CGPA 2.50 from recognized institution			

### 13. Programme Objectives

- (i) To produce graduates who have an extensive understanding in various fields of chemistry and applications in various sectors.
- (ii) To produce graduates who are able to apply their knowledge and skills safely and accurately in the planning, analysis, and supervision of tasks related to various private and public industrial sectors.
- (iii) To develop responsive and adaptive chemistry graduates to changing situations with high technical competency in solving chemistry problems critically, logically, creatively and analytically based on facts and ideas.
- (iv) To produce chemistry graduates who are professionally able to work effectively as part of a team or group in a chemical analysis project.



14. Programme Learning Outcomes			
(a) Technical Knowledge and Competencies			
Code	Intended Learning Outcomes	Teaching and Learning Methods	Assessment
PO1	Ability to acquire and apply knowledge and understanding of the chemical principles, terminology, nomenclatures, conventions and units, and basic mathematics	Lectures, tutorials, laboratory works, directed reading, group discussion and problem solving assignments	Examinations, tests, quizzes, assignments, and laboratory reports
PO2	Ability to demonstrate skills in the application of chemical principles, procedures, latest techniques and equipments in chemical analysis	Lectures, laboratory practical, assigned reading, group discussion and problem solving assignments, hands-on instrumentations, chemistry software skills, research project and industrial training	Examinations, tests, quizzes, assignments, and laboratory reports, oral presentations, group projects, computer simulation and industrial training reports
PO3	Possess high competency in the planning, design and execution of chemical investigation to solve problems faced by industry and society	Lectures, laboratory practical, assigned reading, group discussion and problem solving assignments  hands-on instrumentations, chemistry software skills and research project  Research proposal, experimental works, project presentation and report.	Examinations, tests, quizzes, assignments, and laboratory reports,  oral presentations, group projects, computer simulation.  Proposal, presentation and project report
(b) Generic Skills			
PO4	Ability to learn independently and understand new concept and procedures in chemical analysis	Independent research projects, group research projects, industrial training	Industrial training report, independent project report



PO5	Ability to present technical, scientific and chemical information and arguments clearly and correctly, in writing and orally to a range of audiences	Group projects, independent research, individual assignments, tutorials, industrial training.	Oral presentations, written assignments, laboratory reports, research project report
PO6	Ability to portray good interpersonal skills with high ability to work collaboratively as part of a team undertaking a range of different team roles	Tutorials, laboratory works, group assignments	Laboratory reports and group presentation
PO7	Ability to seek new knowledge, skills and manage relevant information from various sources	Tutorials, research projects, laboratory works	Laboratory reports, research project report.
PO8	Ability to demonstrate leadership, to take action and to get others involved.	Group assignment and presentation	Group assignment report and presentation
PO9	Ability to act with integrity and good ethics in their profession and their obligation to society	Examination, individual assignment, individual research projects and industrial training	Reports and seminar presentation
PO10	Ability to demonstrate knowledge and skill in analyzing and identifying business opportunities.	Final year project, Laboratory works, Industrial training and case studies	Written assignments, Laboratory reports, essays, Final year reports

#### 15. Classification of Subjects

No.	Classification	Credit Hours	Percentage %	Standard (QA) %
i.	Basic Sciences and Mathematics	12	11.5	10 - 30%
ii.	Program Core	65	62.5	60 - 70%
iii.	Program Electives	9	8.7	5 - 30%
iv.	Compulsory University Subjects	18	17.3	5 - 10%
	a. Humanity	8	7.7	
	b. English Language	6		
	c. Co-curriculum	2		
	d. Entrepreneurship	2		
	<b>Total</b>	<b>104</b>	<b>100 %</b>	<b>100%</b>





For science program please fill up the following classification.  
(Others please refer to the Statutory Body Guidelines)

A	Chemistry subjects	Credit Hours	Percentage %
	- Lecture	68	82.7%
	- Laboratory/Workshop/Field	7	
	- Industrial Training	5	
	- Final Year Project	6	
	<b>Total credit hours for Part A</b>	<b>86</b>	
B	Related Subjects		
	a. Mathematics	6	17.3%
	b. Humanities/Ethics	8	
	c. Co-Curriculum	2	
	d. English	6	
	e. Entrepreneurship	2	
	<b>Total credit hours for Part B</b>	<b>18</b>	
	<b>Total credit hours for Parts A and B</b>	<b>104</b>	<b>100%</b>

<b>16. Total credit hours to graduate</b>	<b>104 credit hours</b>
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**YEAR 1 (Semester 1)**

SSC 1703	Inorganic Chemistry I	3
SSC 1851	Practical Inorganic Chemistry I	1
SSC 1603	Organic Chemistry – Functional Groups	3
SSC 1831	Practical Organic Chemistry I	1
SSH 1013	Intermediate Mathematics	3
SSH 1113	Statistics I	3
ULT 1112	Islamic and Asian Civilizations (TITAS)	2
<b>Total Credit Hours</b>		<b>16</b>

**(Semester 2)**

SSC 1312	Laboratory Management and Safety	2
SSC 1613	Organic Chemistry - Biomolecule	3
SSC 1861	Practical Organic Chemistry II	1
SSC 1403	Physical Chemistry	3
SSC 1841	Practical Physical Chemistry I	1
UHB 1412	English for Academic Communications	2
UHS 1152	Ethnic Relation	2
<b>Total Credit Hours</b>		<b>14</b>



### YEAR 2 (Semester 3)

SSC 2203	Fundamental Analytical Chemistry	3
SSC 2831	Practical Analytical Chemistry I	1
SSC 2413	Physical Chemistry II	3
SSC 2433	Molecular Symmetry and Spectroscopy	3
SHD 1513	Principles of Management	3
UQ_ 2xx1	Co-curriculum	1
<b>Electives (2 credits)</b>		
ULT 2122	Islamic Institutions	2
ULT 2132	Islam and Current Issues	
<b>Total Credit Hours</b>		<b>16</b>

### (Semester 4)

SSC 2213	Instrumentation in Analytical Chemistry	3
SSC 2871	Practical Analytical Chemistry II	1
SSC 2713	Coordination Chemistry	3
SSC 2851	Practical Inorganic Chemistry II	1
SSC 2423	Industrial Chemical Processes	3
SHF 1113	Marketing Principles	3
UHB2422	Advanced English for Academic Communications	2
UHS 2xx2	Nationhood Electives	2
<b>Total Credit Hours</b>		<b>18</b>

### Short Semester

SSU 2915	Industrial Training	5
<b>Total Credit Hours</b>		<b>5</b>

### YEAR 3 (Semester 5)

SSC 3223	Environmental Chemistry	3
SSC 3533	Application of Computer in Chemistry	3
SSU 3922	Undergraduate Project I	2
UHB 3xx2	Compulsory English Elective	1
UQ_ 3xx1	Co-curriculum II	
<b>Electives (6 credits)</b>		<b>6</b>
SSC 3243	Separation Methods	
SSC 3273	Forensic Science	
SSC 3493	Surface and Colloid Chemistry	
SSC 3743	Materials Chemistry	
SSC 3623	Polymer Chemistry	
SSC 3643	Application of Spectroscopy	
<b>Total Credit Hours</b>		<b>17</b>

### (Semester 6)

SSC 3353	Consumer Chemistry	3
SSU 3924	Undergraduate Project II	4
SHD 1523	Organizational Behaviour	3
UHS 3102	Entrepreneurship and Enterprise Development	2
<b>Electives (6 credits)</b>		<b>6</b>
SSC 3253	Food Analysis	
SSC 3263	Thermal Analysis	
SSC 3293	Analytical Radiochemistry	
SSC 3483	Corrosion Chemistry	
SSC 3663	Natural Product Chemistry	
SSC 3673	Industrial Organic Chemical	
SSC 3683	Biotechnology	
SSC 3753	Catalytic Chemistry	
<b>Total Credit Hours</b>		<b>18</b>



18. Mapping of Programme Learning Outcome to Subjects										
Subjects offered	Learning Outcomes									
	Fundamental Knowledge	Chemical techniques	Application	Critical Thinking	Communication Skills	Teamworking	Lifelong Learning	Leadership	Ethics & Integrity	Entrepreneurship
Subjects	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Core Subjects										
SSC 1703 Inorganic Chemistry I	a	b	c	1	1					
SSC 1851 Practical Inorganic Chemistry I	c	b	a	1	1				1	
SSC 1603 Organic Chemistry – Functional Groups	a	b	c	1		1				
SSC 1831 Practical Organic Chemistry I	c	b	a	1		1			1	
SSH 1013 Intermediate Mathematics	a	a			1					
SSH 1113 Statistics I	a	a	a	1						
SSC 1312 Laboratory Management and Safety	a	b		1	1	2				
SSC 1613 Organic Chemistry - Biomolecule	a	b	c	1	1					
SSC 1861 Practical Organic Chemistry II	c	b	a	1	1				1	
SSC 1403 Physical Chemistry	a	b	c	1	1					
SSC 1841 Practical Physical Chemistry I	c	b	a	1	1				1	
SSC 2203 Fundamental Analytical Chemistry	a	b	c	1	1					
SSC 2831 Practical Analytical Chemistry I	c	b	a	1	1				1	
SSC 2413 Physical Chemistry II	a	b	c	1		1				
SSC 2433 Molecular Symmetry and Spectroscopy	a	b	c	1		1				
SSC 2213 Instrumentation in Analytical Chemistry	a	b	c	1			1			
SSC 2871 Practical Analytical Chemistry II	c	b	a	1	1	1			1	
SSC 2713 Coordination Chemistry	a	b	c	1	1	1				
SSC 2851 Practical Inorganic Chemistry II	c	b	a	1	1	1			1	
SSC 2423 Industrial Chemical Processes	a	b	c	1		1				
SSU 2915 Industrial Training	a	a	a	1	1	1		1	1	1



Subjects offered		Fundamental Knowledge	Chemical techniques	Application	Critical Thinking	Communication Skills	Teamworking	Lifelong Learning	Leadership	Ethics & Integrity	Entrepreneurship
Subjects		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
<b>Core Subjects</b>											
SSC 3223	Environmental Chemistry	a	b	c	1		1		1		
SSC 3533	Application of Computer in Chemistry	a	b	c	1			1			
SSU 3922	Undergraduate Project I	a	a	a	1				1		
SSU 3924	Undergraduate Project II	a	a	a	1	1		1		1	
SSC3353	Consumer Chemistry	a	b	c	1	1		1		1	
SHF 1113	Marketing Principles										
SHD1513	Principles of Management										
SHD1523	Organizational Behaviour										
<b>Elective Subjects</b>											
SSC 3243	Separation Methods	a	b	c	1			1			
SSC 3623	Polymer Chemistry	a	b	c	1	1	1				
SSC 3643	Application of Spectroscopy	a	b	c	1		1				
SSC 3273	Forensic Science	a	b	c	1		1				
SSC 3493	Surface and Colloid Chemistry	a	b	c	1		1				
SSC 3743	Materials Chemistry	a	b	c	1	1					
SSC 3253	Food Analysis	a	b	c	1	1		1			
SSC 3263	Thermal Analysis	a	b	c	1	1	1				
SSC 3293	Analytical Radiochemistry	a	b	c	1	1					
SSC 3483	Corrosion Chemistry	a	b	c	1	1	1				
SSC 3663	Natural Product Chemistry	a	b	c	1			1			
SSC 3673	Industrial Organic Chemical	a	b	c	1	1		1			
SSC 3683	Biotechnology	a	b	c	1			1			
SSC 3753	Catalytic Chemistry	a	b	c	1	1					
<b>University Subjects</b>											
ULT 1022	Islamic and Asian Civilizations (TITAS)	c			2	2		2	2	2	2
UHB1412	English for Academic Communications	a	a	c	2	1	2	2	1		1
UHS1152	Ethnic Relation	c			2						
UQ_2xx1	Co-curriculum	c			1	2		1	1	2	1
UHB2422	Advanced English for Academic Communications	a	a	b	2	1	2	2	1		1
UHS 2xx2	Nationhood Electives	c			2						
UHB 3xx2	Compulsory English Elective	a	c		2	1	2	2	1		1
UQ_3xx1	Co-curriculum II	c			1	2		1	1	2	
ULT 2122	Islamic Institutions										
ULT 2132	Islam and Current Issues	c			2	2		2	2	2	2
UHS3102	Entrepreneurship and Enterprise Development	c									1



**Key:**

- Technical Skills : a = major contribution to outcome (Final/Test/Quiz)  
b = moderate contribution to outcome (Assignment)  
c = minor contribution to outcome
- Generic Skills: 1 = Substantial (with assessment)  
2 = not substantial (introduce)

**19. Our Uniqueness**

- i. The program was specially tailored to suit with the current industrial needs
- ii. It is diversify program with experienced lecturers
- iii. State of the art facilities and instrumentations

**20. Career Prospects and Career Path**

- iv. Graduates of the program can work as
- v. chemists or scientists in government research institutions such as MARDI, Malaysia Palm Oil Board (MPOB), RRI, PRSS, AMREC, SIRIM and Malaysia Nuclear Agency (MNA)
- vi. chemists or process engineers in private sectors such as in petrochemicals, rubber, palm oil, pharmaceuticals, textiles and dyes, cosmeceuticals, electronics, water treatment and food processing companies.
- vii. lecturers or researchers in higher learning institutions, following further their degree qualifications at Masters of PhD levels.
- viii. quality control or assurance and marketing officers in agencies or industries in which sound knowledge of chemistry and high levels of generic skills are required.

**21. Cross Campus Programme**

Students are given the opportunity to enroll few courses in participating universities and the grades and credits (up to 1/3 of the total credits of the curriculum) are transferable. At the moment, there are four participating universities i.e. Universiti Teknologi Malaysia, Universiti Sains Malaysia, Universiti Malaya and Universiti Malaysia Sarawak.

**22. UTM Degree ++ Programme**

Students are given a chance to enroll in certificate programs offered by Centers of Excellence in the university during their semester breaks. For example, Certificate of Attendance in *Basic Electronics, Communicate with Confidence, Good Resume Writing, Personal Grooming* etc

**23. Facilities available**

List of laboratories:

- |  |  |
|--|--|
| i. Inorganic Chemistry Laboratory 1 & 2        | 9. High Performance Liquid Chromatograph |
| ii. Physical Chemistry Laboratory 1 & 2        | 10. Gas Chromatograph                    |
| iii. Organic Chemistry Laboratory 1 & 2        | 11. Liquid Chromatograph                 |
| iv. Analytical Laboratory 1, 2, & 3            | 12. Atomic Absorption Spectrometer       |
| v. Project Laboratories                        | 13. Ion Chromatograph                    |
| vi. Biotechnology Laboratory                   | 14. Capillary Electrophoresis Unit       |
| vii. Macromolecule Laboratory                  | 15. BET Surface Analyzer                 |
| viii. Resource Centre                          | 16. Differential Scanning Calorimeter    |
| ix. Students Computer Room                     | 17. Voltammetric System                  |
|  | 18. Fluorescence Spectrometer            |
| List of Capital Instruments                    | 19. Surface Adsorption/Desorption System |
| 4. Nuclear Magnetic Resonance Spectrometer     | 20. Total Organic Carbon Analyzer        |
| 5. Gas Chromatography-Mass Spectrometer System | 21. Flame Photometer                     |
| 6. Fourier Transform Infrared Spectrometers    | 22. Electron Spin Resonance Spectrometer |
| 7. Gel Permeation Chromatograph                | 23. X-Ray Diffraction Spectrometer       |
| 8. UV-Visible Spectrometers                    | 24. Inductively Coupled Plasma (ICP)     |





#### 24. Support for Students and Their Learning

##### Personal support

- Academic Advisor
- Counseling

##### Infrastructure support

- Internet access
- e-learning
- Digital library
- Health care and Recreational
- Conducive area of study
- Smart classroom

##### Financial support

- Perbadanan Tabung Pendidikan Tinggi Negara (PTPTN)
- MARA
- JPA

#### 25. Methods for Evaluating and Improving the Quality and Standards of Teaching and Learning Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards

1. Students performance in terms of:
  - KS/KB
  - CPA
  - Graduating students performance
  - GOT
  - Completion rate
  - Analysis of course performance
2. Employability
  - Exit survey
  - Alumni survey
  - Market survey
3. Lecturer's performance
  - Teaching evaluation by students (OMR)
  - Competency check-list for staff (CV)
  - Annual staff appraisal (SKT)
4. Curriculum review
  - Faculty academic committee
  - Industrial training survey
  - PSM survey
  - External examiner reports
  - CO achievement survey by students
  - Students e-Portfolio
  - Generic skills evaluation (Performance Criteria Report)
5. Delivery system
  - Academic Quality Assurance Committee
  - CSI
  - SSI
  - AKNC audit report
  - MQA standard





## 26. Regulation of Assessment

### a. Summary of grades and marks

Marks	Grade	Evaluation Point
90-100	A+	4.00
80-89	A	4.00
75-79	A-	3.67
70-74	B+	3.33
65-69	B	3.00
60-64	B-	2.67
55-59	C+	2.33
50-54	C	2.00
45-49	C-	1.67
40-44	D+	1.33
35-39	D	1.00
30-34	D-	0.67
00-29	E	0.00

### b) Role of External Examiners (Visiting Examiners)

Visiting Examiners are appointed by the Faculty Academic Committee to

- review and evaluate programme curriculum
- review and evaluate assessment procedure and methods
- make necessary recommendations to the Academic Committee

## 27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by	
	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10			
e- Portfolio	x	x	x	x	x	x	x	x	x	x	x	Continuous	Student
Course outcome survey	x	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Course outcome report	x	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Final Year Project survey	x	x	x	x	x		x		x			End of sem	Faculty
PO survey by final year students	x	x	x	x	x	x	x	x	x	x	x	End of sem	Faculty
Industrial training survey			x	x	x	x	x	x	x			End of session	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept
Employer Survey	x	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept



# SPEKIFIKASI PROGRAM SSE *PROGRAMME SPECIFICATIONS* SSE



UNIVERSITI TEKNOLOGI MALAYSIA

Buku Panduan Akademik Fakulti Sains **09/10**  
Academic Guide Book Faculty Of Science **09/10**





1. Awarding Institution	UTM			
2. Teaching Institution	UTM			
3. Programme Name	Bachelor of Science in Mathematics			
4. Final Award	Bachelor of Science(Mathematics)			
5. Programme Code	TS08 (SSE)			
6. Professional or Statutory Body of Accreditation	Kementerian Pengajian Tinggi			
7. Language(s) of Instruction	Bahasa Melayu and English			
8. Mode of Study (Conventional, distance learning, etc)	Conventional			
9. Mode of operation (Franchise, self-govern, etc)	Self-govern			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Minimum : 3 yrs Maximum : 5 yrs			
Type of Semester	No. of Semesters		No. of weeks per semester	
	Full Time	Part Time	Full Time	Part Time
Normal	6		17	
12. Entry Requirement	Fulfil all university requirements and the following programme requirements: 1. Matriculation with minimum B in Mathematics and a minimum of C in Chemistry and Physics or Biology or 2. SPM with a minimum of B- in Mathematics and a minimum of C in Chemistry and Physics or Biology or 3. Diploma in Science or Engineering with a minimum CPA of 2.70 from recognized institutions			

### 13. Programme Objectives

To produce graduates who are:

- (i) Able to apply their mathematical knowledge and skills ethically in teaching, research and development of new knowledge.
- (ii) Technically competent in solving theoretical and applied problems.
- (iii) Able to disseminate mathematical knowledge effectively.
- (iv) Able to respond and adapt readily to changing working situations and identify business opportunities.
- (v) Able to continue learning in the acquisition of new knowledge and skills in depth.



#### 14. Programme Learning Outcomes

##### (a) Technical Knowledge and Competencies

Code	Intended Learning Outcomes	Teaching and Learning Methods	Assessment
PO1	Ability to demonstrate knowledge and understanding of the fundamental concepts, theories and results of mathematics	Lectures, tutorials, projects (PSM, Group/individual), directed reading, computer-based exercises, simulation exercises, problem-based learning, cooperative learning, active learning	Examinations, computing output, computer laboratory reports, presentations, project reports, tutorial exercises.
PO2	Ability to demonstrate skills in mathematical reasoning, construct mathematical proofs and display proficiency in a variety of mathematical methods to solve problems of mathematics.	Lectures, tutorials, projects (PSM, Group/individual), directed reading, computer-based exercises, simulation exercises, problem-based learning, cooperative learning, active learning	Examinations, computing output, computer laboratory reports, presentations, project reports, tutorial exercises.
PO3	Ability to identify, formulate, analyze and solve theoretical and applied problems through the integration between fundamental concepts of mathematics and their applications in other areas of mathematics or other disciplines.	Lectures, tutorials, projects (PSM, Group/individual), directed reading, computer-based exercises, simulation exercises, problem-based learning, cooperative learning, active learning	Examinations, computing output, computer laboratory reports, presentations, project reports.

##### (b) Generic Skills

PO4	Demonstrate the ability to understand, extract, analyse and identify problems from a variety of sources and apply the mathematical knowledge to solve problems	Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual)	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio.
PO5	Ability to convey ideas and mathematical knowledge clearly and effectively in both written and oral forms	Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual)	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio.



PO6	Ability to work collaboratively as part of a team	Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual)	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio.
PO7	Ability to pursue independent study and demonstrate the awareness for continuous personal and professional development.	Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual), professional development courses	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio.
PO8	Demonstrate the basic knowledge of leadership and the ability to lead	Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual), seminars, workshops, community service, co-curricular activities, group work.	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio.
PO9	Demonstrate an awareness of responsible and ethical conduct as well as integrity in the context of their profession and obligations to society	Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual), seminar, workshop, community service, co-curricular activities, group work.	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio.
PO10	Acquire awareness of business and entrepreneurship opportunities	Lectures, assignments, case studies, Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual), seminar, workshop, community service, co-curricular activities, group work.	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio, examination.

#### 15. Classification of Subjects

No.	Classification	Credit Hours	Percentage %	Standard (QA) %
i.	Basic Sciences and Mathematics	6	6.1%	10 - 30%
ii.	Program Core	62	63.3%	60 - 70%
iii.	Program Electives	12	12.2%	5 - 30%
iv.	Compulsory University Subjects	18	18.4%	5 - 10%
	a. Humanity	8	8.2%	
	b. English Language	6		
	c. Co-curriculum	2		
	d. Entrepreneurship	2		
	<b>Total</b>	<b>98</b>	<b>100 %</b>	<b>100%</b>





For science program please fill up the following classification. (Others please refer to the Statutory Body Guidelines)			
A	Mathematics Subjects	Credit Hours	Percentage %
	- Lecture	74	81.6%
	- Final Year Project	6	
	<b>Total credit hours for Part A</b>	80	
B	Related Subjects		18.4%
	(a) Humanities/Ethics	8	
	(b) Co-curriculum	2	
	(c) English	6	
	(d) Entrepreneurship	2	
	<b>Total credit hours for Part B</b>	18	
C	<b>Total credit hours for Parts A and B</b>	98	<b>100%</b>

<b>16. Total credit hours to graduate</b>	<b>98 credit hours</b>
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**17. Programme structures and features, curriculum and award requirements**

The course is offered on full-time mode and is based on a 2-Semester Academic Session with several subjects being delivered and assessed in each Semester. Assessment is based on final Examination and coursework conducted throughout the semester.

Award requirements:

To graduate, students should:

- Attain a total of 98 credit hours with minimum CPA of 2.0.
- Pass the undergraduate Final Year Project.

**YEAR 1 (Semester 1)**

SSH1013	Intermediate Mathematics	3
SSH1113	Statistics 1	3
SSH1313	Computer Programming	3
SSH1713	Calculus 1	3
ULT1022	Islamic and Asian Civilizations	2
<b>Total Credit Hours</b>		<b>14</b>

**(Semester 2)**

SSH1123	Statistics II	3
SSH1523	Linear Algebra	3
SSH1783	Calculus II	3
SSH1743	Differential Equation	3
UHB1412	English for Academic Comm.	2
UHS1152	Ethnic Relations	2
<b>Total Credit Hours</b>		<b>16</b>



### YEAR 2 (Semester 3)

SSH2433	Numerical Analysis I	3
SSH2553	Set Theory and Logic	3
SSH2733	Vector Analysis	3
SSH2753	Complex Variables	3
SSU2612	History of Nobel Laureate	2
UQ-2---1	Co-curriculum I	1
<b>Optional (2 credits)</b>		
ULT 2122	Islamic Institutions	2
ULT 2132	Islam and Current Issues	2
<b>Total Credit Hours</b>		<b>17</b>

### (Semester 4)

SSH2523	Modern Algebra	3
SSH2623	Real Analysis	3
SSH2743	Partial Differential Equations	3
SSU2623	Research Methodology and Information Retrieval	3
UHB2422	Advanced English for Academic Comm	2
UHS2122	Creative and Critical Thinking	2
<b>Total Credit Hours</b>		<b>16</b>

### YEAR 3 (Semester 5)

SSH 3673	Functional Analysis	3
SSH 3713	Mathematical Modelling	3
SSU 3922	Undergraduate Project I	2
UHB 3---2	English for Technical Writing	2
UHB 3---2	Co-curriculum II	1
<b>Optional (6 credits)</b>		
SSH 2123	Design of Experiments Inferential Statistics	3
SSH 2143	Statistical Quality Control	3
SSH 2113	Generalized Linear	3
SSH 2663	Model Number Theory	3
SSH 2663	Fields and Rings Theory	3
SSH 3513	Differential Geometry Discrete	3
SSH 3613	Mathematics Advanced	3
SSH 2763	Differential Equation	3
SSH 3453	Applied Numerical Methods	3
SSH 3733	Dynamical System	3
SSH 3753	Fluid Mechanics	3
SSH 3813	Optimal Control	3
<b>Total Credit Hours</b>		<b>17</b>

### (Semester 6)

SSH 3683	Topology	3
SSH 3793	Calculus of Variation	3
SSU 3924	Undergraduate Project II	4
UHS 3102	Entrepreneurship and Enterprise Development	2
<b>Optional (6 credits)</b>		
SSH 3123	Multivariate Analysis	3
SSH 3143	Decision Theory	3
SSH 3163	Stochastic Process	3
SSH 3243	Sampling Techniques	3
SSH 3633	Applied Abstract Algebra	3
SSH 3653	Non-Euclidean Geometry	3
SSH 3623	Numerical Analysis II	3
SSH 3463	Computational Fluid	3
SSH 3763	Mechanics	3
SSH 3783	Quantum Mechanics	3
SSH 3843	Optimization Method	3
<b>Total Credit Hours</b>		<b>18</b>



18. Mapping of Programme Learning Outcome to Subjects											
Learning Outcomes											
Courses Offered		Fundamental Knowledge	Mathematical Techniques	Application	Critical Thinking and Problem Solving	Communication	Team Working	Lifelong Learning	Leadership Skills	Ethics and Integrity	Entrepreneurship
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Code	Course Name	Core Subjects									
SSH 1013	Intermediate Mathematics	a	a	-	-	1	-	-	-	-	-
SSH 1113	Statistics I	a	a	a	1	-	-	-	-	-	-
SSH 1313	Computer Programming	a	b	b	-	-	1	-	-	-	-
SSH 1713	Calculus I	a	a	b	1	1	-	-	-	-	-
SSH 1123	Statistics II	a	b	b	1	-	1	-	-	-	-
SSH 1523	Linear Algebra	a	b	b	=	-	1	-	-	-	-
SSH 1783	Calculus II	a	a	a	1	1	-	-	-	-	-
SSH 1743	Differential Equation	a	b	b	-	-	-	-	-	-	-
SSH 2433	Numerical Analysis I	a	a	b	1	-	-	-	-	-	-
SSH 2553	Set Theory and Logic	a	a	b	1	1	-	-	-	-	-
SSH 2773	Vector Analysis	a	a	b	-	-	-	-	-	-	-
SSH 2753	Complex Variables	a	a	b	-	1	1	-	-	-	-
SSH 2523	Modern Algebra	a	a	a	-	1	1	-	-	1	-
SSH 2623	Real Analysis	a	a	a	1	1	1	-	-	-	-
SSH 2743	Partial Differential Equation	a	a	a	1	-	-	-	-	-	-
SSH 3673	Functional Analysis	a	a	b	-	-	-	-	-	-	-
SSH 3713	Mathematical Modelling	a	a	a	1	1	1	-	1	-	-
SSH 3683	Topology	a	a	-	1	1	1	-	-	-	-
SSH 3793	Calculus of Variations	a	a	a	-	-	-	-	-	-	-
SSU 2612	History of Nobel Laureate										
SSU 2623	Research Methodology an Information Retrieval										
SSU 3922	Undergraduate Project I										
SSU 3924	Undergraduate Project II										
Elective Subjects											
SSH 2123	Design of Experiments	a	a	a	-	1	1	1	-	-	-
SSH 2143	Inferential Statistics	a	b	b	-	1	-	-	-	-	-
SSH 2113	Statistical Quality Control	a	a	b	1	1	1	-	-	-	-
SSH 3213	Generalized Linear Model	a	b	b	-	1	1	-	-	-	-
SSH 2663	Number Theory	a	a	b	1	-	-	-	-	-	-
SSH 3513	Fields and Rings Theory	a	a	b	-	-	-	-	-	-	-
SSH 3613	Differential Geometry	a	a	b	-	-	-	-	-	-	-
SSH 2673	Discrete Mathematics	a	a	b	-	1	1	-	-	-	-
SSH 2763	Advanced Differential Equation	a	a	b	-	-	-	-	-	-	-
SSH 3453	Applied Numerical Methods	a	a	a	-	-	-	-	-	-	-



Subjects offered		Fundamental Knowledge	Mathematical Techniques	Application	Critical Thinking and Problem Solving	Communication	Team Working	Lifelong Learning	Leadership Skills	Ethics and Integrity	Entrepreneurship
Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
<b>Core Subjects</b>											
SSH3733	Dynamical Systems	a	a	a	-	1	1	-	-	-	-
SSH3753	Fluid Mechanics	a	a	a	-	1	1	-	-	-	-
SSH3813	Optimal Control	a	a	b	-	1	1	-	-	-	-
SSH3123	Multivariate Analysis	a	a	a	-	1	1	-	-	-	-
SSH3143	Decision Theory	a	a	b	-	1	1	-	-	-	-
SSH3163	Stochastic Process	a	a	b	1	1	1	-	-	-	-
SSH3243	Sampling Techniques	a	a	b	-	1	1	-	-	-	-
SSH3633	Fuzzy Set Theory	a	a	a	-	-	-	-	-	-	-
SSH3653	Applied Abstract Algebra	a	a	b	-	-	-	-	-	-	-
SSH3623	Non-Euclidean Geometry	a	a	b	1	1	1	-	-	-	-
SSH3463	Numerical Analysis II	a	a	b	1	-	-	-	-	-	-
SSH3763	Computational Fluid Dynamics	a	a	a	-	-	-	-	-	-	-
SSH3843	Optimization Methods	a	a	b	-	1	1	-	-	-	-
<b>University Subjects</b>											
ULT1022	Islamic and Asian Civilizations (TITAS)	c			2	2		2	2	2	2
UHB1412	English for Academic Communications	a	a	c	2	1	2	2	1		1
UHS1152	Ethnic Relation	c			2						
UQ_2xx1	Co-curriculum	c			1	2		1	1	2	1
UHB2422	Advanced English for Academic Communications	a	a	b	2	1	2	2	1		1
UHS2122	Creative and Critical Thinking	c			2						
UHB 3xx2	Compulsory English Elective	a	c		2	1	2	2	1		1
UQ_3xx1	Co-curriculum II	c			1	2		1	1	2	1
ULT 2122	Islamic Institutions										
ULT 2132	Islam and Current Issues	c			2	2		2	2	2	2
UHS3102	Entrepreneurship and Enterprise Development	c									1



**Key:**

Technical Skills: **a** = major contribution to outcome; **b** = moderate contribution to outcome; **c** = minor contribution to outcome

Generic Skills: **1** = Substantial (with assessment); **2** = not substantial (introduce)

**19. Programme Uniqueness**

1. The only B.Sc in Mathematics programme offered in the country leading to Nobel Laureate Programme.
2. Prepares students to be able to develop and apply their mathematical knowledge and skills ethically in other areas of mathematics or other disciplines.

**20. Career Prospects and Career Path**

Graduates of this programme can work as

- Civil servants in government departments.
- Academicians in academic institutions.
- Researchers in research institutions and industries.

**21. Cross Campus Programme**

Students are given the opportunity to enroll few courses in participating universities and the grades and credits (up to 1/3 of the total credits of the curriculum) are transferable. At the moment, there are four participating universities i.e. Universiti Teknologi Malaysia, Universiti Sains Malaysia, Universiti Malaya and Universiti Malaysia Sarawak.

**22. UTM Degree ++ Programme**

Students are given a chance to enrol in certificate programmes offered by Centres of Excellence in the university during their semester breaks. For example, *Certificate in Total Quality Management*.

**23. Facilities Available**

List of computer laboratories and rooms with IT facilities

1. Computer Lab 1
2. Computer Lab 2
3. Computer Lab 3
4. Computer Lab 4
5. Smart Classroom
6. Resource Centre

**24. Support for Students and their learning**

- Two weeks induction programme for orientation and introductory study skills
- Student Handbook and Module Guides
- Staff student ratios for teaching of 1:15
- Extensive library and other learning resources and facilities.
- All students are allocated with personal advisors whose role is to assist them in education planning and personal problems



**25. Methods for Evaluating and Improving the Quality and Standards of Teaching and Learning Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards**

1. Students performance in terms of:
  - KS/KB
  - CPA
  - Graduating students performance
  - Graduate on time, GOT
  - Completion rate
  - Analysis of course performance
2. Employability
  - Exit survey
  - Alumni survey
  - Market survey
3. Lecturer's performance
  - Teaching evaluation by students (OMR)
  - Competency check-list for staff (CV)
  - Annual staff appraisal (SKT)
4. Curriculum review
  - Faculty academic committee
  - PSM survey
  - External examiner reports
  - CO achievement survey by students
  - Students e-Portfolio
  - Generic skills evaluation (Performance Criteria Report)
5. Delivery system
  - Academic Quality Assurance Committee
  - CSI
  - SSI
  - AKNC audit report
  - MQA standard





## 26. Regulation of Assessment

### a) Summary of grades, marks and their evaluation points

Marks	Grade	Evaluation Point
90-100	A+	4.00
80-89	A	4.00
75-79	A-	3.67
70-74	B+	3.33
65-69	B	3.00
60-64	B-	2.67
55-59	C+	2.33
50-54	C	2.00
45-49	C-	1.67
44-40	D+	1.33
35-39	D	1.00
30-34	D-	0.67
00-29	E	0.00

- b) Role of External Examiners (Visiting Examiners)  
Visiting Examiners are appointed by Academic Board.  
The role of visiting examiners are to:
- review and evaluate programme curriculum
  - review the assessment methods
  - make a necessary recommendation to the faculty's academic committee

## 27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by	
	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10			
e- Portfolio	x	x	x	x	x	x	x	x	x	x	x	Continuous	Student
Course outcome survey	x	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Course outcome report	x	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Final Year Project survey	x	x	x	x	x		x		x			End of sem	Faculty
PO survey by final year students	x	x	x	x	x	x	x	x	x	x	x	End of sem	Faculty
Industrial training survey			x	x	x	x	x	x	x			End of session	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept
Employer Survey	x	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept



# SPEKIFIKASI PROGRAM SSM PROGRAMME SPECIFICATIONS SSM



UNIVERSITI TEKNOLOGI MALAYSIA

Buku Panduan Akademik Fakulti Sains **09/10**  
Academic Guide Book Faculty Of Science **09/10**





1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Program Name	Bachelor of Science in Industrial Mathematics			
4. Final Award	Bachelor of Science(Industrial Mathematics)			
5. Program Code	TS34 (SSM)			
6. Professional or Statutory Body of Accreditation	Kementerian Pengajian Tinggi			
7. Language(s) of Instruction	Bahasa Melayu and English			
8. Mode of Study (Conventional, distance learning, etc)	Conventional			
9. Mode of operation (Franchise, self-govern, etc)	Self-govern			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Minimum : 3 yrs Maximum : 5 yrs			
Type of Semester	No. of Semesters		No. of weeks per semester	
	Full Time	Part Time	Full Time	Part Time
Normal	6		17	
Short (Industrial Training)	1		10	
12. Entry Requirement	Fulfil all university requirements and the following program requirements: 1.Matriculation with minimum B in Mathematics or 2.STPM with minimum a of B- in Mathematics and a minimum of C in Chemistry and Physics or Biology Or 3.Diploma in Science or Engineering with minimum CPA of 2.70 from recognized institutions			

### 13. Programme Objectives

To produce graduates who are:

- (i) Able to apply their mathematical knowledge and skills ethically in the planning, decision making, analysis and supervision of work related to industries and public or private sectors.
- (ii) Technically competent in solving applied and industrial problems.
- (iii) Able to work and communicate effectively in team projects either as a leader or a team member.
- (iv) Able to respond and adapt readily to changing working situations and identify business opportunities.
- (v) Able to continue learning towards the acquisition of new knowledge and skills in breadth.



#### 14. Programme Learning Outcomes

##### (a) Technical Knowledge and Competencies

Code	Intended Learning Outcomes	Teaching and Learning Methods	Assessment
PO1	Ability to demonstrate knowledge and understanding of the fundamental concepts, theories and results of mathematics	Lectures, tutorials, projects (PSM, Group/individual), directed reading, computer-based exercises, simulation exercises, problem-based learning, cooperative learning, active learning	Examinations, computing output, computer laboratory reports, presentations, project reports, tutorial exercises.
PO2	Ability to demonstrate skills in mathematical reasoning and display proficiency in a variety of mathematical techniques to solve problems of mathematical sciences.	Lectures, tutorials, projects (PSM, Group/individual), directed reading, computer-based exercises, simulation exercises, problem-based learning, cooperative learning, active learning	Examinations, computing output, computer laboratory reports, presentations, project reports, tutorial exercises.
PO3	Ability to identify, formulate, analyze and solve applied and industrial problems through the integration of mathematical sciences, management sciences and information and communication technology (ICT).	Lectures, tutorials, projects (PSM, Group/individual), directed reading, computer-based exercises, simulation exercises, problem-based learning, cooperative learning, active learning	Examinations, computing output, computer laboratory reports, presentations, project reports, tutorial exercises.

##### (b) Generic Skills

PO4	Ability to understand, extract, analyse and identify problems from a variety of sources and apply the mathematical knowledge to solve problems	Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual)	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio, industrial training evaluation.
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PO5	Ability to convey ideas and mathematical knowledge clearly and effectively in both written and oral form	Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual)	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio, industrial training evaluation.
PO6	Ability to work collaboratively as part of a team	Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual)	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio, industrial training evaluation.
PO7	Ability to pursue independent study and demonstrate the awareness for continuous personal and professional development	Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual), professional development courses	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio, industrial training evaluation.
PO8	Demonstrate the basic knowledge of leadership and the ability to lead	Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual), seminars, workshops, community service, co-curricular activities, group work	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio, industrial training evaluation.
PO9	Demonstrate an awareness of responsible and ethical conduct as well as integrity in the context of their profession and obligations to society	Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual), seminar, workshop, community service, co-curricular activities, group work, industrial training	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio, industrial training evaluation
PO10	Acquire awareness of business and entrepreneurship opportunities	Lectures, assignments, case studies, Cooperative learning, problem based learning, active learning, projects (PSM, Group/individual), seminar, workshop, community service, co-curricular activities, group work, industrial training.	Written assignments, oral presentations, project reports, computer laboratory reports, peer evaluation, learning portfolio, industrial training evaluation, examination.





15. Classification of Subjects				
No.	Classification	Credit Hours	Percentage %	Standard (QA) %
i.	Basic Sciences and Mathematics	6	5.8	10 - 30%
ii.	Program Core	68	65.4	60 - 70%
iii.	Program Electives	12	11.5	5 - 30%
iv.	Compulsory University Subjects	18	17.3	5 - 10%
	a. Humanity	8	7.7	
	b. English Language	6	5.8	
	c. Co-curriculum	2	1.9	
	d. Entrepreneurship	2	1.9	
	<b>Total</b>	<b>104</b>	<b>100 %</b>	<b>100%</b>

For science program please fill up the following classification.  
(Others please refer to the Statutory Body Guidelines)

A	Mathematics Subjects	Credit Hours	Percentage %
	(a) Lectures	66	74.0%
	(b) Industrial Training	5	
	(c) Final year projects	6	
	<b>Total credit hours for Part A</b>	<b>77</b>	
B	Related Subjects		26.0%
	(a) Humanities/Ethics	8	
	(b) Management	9	
	(c) Co-curriculum	2	
	(d) English Languages	6	
	(e) Entrepreneurship	2	
C	<b>Total credit hours for Part B</b>	<b>27</b>	
	<b>Total credit hours for Parts A and B</b>	<b>104</b>	<b>100%</b>

<b>16. Total credit hours to graduate</b>	<b>104 credit hours</b>
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**17. Programme structures and features, curriculum and award requirements**

The course is offered on full-time mode and is based on a 2 Semester Academic Session with several subjects being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester.

Award requirements:

To graduate, students should:

- Attain a total of 104 credit hours with minimum CPA of 2.0.
- Pass industrial training.
- Pass the undergraduate final year project.



### YEAR 1 (Semester 1)

SSH1013	Intermediate Math	3
SSH1113	Statistics I	3
SSH1313	Computer Programming	3
SSH1713	Calculus I	3
ULT1022	Islamic and Asian Civilizations	2
Total Credit Hours		14

### (Semester 2)

SSH 1123	Statistics II	3
SSH 1523	Linear Algebra	3
SSH 1783	Calculus II	3
SSH 1743	Differential Equations	3
UHB 1412	English for Academic Comm.	2
UHS 1152	Ethnic Relations	2
Total Credit Hours		16

### YEAR 2 (Semester 3)

SSH 2113	Statistical Quality Control	3
SSH 2353	C++ Programming Computational	3
SSH 2413	Numerical Methods	3
SSH 2813	Operational Research	3
SHD 1513	Principles of Management	3
UQ- 2---1	Co-curriculum I	1
Optional (2 credits)		
ULT 2122	Islamic Institutions	2
ULT 2132	Islam and Current Issues	2
Total Credit Hours		18

### (Semester 4)

SSH 2123	Design of Experiment	3
SSH 2623	Real Analysis	3
SSH 2743	Partial Differential Equations	3
SHF 1113	Principles of Marketing	3
UHB 2422	Advanced English for Academic Comm	2
UHS 2---2	Nationhood Elective	2
Total Credit Hours		16

### Short Semester

SSU 2915	Industrial Training	5
Total Credit Hours		5

### YEAR 3 (Semester 5)

SSH 2143	Inferential Statistics	3
SSH 3713	Mathematical Modelling	3
SSU 3922	Undergraduate Project I	2
UHB 3---2	Compulsory English Elective	2
UQ 3---1	Co-curriculum II	1
Electives (6 credits)		
SSH 2673	Discrete Mathematics	3
SSH 3453	Applied Numerical methods	3
SSH 3813	Optimal Control	3
SSH 3833	Discrete Event Simulation	3
Total Credit Hours		17

### (Semester 6)

SSH 2783	Vector Calculus	3
SSU 3924	Undergraduate Project II	4
SHD 1523	Organizational Behaviour	3
UHS 3102	Entrepreneurship and Enterprise Development	2
Electives (6 credits)		
SSH 3113	Time Series	3
SSH 3123	Multivariate Analysis	3
SSH 3143	Decision Theory	3
SSH 3163	Stochastic Process	3
SSH 3243	Sampling Techniques	3
SSH 2753	Complex Variables	3
SSH 3323	Intelligent System	3
SSH 3723	Advanced Mathematical Modelling	3
SSH 3793	Calculus of Variations	3
SSH 3823	Advanced Operational Research	3
SSH 3843	Optimization Methods	3
SSH 3863	Financial Mathematics	3
Total Credit Hours		18



### 18. Mapping of Programme Learning Outcome to Subjects

Courses Offered		Learning Outcomes									
		Fundamental Knowledge of Mathematics	Skills in Mathematical Techniques	Application Skills	Critical Thinking and Problem Solving	Communication	TeamWorking	Lifelong Learning and Information Management	Entrepreneurship	Leadership	Ethics and Integrity
Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Core Subjects											
SSH 1013	Intermediate Mathematics	a	a	-	-	1	-	-	-	-	-
SSH 1113	Statistics I	a	a	a	1	-	-	-	-	-	-
SSH 1313	Computer Programming	a	b	b	-	-	1	1	-	-	-
SSH 1713	Calculus I	a	a	b	1	1	-	-	-	-	-
SSH 1123	Statistics II	a	b	b	1	-	1	-	-	-	-
SSH 1523	Linear Algebra	a	b	b	-	1	-	-	-	-	-
SSH 1783	Calculus II	a	a	a	1	1	-	-	-	-	-
SSH 1743	Differential Equation	a	b	b	-	-	-	-	-	-	-
SSH 2113	Statistical Quality Control	a	a	b	1	1	1	-	-	-	-
SSH 2353	C++ Programming	a	a	b	1	1	1	1	-	-	-
SSH 2413	Computational Numerical Method	a	a	a	1	-	-	-	-	-	-
SSH 2813	Operational Research	a	a	b	1	-	1	1	-	-	-
SSH 2123	Design of Experiments	a	a	a	-	1	1	1	-	-	-
SSH 2623	Real Analysis	a	a	a	1	1	1	-	-	-	-
SSH 2743	Partial Differential Equation	a	a	a	1	-	-	-	-	-	-
SSH 2143	Inferential Statistics	a	b	b	-	1	-	-	-	-	-
SSH 3713	Mathematical Modelling	a	a	a	1	1	1	-	1	-	-
SSH 2783	Vector Calculus	a	a	-	-	-	-	-	-	-	-
SSU 2915	Industrial Training	-	a	a	1	1	1	1	1	1	1
SSU 3922	Undergraduate Project I	b	b	b	1	1	-	1	-	1	-
SSU 3924	Undergraduate Project II	a	a	a	1	1	-	1	-	1	-
Elective Subjects											
SSH 2673	Discrete Mathematics	a	a	b	-	1	1	-	-	-	-
SSH 3453	Applied Numerical Method	a	a	a	-	-	-	-	-	-	-
SSH 3813	Optimal Control	a	a	b	-	1	1	-	-	-	-
SSH 3833	Discrete Event Simulation	b	b	b	-	-	-	-	-	-	-
SSH 2753	Complex Variables	a	a	b	-	1	1	-	-	-	-
SSH 3113	Time Series	b	a	b	-	1	1	-	-	-	-
SSH 3123	Multivariate Analysis	a	a	a	-	1	1	-	-	-	-
SSH 3143	Decision Theory	a	a	b	-	1	1	-	-	-	-
SSH 3163	Stochastic Process	a	a	b	1	1	1	-	-	-	-
SSH 3243	Sampling Techniques	a	a	b	-	1	1	-	-	-	-



Subjects offered		Fundamental Knowledge of Mathematics	Skills in Mathematical Techniques	Application Skills	Critical Thinking and Problem Solving	Communication	Team Working	Lifelong Learning and Information Management	Entrepreneurship	Leadership	Ethics and Integrity
Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
<b>Core Subjects</b>											
SSH3323	Intelligent System	a	a	a	-	1	1	-	-	-	-
SSH3723	Advanced Mathematical Modelling	a	a	a	-	1	1	-	-	-	-
SSH3793	Calculus of Variations	a	a	a	-	1	1	-	-	-	-
SSH3823	Advanced Operational Research	a	a	b	-	1	1	-	-	-	-
SSH3843	Optimization Method	a	a	b	-	1	1	-	-	-	-
SSH3863	Financial Mathematics	a	a	a	-	-	-	-	-	-	-
<b>University Subjects</b>											
ULT1022	Islamic and Asian Civilizations (TITAS)	c			2	2		2	2	2	2
UHB1412	English for Academic Communications	a	a	c	2	1	2	2	1		1
UHS 1152	Ethnic Relation	c			2						
UQ_2xx1	Co-curriculum	c			1	2		1	1	2	1
UHB 2422	Advanced English for Academic Communications	a	a	b	2	1	2	2	1		1
UHS 2xx2	Nationhood Electives	c			2						
UHB3xx2	Compulsory English Elective	a	c		2	1	2	2	1		1
UQ_3xx1	Co-curriculum II	c			1	2		1	1	2	1
ULT2122	Islamic Institutions	c									
ULT2132	Islam and Current Issues	c			2	2		2	2	2	2
UHS3102	Entrepreneurship and Enterprise Development	c									1

**Key:**

Technical Skills: **a** = major contribution to outcome;

**b** = moderate contribution to outcome; **c** = minor contribution to outcome

Generic Skills: **1** = Substantial (with assessment); **2** = not substantial (introduce)



#### 19. Programme Uniqueness

1. The only B.Sc in Industrial Mathematics programme offered in the country.
2. Prepares students to be able to apply their mathematical knowledge and skills ethically in the planning, decision-making, analysis and supervision of work related to industries and public or private sectors.

#### 20. Career Prospects and Career Path

Graduates of this programme can work as

- Quality assurance officer, project manager in manufacturing industries.
- Finance officer in financial institutions.
- Academicians in academic institutions.
- Researchers in research institutions.

#### 21. Cross Campus Programme

Students are given the opportunity to enroll few courses in participating universities and the grades and credits (up to 1/3 of the total credits of the curriculum) are transferable. At the moment, there are four participating universities i.e. Universiti Teknologi Malaysia, Universiti Sains Malaysia, Universiti Malaya and Universiti Malaysia Sarawak.

#### 22. UTM Degree ++ Programme

Students are given a chance to enrol in certificate programmes offered by Centres of Excellence in the university during their semester breaks. For example, *Certificate in Total Quality Management*.

#### 23. Facilities Available

List of computer laboratories and rooms with IT facilities

1. Computer Lab 1
2. Computer Lab 2
3. Computer Lab 3
4. Computer Lab 4
5. Smart Classroom
6. Resource Centre

#### 24. Support for Students and their learning

- Two weeks induction programme for orientation and introductory study skills
- Student Handbook and Module Guides
- Staff student ratios for teaching of 1:15
- Extensive library and other learning resources and facilities.
- Students are assigned to academic advisors to assist them in education planning.



**25. Methods for Evaluating and Improving the Quality and Standards of Teaching and Learning Mechanisms for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards**

1. Students performance in terms of:
  - KS/KB
  - CPA
  - Graduating students performance
  - Graduate on time, GOT
  - Completion rate
  - Analysis of course performance
2. Employability
  - Exit survey
  - Alumni survey
  - Market survey
3. Lecturer's performance
  - Teaching evaluation by students (OMR)
  - Competency check-list for staff (CV)
  - Annual staff appraisal (SKT)
4. Curriculum review
  - Faculty academic committee
  - Industrial training survey
  - PSM survey
  - External examiner reports
  - CO achievement survey by students
  - Students e-Portfolio
  - Generic skills evaluation (Performance Criteria Report)
5. Delivery system
  - Academic Quality Assurance Committee
  - CSI
  - SSI
  - AKNC audit report
  - MQA standard





## 26. Regulation of Assessment

### a) Summary of marks, grades and their evaluation points

Marks	Grade	Evaluation Point
90-100	A+	4.00
80-89	A	4.00
75-79	A-	3.67
70-74	B+	3.33
65-69	B	3.00
60-64	B-	2.67
55-59	C+	2.33
50-54	C	2.00
45-49	C-	1.67
40-44	D+	1.33
35-39	D	1.00
30-34	D-	0.67
00-29	E	0.00

### b) Role of External Examiners (Visiting Examiners)

Visiting Examiners are appointed by the Faculty Academic Committee to

- review and evaluate programme curriculum
- review and evaluate assessment procedure and methods,
- make a necessary recommendations to the Academic Committee.

## 27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by	
	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10			
e- Portfolio	x	x	x	x	x	x	x	x	x	x	x	Continuous	Student
Course outcome survey	x	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Course outcome report	x	x	x	x	x	x	x	x	x	x	x	End of sem	Lecturer
Final Year Project survey	x	x	x	x	x		x		x			End of sem	Faculty
PO survey by final year students	x	x	x	x	x	x	x	x	x	x	x	End of sem	Faculty
Industrial training survey			x	x	x	x	x	x	x			End of session	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept
Employer Survey	x	x	x	x	x	x	x	x	x	x	x	Once/3 years	Head of Dept



# SINOPSIS KURSUS FIZIK *SYNOPSIS OF PHYSICS COURSE*



UNIVERSITI TEKNOLOGI MALAYSIA

Buku Panduan Akademik Fakulti Sains **09/10**  
Academic Guide Book Faculty Of Science **09/10**





### **SSP 1103      PHYSICS I** •

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Pre-requisite: None

Introduces the basic concepts in physics which include concepts in kinematics, static, dynamics, and fluid dynamics. The concepts will be applied to linear, planar and rotational motion. Oscillatory and wave motion will also be discussed. The physical laws involved will be explained so that they may be applied in solving various related problems. Upon completion, students should be able to apply the concepts and laws introduced to solve related physical problems.

### **SSP 1123      THERMODYNAMICS** •

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Pre-requisite: None

Introduces important principles in thermodynamics, thermodynamic properties of materials and thermodynamic processes. The first and second laws of thermodynamics are explained and used in the analyses of systems and processes. Upon completion, the student must have the ability to describe the three-element structure of thermodynamics (principles, properties and processes), to use the first and second laws of thermodynamics including equations and property data to study and analyze common thermodynamic processes, devices, and systems.

### **SSP 1133      PHYSICS II** •

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Pre-requisite: None

Introduces the basic concepts in physics which include electrical, magnetic and electromagnetic concepts. The concepts of electric charge, electric field, electric potential, electric current and electric flux will be discussed. These concepts will be extended to their application in AC circuits. Magnetic concepts will be presented and blended to expose the students to electromagnetism with the introduction of Maxwell's equations. The physical laws involved will be explained so that they may be applied in solving various related problems. Upon completion, students should be able to apply the concepts and laws introduced to solve related physical problems.

### **SSP 1223      MODERN PHYSICS** •

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Pre-requisite: None

Introduces students to the basic theory of relativity and quantum physics, including basic concepts in relativity, quantum theory and wave mechanics. The development in the modern atomic theory is explained which includes the Bohr theory in understanding the atomic structure with the concepts of energy levels, the existence of line spectra and the concept of magnetic moment. Upon completion, students should be able to apply the concepts and laws introduced to solve related physical problems.

### **SSP 1323      BASIC ELECTRONICS** •

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Pre-requisite: None

Designed to expose the students to basic working concept of electronic components. Techniques in analyzing simple circuits using Kirchhoff law, Thevenin and Norton theorem are explained. AC circuit analysis and the use of semiconductor devices such as diodes and transistors are described. Upon completion, students should be able to understand the working concept of electronic components, be able to analyze simple DC and AC circuits and be familiarize with the properties of semiconductor devices such as diode and transistor and also their function in electronic circuits.



### **SSP 1513 OPTICAL PHYSICS**

Pre-requisite: None

Introduces students to the theory of optics, including the basic concepts in ray, wave and quantum optics. The phenomena of reflection, refraction, interference, diffraction and polarization are explained using the ray and electromagnetic wave models of light. The quantum model is utilized in explaining the generation of ordinary and laser lights. Upon completion, students should be able to apply the concepts and models introduced to solve problems related to the phenomena of reflection, refraction, interference, diffraction and polarization of light. Students should also be able to explain and solve problems related to quantum optics.

### **SSP 1811 PHYSICS PRACTICAL I**

Pre-requisite: None

Students perform experiments related to the physics of mechanics, electricity and magnetism. These experiments will be performed either in a group or individually. At the end of each experiment, the student present a technical report which describes the experiment, the analysis and the findings. Upon completion, the student should have the ability to relate the experiment to the theory learned in Physics I, that is, mechanics, electricity and magnetism, perform and experimental analysis on the laboratory works and write technical reports.

### **SSP 1821 PRACTICAL PHYSICS II**

Pre-requisite: None

Students perform experiments related to the physics of thermodynamics, optics, modern physics and electronics. These experiments will be performed either in a group or individually. At the end of each experiment the student present a technical report which describes the experiment, the analysis and the findings. Upon completion, the student should have the ability to relate the experiment to the theory learned in thermodynamics, optics, modern physics and electronics, perform an experimental analysis on the laboratory works and write technical reports.

### **SSP 2122 COMPUTATIONAL PHYSICS**

Pre-requisite: None

Introduces the basic concepts in the operation of a computer system. Techniques in building a computer program will be described, including the usage of various types of data in a computing system. Upon completion, students should be able to develop a computer program and solve basic problems in computational physics.



### **SSP 2213 NUCLEAR PHYSICS**

Pre-requisite: None

Introduces some major concepts and theories in nuclear physics which include a basic concept of interaction processes of nuclear radiation so that the students will have an appreciation of nuclear physics. The course begins with understanding the basic knowledge of the constituents of nucleus and the properties of nuclear forces. Radiation sources, types and properties of ionizing radiation and the nuclear decay process and the properties of ionizing radiations will be discussed. The interactions of nuclear radiations with matter and mechanism of nuclear reaction are also covered. Some basic concept on radioactivity including radioactive decay law, radioactive decay series and radioactive equilibriums and some nuclear models such as liquid drop model, shell model and optical model of the nucleus will be introduced. Upon completion, students should be able to describe the nuclear structure and reactions based on the liquid drop, shell and optical models. The students should also be able to discuss radioactivity, radioactive decay, radioactive equilibrium and the sources of radioactivity and ionizing radiation, including their interactions with matter.

### **SSP 2223 RADIATION PROTECTION**

Pre-requisite: None

Designed to ground students in the principles of radiation protection, that is, on justification, optimization and dose limits. It will emphasize on the theories, the techniques and the procedures for external dose control, that is on the use of distance, shielding and time; and internal dose control, including introduction to the physics of aerosol, use of unsealed sources, primary and secondary containments, radioactive laboratories and leak tests. The course will also discuss organization and radiation protection programme; emergency procedures, monitoring, radiological protection in radiation devices, transport regulations and radioactive waste management. Upon completion, students should have an overall grasp of the radiation protection principles and practice; and most importantly the safety culture required.

### **SSP 2233 RADIOBIOLOGY**

Pre-requisite: None

This course introduces students to the theoretical basis and the model on the biological effects of radiation. Physical, chemical to cellular perspectives will be elaborated. It will then examine the macroscopic effects of radiation exposures, be they deterministic, somatic stochastic or genetic. The course will also discuss the effects of ingested radionuclide and the various models involved in it, radiation ecology and the effects of non-ionizing radiations. At the end of the course students should be able to make informed judgments on the short and the long-term health physics and radiological protection implications of a radiation exposure.





### **SSP 2243 RADIATION PHYSICS**

Pre-requisite: SSP 2213

An follow-up of the Nuclear Physics course. It is designed to expose student to the different types of radiation that exist in nature and environment, in particular the nuclear-based radiation. However, others like the non-nuclear radiation will also be discussed but in brief. Some of the topics previously studied in nuclear physics will again be reviewed but now in greater detail. The theories of alpha, beta and gamma radiation productions will be dealt with more emphasis on mathematical formulations. Other topics that will be covered in this course include the radiation sources, the interaction of charged particles, photon and neutron with matter. Topics on radiation effects especially on polymers, solid and liquid will also be discussed. To highlight the importance of radiation effect, a small section will be devoted to the theory of microdosimetry. Upon completion, the student will be exposed to the concepts of accelerators as sources of radiation and their usefulness in the field of nuclear and particle physics.

### **SSP 2323 ADVANCED ELECTRONICS**

Pre-requisite: SSP 1323

Introduces students to the small signal analysis technique. Analyses of simple circuits containing filters, wave generators, oscillators and OPAM's are discussed. Basic concepts and principles in understanding digital systems are explained. Upon completion, the student should have the ability to understand and analyze small signal amplifier, understand and analyze simple circuits including basic digital systems, understand logic principle and various logic devices employed in digital system and to understand the function of digital circuit in the development of a simple computer.

### **SSP 2343 INSTRUMENTATION AND MEASUREMENT**

Pre-requisite: None

Introduces the basic configuration and function of instrumentation systems. The static and dynamic characteristics of instruments, sensors and transducers will be discussed and the principle of signal sensing and processing will be explained. Upon completion, the student should have the ability to describe basic configuration and function of instrumentation systems and the static and dynamic characteristics of instruments, sensors and transducers. The student should also be able to provide guidelines on selecting instruments for certain measurement purposes.

### **SSP 2412 MATERIALS SCIENCE**

Pre-requisite: None

Introduces students to types of materials, structure-process-properties relationship, structure and bonding in materials. Crystal structure and the band theory will be described. Upon completion, the student must have the ability to identify the properties and characteristic of materials, the structure of many types of materials and the sources and types of defects in materials.



### **SSP 2413 SOLID STATE PHYSICS**

Pre-requisite: SSP 1103, SSP 1133

Introduces basic concepts in solid state physics, with emphasis on crystal structures. The roles of phonons and electrons in a solid are discussed, using various models. Upon completion, students should be able to explain basic concepts used in solid state physics and techniques used in determining crystal structures. Students should also be able to discuss thermal properties of solids and the behaviour of electrons in solids, using various models.

### **SSP 2423 SPECTROSCOPY TECHNIQUES AND MATERIAL ANALYSIS**

Introduces the basic principle of spectroscopy in the analysis of materials. Different types of spectroscopy such as Raman spectroscopy IR spectroscopy and the NMR technique are discussed. Upon completion, the student should have the ability to describe the various types of spectroscopy available for material analysis. The students should also be able to analyze spectroscopic data and compare them with other material analysis techniques.

### **SSP 2433 THIN FILM TECHNOLOGY**

Pre-requisite: None

Introduces the basic concept of vacuum and thin film. The vacuum system and the vacuum deposition technique for producing thin film will be described. Upon completion, the student must have the ability to describe a vacuum system for producing thin film, analyze thin film properties and describe the fabrication of thin film devices.

### **SSP 2613 MATHEMATICAL PHYSICS**

Pre-requisite: SSH 1013

Introduces important mathematical tools, such as calculus, differential equations and vector analysis. Various techniques in problem solving related to force-mass acceleration relations, work and energy impulse and momentum, and moments of inertia will be explained. Upon completion, the student should have the ability to make use of the mathematical tools in solving related problems including determining the center of mass, moment of inertia, and radius of gyration of a system.

### **SSP 2623 ELECTROMAGNETISM**

Pre-requisite: SSP 1133, SSH 1013

Introduces the vectorial approach in understanding various laws and equations in electrostatics and magnetostatics such as Coulomb's Law, Gauss's Law, Poisson's equation, Maxwell equations, Law of magnetic force, Biot-Savart's Law, Ampere's Law and Faraday's Law. Propagation of electromagnetic waves in vacuum, dielectric and in conducting medium will be discussed. Upon completion, students should be able to explain and apply the basic knowledge in electromagnetism, and relate the knowledge of electromagnetism to the application in industries.



### **SSP 2633 CLASSICAL MECHANICS** •

Pre-requisite: SSP 1103, SSH 1013

Introduces the different types of oscillations and expose them to the techniques in classical mechanics. Lagrangian and Hamiltonian dynamics, centred field motion, dynamics of rigid body and coupled oscillation are discussed. Upon completion, students should be able to solve a wide variety of real world problems by applying the techniques in classical mechanics and be able to logically analyze mechanical problems within the frame work of classical mechanics. The student should then be able to appreciate the elegance of classical mechanics in describing natural phenomena.

### **SSP 2811 PRACTICAL PHYSICS III** •

Pre-requisite: None

Students perform experiments related to advanced electronics, optoelectronics and nuclear physics. These experiments will be conducted either in a group or individually. At the end of each experiment the student presents a technical report which describes the experiment, the analysis and the findings. Upon completion, the student should have the ability to relate the experiment to the theory learned in advanced electronics, optoelectronics and nuclear physics, perform an experimental analysis on the laboratory works and write technical reports.

### **SSP 2821 PRACTICAL PHYSICS IV** •

Pre-requisite: None

Students perform experiments related to advanced electronics, computer interfacing, optoelectronics and instrumentation. These experiments will be conducted either in a group or individually. At the end of each experiment the student presents a technical report which describes the experiment, the analysis and the findings. Upon completion, the students should have the ability to relate the experiment to the theory learned in advanced electronics, computer interfacing, optoelectronics and instrumentation, perform an experimental analysis on the laboratory works and write technically reports.

### **SSP 2831 MATERIAL PHYSICS PRACTICAL** •

Pre-requisite: None

Students perform experiments related to material science, semiconductor physics, science of material corrosion and metallurgy. These experiments will be conducted either in a group or individually. At the end of each experiment the student presents a technical report which describes the experiment, the analysis and the findings. Upon completion, the student should have the ability to relate the experiment to the theory learned in material science, semiconductor physics, science of material corrosion and metallurgy, perform an experimental analysis on the laboratory works and write technical reports.



### **SSP 2841 HEALTH PHYSICS PRACTICAL**

Pre-requisite: None

Students perform experiments related to radiation physics and dosimetry. These experiments will be conducted either in a group or individually. At the end of each experiment the student must presents a technical report which describes the experiment, the analysis and findings. Upon completion,, the student should have the ability to relate the experiment to the theory learned in radiation physics and dosimetry, perform an experimental analysis on the laboratory works and write technical reports.

### **SSP 3212 NUCLEAR TECHNIQUES**

Pre-requisite: None

Introduces students to the various nuclear techniques commonly used in science and technology. The application of the techniques in various fields, such as in agriculture, reproduction, pest control, food conservation, oil exploration and mining, archeology, are described and discussed. Upon completion, the student must have the ability to explain and discuss the application of nuclear techniques in various fields.

### **SSP 3213 RADIATION DETECTION AND DOSIMETRY**

Pre-requisite: SSP 2213

The important detection techniques for ionizing radiations are introduced. The discussion begins with introducing the principles of radiation detection related to radiation units, radiation sources and radiation interactions. Nuclear radiation detector parameters such as detector model, detector efficiency, energy resolution, counting curve and counting statistics are discussed. The next topic will emphasize on the principles of operation and basic characteristics of various detection systems. Various nuclear detectors such as gas filled detector, scintillation detector and semiconductor detector are the main concerned of the subject. The course also emphasizes on the principle and operation of thermal and fast neutron detector. Detection electronics and pulse processing are briefly highlighted. The principle of radiation dosimetry such as thermoluminescent dosimetry, chemical dosimetry, film dosimetry and calorimeter are also discussed at the end of the course.

### **SSP 3222 LASER IN MEDICINE**

Pre-requisite: None

Introduces students to the applications of lasers for diagnosis and therapy in medicine. The basic concepts involved in laser applications for medical use are discussed, including the laser safety techniques in medical application. Upon completion, the student should have the ability to explain and discuss applications of lasers for diagnosis and therapy in medicine, describe the basic concepts involved in laser applications for medical use and be familiar with safety procedures of using lasers in medicine.



### **SSP 3223      RADIOLOGICAL PROTECTION**

Pre-requisite: SSP 2223

A follow-up of SSP 2223; designed to give students a comprehensive view of radiological protection for environmental management and medical practice. For environmental management the emphasis is on understanding of the behaviour of released radionuclides and environmental modeling. The course will also touches on natural environmental radiation, nuclear facilities and TENORM. For medical practice students will be introduced to issues and trends, quality assurance, rules and regulations in diagnostic radiology, radiotherapy, and nuclear medicine. Students will be exposed to various radiation management software and will be required to demonstrate ability to operate one of the suitable software. Upon completion, students should be able to apply the knowledge gained to implement radiological protection programme.

### **SSP 3232      BIOPHYSICS**

Pre-requisite: None

Designed to enable student to comprehend the many types of physical processes occurring at cell level of the body. Emphasis is on the transport mechanism in an infinite medium which will include the flow, flux, diffusion Brownian motion and fluid drag. Transport through membrane structure will be dealt with, especially with regards to the volume transport, solute transport and ionic motion in and outside cell membrane. Properties of the signal transport by nerve cell will be studied and modeling of nerve impulse will be based on Hodgkin-Huxley experiment. Upon completion, the student will have been exposed to the study of electrical properties of heart cell based on non-conducting model, including some typical examples of ECG graphs with regards to different heart disorders.

### **SSP 3242      MEDICAL IMAGING**

Pre-requisite: None

Designed to expose the students to medical imaging from physics point of view. Topics include design of X-ray machine, circuit, specification and quality of X-ray beam, X-ray film, radiography, image quality, fluoroscopy, tomography, computed tomography, ultrasound, magnetic resonance imaging, thermography, and quality assurance. Upon completion, students should be able to explain basics of medical imaging and its applications, relate scientific and technological basis to medical imaging, and identify various medical imaging modalities available today.

### **SSP 3252      OCCUPATIONAL HEALTH**

Pre-requisite: None

Designed in such a way that the student understands the issues of health that prevailed among workers. The concept of the relationship between work and health will be discussed in detail. Some of the relevant topics covered will be the subject of toxicology, thermal stress and mental health. Students will also learn the principles of epidemiology, ergonomics and health services related to work. This course also prepares student to understand the management of occupational health through health education, health promotion program, management of risks as well as from the legislative point of views such as the Safety and Health Act.





### **SSP 3262 NEUTRON AND REACTOR PHYSICS**

Pre-requisite: SSP 2213

Begins with brief discussion on neutron physics related to production of neutron, absorption and scattering of neutron, neutron cross sections and nuclear fission. The next topics will emphasize on the principle of neutron moderation and neutron multiplication leading to steady state fission reactor core design based on diffusion theory. The principle of fusion reaction and energy production from controlled thermonuclear fusion are also briefly highlighted. In general, the course provides on the general concepts of neutron physics and its application in nuclear reactor for energy generation.

### **SSP 3272 RADIOTHERAPY**

Pre-requisite: None

Introduces the theory and operation of various radiotherapeutic machines, such as LINAC, kilovolt X-ray machines and Co-60; and the theoretical basis of radiotherapeutic treatments. The emphasis is on the production and characterisations of clinically useful photon and electron beams; and the accessories and techniques used to modify and shape them. The course will provide students with general principles and basic ideas on the techniques of treatment planning, quality control in treatment planning, and on brachytherapy. Upon completion, students should have an overall understanding on the theory and practice of radiotherapy to well prepare them for further career developments in this field.

### **SSP 3282 NUCLEAR MEDICINE**

Pre-requisite: None

Introduces the theoretical basis of nuclear medicine. This course emphasizes on the basics of internal dosimetry including the use of MIRD method to estimate doses to organs. The course will also discuss radioisotope scanning and radionuclide imaging including total body counting, organ function diagnosis, gamma camera, bone imaging, SPECT, PET. The course will also touch on radionuclide therapy, radiopharmaceutics and body fluid analysis. Upon completion, students should have an overall view on the theory and practice of nuclear medicine.

### **SSP 3312 COMPUTER INTERFACING**

Pre-requisite: SSP 1323

Introduces the internal hardware of a computer principle and the various techniques in electronic circuit simulation. Parallel and serial data communication, logic devices interfacing and data conversion using analog to digital and digital to analog converter are discussed. Upon completion, the student must have the ability to describe the concept of computer ports: parallel and serial, build and control simple circuit via the parallel port, manipulate the bits of parallel port using computer program, explain the RS232 protocol and describe the methods of data conversion; analog to digital and digital to analog





### **SSP 3313 INDUSTRIAL ELECTRONICS**

Pre-requisite: SSP 1323

Designed to expose the students to the working principles of electronic devices and systems commonly used in industries. Industrial safety, industrial electronic diagrams, transformers and power distribution systems, industrial control devices, power electronics, industrial motors and generators, relays, motor contacts and starters, motor control circuits, types of control, process control systems, programmable logic controller (PLC), machines, and computer controlled processes are described. Upon completion, students should be able to describe electronic devices, motors and machines related to industrial applications, explain the working principle of common instruments in industrial applications and describe the control of common industrial equipments.

### **SSP 3322 ELECTRONIC CIRCUIT SIMULATION**

Pre-requisite: None

Introduces the principle and the various techniques in electronic circuit simulation. Circuit simulation based on PSPICE. circuit concepts and components are exposed and explained. Upon completion, the student should have the ability to describe the principle and the various techniques in electronic circuit simulation. The student should also be able to utilize some popular electronic circuit simulation software.

### **SSP 3332 SIGNAL PROCESSING**

Pre-requisite: None

Introduces the characterization and classification of digital signals. Digital processing of continuous-time signals, the z-transform and the linear time invariant (LTI) discrete-time systems will be discussed. At the end of the course, students should be able to describe the fundamentals of digital signal processing, appreciate the importance of the z-transform and its properties, have an awareness of different structures available for the realization of finite impulse response (FIR) and infinite impulse response (IIR) digital filters and be familiar with ideal filter approximation function.

### **SSP 3342 NON-DESTRUCTIVE TESTING METHOD I**

Pre-requisite: None

Introduces various non-destructive testing techniques available. The principles and application of those techniques are exposed and explained. Parameters. Upon completion, the student should have the ability to describe the formation and detection of material defects. The student should also be able to explained the theory and applications of eddy current methods and the basic principles and theory of radiology methods

### **SSP 3352 PROCESS CONTROL**

Pre-requisite: None

Introduces various several process controls in industries. The process control characteristics and some aspects of digital process control are discussed. Upon completion, the student should have the ability to describe the various industrial process controls. The student should also be able to explain the techniques in digital process control.



### **SSP 3362      COMMUNICATION ELECTRONICS**

Pre-requisite: None

Introduces various modern electronic communication systems. The various techniques of modulation in signal transmission are discussed. Basic concepts and principles in digital communication systems are explained. Upon completion, the student should have the ability to describe the various techniques of modulation in signal transmission and analyze modern electronic communication systems. The student must also be able to explain the techniques in the transmission of information in digital systems.

### **SSP 3372      ELECTRONIC TESTING AND MAINTENANCE**

Pre-requisite: None

Students will be exposed to the principle of electronic maintenance and troubleshooting. Reliability testing and maintainability testing of the electronic components and various Electronic testing equipment commonly used will be described. Upon completion, the student must have the skill on how to identify and troubleshoot the failure of electronic components and electronic instruments and have the skill of using electronic testing equipment.

### **SSP 3382      NON-DESTRUCTIVE TESTING METHOD II**

Pre-requisite: None

Designed to expose the students to the physical principles of ultrasonics and their interactions with media. The theory of ultrasonic propagation and transductions are described. Upon completion, students should be able to describe the physical principles of ultrasonics and its theory of propagation. The students should also be able to analyze the various ultrasonic propagation behaviour in different media and describe various ultrasonic's application techniques.

### **SSP 3412      X-RAY CRYSTALLOGRAPHY**

Pre-requisite: None

Introduces the basic properties, generation and detection of x-ray. The students are exposed to the Laue and powder methods in the determination of crystal structures. Upon completion, students should be able to describe the generation and detection of X-ray. The students should also be able to describe and explain techniques for the determination of crystal orientation and structures.

### **SSP 3413      SEMICONDUCTOR PHYSICS**

Pre-requisite: SSP 2413

Introduces semiconductors and semiconductor devices, from the past to current development. The growth method, the band theory and the principle, structure & operation of semiconductor materials are described. Upon completion, the students should be able to distinguish between semiconductor, metal and insulator. List out some semiconductor properties (conductivity, mobility, carrier density) and its dependence on temperature, explain the application of semiconductor materials and describe the mechanism and operation of semiconductor devices.



### **SSP 3422      MAGNETISM**

Pre-requisite: None

Introduces students to the fundamental knowledge on magnetic field and its effect on materials. basic techniques in magnetic field calculation and magnetic field generation will be discussed. Upon completion, students should be able to describe the basic techniques in magnetic field calculation and various applications of magnetic materials in industry.

### **SSP 3423      AMORPHOUS AND CERAMIC MATERIALS**

Pre-requisite: None

Introduces amorphous materials, glass and ceramics. The methods of preparation and the macro- and micro-structure of amorphous materials are discussed. Various properties of amorphous materials are described, including optical, mechanical, thermal and electrical properties of the above materials are described. Upon completion, students should be able to describe the above materials and discussed their optical, thermal, magnetic and mechanical properties.

### **SSP 3432      SCIENCE OF MATERIAL CORROSION**

Pre-requisite: None

Introduces the fundamentals of corrosion science. The students are exposed to the types of corrosion in materials such as uniform corrosion, pitting, crevice corrosion, galvanic corrosion, erosion corrosion, cavitation, fretting corrosion, intergranular corrosion, dealloying, stress corrosion cracking, corrosion fatigue and hydrogen embrittlement. Upon completion, students should be able to describe different types of corrosion, including those due to atmospheric corrosion and chemical corrosion. The students should also be able to describe and explain techniques of controlling, testing and measurement of corrosion.

### **SSP 3442      QUALITY CONTROL**

Pre-requisite: None

Introduces Quality Management System (QMS), Total Quality Management (TQM) and Statistical Quality Control. Types of quality cost, Standard series ISO 9000 and quality management principle will be described. Upon completion, the student should have the ability to explain quality management system based on the ISO 9000 standard and the main techniques in statistical quality control.

### **SSP 3452      METALLURGY**

Pre-requisite: None

Introduces students to the basic principles of the formation of metals and alloys. Various processes such as steel hardening, welding and casting are described. Upon completion, students should be able to describe the origin of defects in welds, castings and forgings and carry out the testing for determining the metallography of materials.



### **SSP3462 POLYMERIC MATERIALS**

Pre-requisite: None

Introduces the basic principle of polymers. The mechanical and thermal properties of polymers, with its structure and morphology, are described. Upon completion, students should be able to relate the chemical structure of polymeric materials to their physical properties and to the methods of their production and use. The students should also be able to interpret the physical and spectral characterization of polymer structures and describe the manufacturing methods, applicable to common polymeric substances.

### **SSP 3472 SUPERCONDUCTIVITY**

Pre-requisite: None

Introduces superconductor materials and high temperature superconductor. The characteristic and properties of superconductor will be described. Upon completion, the student must have the ability solve problems, relating to properties of superconductivity and explain the application of superconductor

### **SSP 3482 MICROSCOPIC TECHNIQUES**

Pre-requisite: None

Designed to expose the students to the importance of microscopy in the study of materials science. The importance of issues pertaining to image's resolution and magnification in microscopy will be discussed. Upon completion, the student must have the ability to draw schematic diagram for construction of electron microscopes and explain their working principles. The student must also be able to draw schematic diagram for construction of other types of microscope such as x-ray microscope, scanning probe microscopes, acoustic microscope, and field emission microscopes.

### **SSP 3512 LASER TECHNOLOGY**

Pre-requisite: None

Introduces the basic components of a laser and their working principles. Techniques of generating and modulating a laser beam are explained. Various types of laser is introduced including their possible application. Upon completion, the student should have the ability to understand what is laser and knowing the components included in the device, how to generate and modulate the laser beam, be able to describe the various types of laser and their applications and be aware of laser safety and know how to orientate and maintain optical components.

### **SSP 3513 APPLIED OPTICS**

Pre-requisite: SSP 1133 & SSP 1513

Students are exposed to the variety of application related to optics. Optical design techniques, photometry, radiometry, application of laser optics, fibre optics components and optical systems are described and discussed. Upon completion, students should have the ability to make simple optical design using standard optical components including laser and fibre optics components. The students should also be able to explain the functions of various components in optical systems in various applications.



### **SSP 3522 FIBRE OPTIC SENSORS**

Pre-requisite: None

Designed to expose the students to the basics of optical sensing, with emphasis on fibre optic sensing, including the classification and types of fibre optic sensors available. The basic principles, the modulation methods possible, the optical components normally used, the multiplexing methods possible and the measuring equipments used, are described. Upon completion, students should be able to describe 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 parameters involved and the various multiplexing schemes available in the design of fibre optic sensing systems and should be grateful to the Creator for the knowledge attained on fibre optic sensors and their applications.

### **SSP 3532 PHOTONICS**

Introduces the various models used in the field of photonics. The basic postulates and the parameters involved in applying photonic phenomena in different applications will be described. Upon completion, the students should be able to apply the postulates and the basic parameters introduced, in different applications.

### **SSP 3542 FIBRE OPTICS TECHNOLOGY**

Pre-requisite: None

Introduces the historical development and the importance of fibre optics in different applications. The parameters involved in the usage of optical fibres and the components of a fibre optic system will be described. Techniques of preparing an optical fibre will be discussed, including instruments used for preparation and measurement. Upon completion, the student must have the ability to describe the structure, material content, the various characteristics of an optical fibre. The student should also be able to analyze the functional role of the various components of an optical fibre system and be able to describe the preparation and measurement techniques involved.

### **SSP 3552 OPTOELECTRONICS**

Pre-requisite: None

Designed to expose the students to the present trends in optoelectronics and they will be introduced to the working principles of various optoelectronic components and devices. The functional principles of components in optoelectronic systems are discussed, including the analyses of parameters essential in the design of optoelectronic systems. Upon completion, the student must have the ability to explain the workings of various optoelectronic components and devices, describe and discuss the functions of components in optoelectronic systems and analyze the parameters involved in the design of optoelectronic systems.

### **SSP 3612 GENERAL RELATIVITY**

Pre-requisite: SSH 1013, SSP 1223

Introduces the main ideas and problems in relativity. Concepts used in Einstein's theory and the tests on the General Theory will be described. Upon completion, students should be able to explain the main ideas and problems in relativity. Students should also be able to explain the precession of mercury, the bending of light near a gravitational source, the gravitational red shift and the Schwarzschild solution of the Einstein equation.





### **SSP 3613 QUANTUM MECHANICS**

Pre-requisite: SSH 1013, SSP 1223

Introduces new phenomena leading to quantum mechanics. Basic concepts in quantum mechanics are described and the use of the quantum mechanical approach in solving contemporary quantum mechanical problems is explained. Upon completion, the student must have the ability to explain and discuss new phenomena in quantum mechanics, which makes it different from classical mechanics, describe the basic concepts involved in quantum mechanics and use the quantum mechanical approach to solve quantum mechanical problems.

### **SSP 3622 ELEMENTARY PARTICLES**

Pre-requisite: SSP 2213

Introduces the basic building blocks of nature. The fundamental forces of nature such as the weak and strong forces, the constituent of matter such as hadrons, leptons and quarks are discussed. The basics of the Grand Unification Theory are also described. Upon completion, the students should be able to describe the basic constituents and explain the fundamental forces of interaction between them. The students should also be able to describe and explain the basics of the unification theory.

### **SSP 3623 THERMAL AND STATISTICAL PHYSICS**

Pre-requisite: SSP 1123

Introduces the concepts of statistical mechanics and quantum statistics. The properties of large numbers of particles and the Fermi Dirac, Bose-Einstein and Maxwell-Boltzmann distribution laws are discussed. Upon completion, the student must have the ability solve problems, relating to the properties of large numbers of particles and explain the connection between entropy and the number of accessible quantum states. The students should also be able to relate between the free energy and the partition function and be able to calculate the properties of different systems.

### **SSP 3632 ADVANCED QUANTUM MECHANICS**

Pre-requisite: SSP 3613

Designed to expose the students to new approaches in tackling quantum mechanics problems. Topics include symmetry in quantum mechanics such as symmetry, conservation law, reduction, discrete symmetry parity, space conversion, lattice translation; detailed study of approximation methods such as perturbation theory; Identical particle: permutation symmetry, postulate, many particle system; scattering theory: Lippman-Schwinger equation, Green function, Born approximation, partial wave expansion and phase transition. Upon completion, the student should be able to give quantum mechanics interpretations and able to solve some contemporary quantum mechanical problems. The students should be able to work in a team and adhere to professional ethics.





### **SSP 3633      ASTROPHYSICS**

Pre-requisite: SSP 1223

Introduces the basic understanding of astronomy and physics of the universe. The structure and properties of terrestrial objects and the determination of stellar spectra & interpretation are discussed. The application of astrophysics theory are also discussed and relativistic dynamics is introduced. Upon completion, students should be able to describe the different methods of time measurement, be able to explain important physical properties of stars and planets and be able to interpret simple stellar spectra. Students should also be able to describe and explain the method in detecting gravitational waves.

### **SSP 3642      CONDENSED MATTER PHYSICS**

Pre-requisite: None

Introduces the study of solids at low temperatures. Discussion includes Helium 4, Normal and superfluid He-4; Bose-Einstein gas, Two-fluid model, Entropy and transport properties; London's equation; Excitation, phonon and proton; Helium-3, normal and superfluid He-3; Models of Fenni's fluid and Fennic-Dirac's gas. Emphasis is on thermodynamic and transport properties 1 under normal conditions; Cooper's tandem, phase A and B; Mutual conductivity, Meissner effect, specific heat, energy gap, isotopic effect; Thermodynamic transition, London's equation, coherent length, BCS theoretical frame, superconductor type I and II; Quantum interference; Josephson's tunnelling, quantum interference devices with superconductor. Upon completion, the student should be able to apply the theory and conduct some relevant experiments. The students should be able to work in a team and adhere to professional ethics.



# SINOPSIS KURSUS KIMIA *SYNOPSIS OF CHEMISTRY COURSE*



UNIVERSITI TEKNOLOGI MALAYSIA

Buku Panduan Akademik Fakulti Sains **09/10**  
Academic Guide Book Faculty Of Science **09/10**





### **SSC 1312      LABORATORY MANAGEMENT AND SAFETY**

Pre-requisite: None

Introduces quality management and good laboratory practices (GLP). Topics include the quality system for management, laboratory, environmental and occupational safety and health supported by other legislative requirements such as the Chemist Act 1975, Environmental Quality Act 1974 and Occupational, Safety & Health Act 1994. In addition, the students will be introduced to the good laboratory practices that include the organization and design of chemical laboratories, managing chemicals and equipment, chemical storing, laboratory safety, and emergency response plan. Upon completion, students should be able to rationalize and appreciate the criteria or requirements of quality management system ISO 9001:2000, the competence of testing and calibration laboratories ISO 17025, the environmental management system ISO 140001, and the Occupational Safety and Health System ISO 18000. Students will be exposed to the Laws of Malaysia related to their future career, viz. Chemists Act 1975, Environmental Quality Act 1974, Occupational Safety and Health Act 1994, and other related laws associated with laboratory safety and will have the confidence to manage a chemical laboratory safely and orderly.

### **SSC 1403      PHYSICAL CHEMISTRY I**

Pre-requisite: None

Introduces the principles and problem solving techniques in physical chemistry; properties of gases, thermodynamics, chemical equilibria and chemical potentials, phase equilibria, solution chemistry and equilibrium and electrochemistry. Upon completion, students should be able to develop and apply knowledge in applying these principles and techniques to perform calculations on data acquired from laboratory experiments, perform suitable forms of error analysis and critically evaluate the results obtained.

### **SSC 1603      ORGANIC CHEMISTRY – FUNCTIONAL GROUPS**

Pre-requisite: None

Discusses the fundamental concept of all organic functional groups. These include aliphatic and aromatic hydrocarbon, hydroxyl, organic halogen, ethers, epoxides, carbonyl, carboxyl and amino groups. For each topic, the student will be introduced to the structure, nomenclatures, physical properties, preparation, reactions, reaction mechanism and visual tests. Upon completion, students should be able to develop and apply knowledge to write structures, to identify classes and to name of organic compounds, to differentiate functional groups by simple chemical reactions and be able to carry out synthesis of organic compounds based on functional groups inter-conversions.

### **SSC 1613      ORGANIC CHEMISTRY – BIOMOLECULES**

Pre-requisite: SSC 1603

Introduces the classifications, synthesis and reactions of biomolecules such as carbohydrates, peptides and proteins, lipids and nucleic acids. Emphasis is on the three-dimensional structures and fundamental concepts on stereochemistry. Infrared spectroscopy is included as a technique in characterizing the functional groups of these compounds. Upon completion, the student should be able to develop and apply knowledge to draw the three-dimensional structural configuration of these biomolecules, to explain the roles and reactions of biomolecules and to apply the knowledge of infrared spectroscopy on characterization of functional groups in biomolecules.



### **SSC 1703 INORGANIC CHEMISTRY**

Pre-requisite: None

Introduces the basic concepts of inorganic chemistry, focusing largely on structure, reactivity and periodicity of inorganic substances. A systematic survey of the descriptive inorganic chemistry of the main group elements and some transition metals, including industrial applications and practical uses of important classes of inorganic compounds will be done. Upon completion, students should be able to rationalize the general trends in main group chemistry and the structures, physical properties and reactivities of selected inorganic compounds, describe and explain the preparation of known important inorganic chemicals in the laboratory and industry and to apply knowledge in understanding the concepts relating properties of inorganic materials to their importance to industry and in everyday life.

### **SSC 1831 ORGANIC CHEMISTRY PRACTICAL I**

Pre-requisite: None

Comprises several laboratory experiments related to organic chemistry. Emphasis is on the basic skills of recrystallization, extraction, separation, reflux and distillation. Upon completion, students should be able to assemble and use basic apparatus for experimental organic chemistry and present scientific data in a clear and logical way and produce a scientific report of their work.

### **SSC 1841 PHYSICAL CHEMISTRY PRACTICAL**

Pre-requisite: None

Introduces students to experimental techniques in Physical Chemistry. Emphasis is on the concepts explored in Physical Chemistry lecture; calorimetry, thermochemistry, chemical equilibrium, electrochemistry and gas kinetic theory. Upon completion, students should be able to perform physical chemistry experiments using common techniques and instruments, to measure, analyze and discuss accurate experimental data and manipulate and present scientific data in a clear and logical way and produce a scientific report of their work.

### **SSC 1851 INORGANIC CHEMISTRY PRACTICAL I**

Pre-requisite: None

Comprises laboratory work used to reinforce concepts presented in Inorganic Chemistry lecture, and to relate experimental work to the scientific theory behind the experiment, thus giving a fuller understanding of the theory. The experiments illustrate the characteristic reactions and compounds of the main group elements. The course also provides a basic training in laboratory skills for Inorganic Chemistry. Upon completion, students should be able to make careful observations of chemical reactions and draw conclusions based on chemical principles and manipulate and present scientific data in a clear and logical way and produce a scientific report of their work.



### **SSC 1861 ORGANIC CHEMISTRY PRACTICAL II**

Pre-requisite: None

Introduces students to the syntheses of isomeric esters, N-heterocyclic compound, derivative of glucose, azo dye and the isolation and purification of lipid. Students will be introduced to the infrared spectroscopic techniques as a method of identification for the synthetic and isolated compounds. Upon completion, students should be able to perform organic synthesis and characterize products using infrared spectroscopy.

### **SSC 2203 FUNDAMENTAL ANALYTICAL CHEMISTRY**

Pre-requisite: None

The course introduces to the students the theories and principles of analytical chemistry. A special emphasis will be placed on the principles, procedures and applications of various analytical techniques. The topics discuss include introduction to analytical chemistry, data analysis, gravimetric analysis, volumetric analysis and separation methods such as gas chromatography and liquid chromatography. Upon completion, students should be able to develop and apply knowledge in describing the principles and procedures and application of the analytical technique. Students are expected to be able to apply statistical procedures in data treatment and manipulation.

### **SSC 2213 INSTRUMENTATION IN ANALYTICAL CHEMISTRY**

Pre-requisite: SSC 2203

Introduces the fundamentals and principles and instrumentation of spectroscopic and electrochemical methods used in analytical chemistry. Emphasis is on the ultraviolet-visible, infrared, nuclear magnetic resonance, atomic absorption and emission spectroscopic, mass spectrometric and polarography and voltammetric methods. Upon completion, students should be able to develop and apply knowledge in explaining the basic principles of spectroscopy and electrochemistry, in describing the instrumentation and application of the spectroscopic and electrochemical methods in chemical analysis and in selecting the best analytical method for a given type of sample.

### **SSC 2413 PHYSICAL CHEMISTRY II**

Pre-requisite: SSC 1403

Discusses the fundamental concept and the application of kinetic chemistry and electrochemistry. For kinetics, emphasis is on rates and mechanism of reactions, orders of reactions, rate law, comparison of theory with experiment-simple gas reactions, reactions in solution, complex reactions, homogeneous catalysis, chain reactions and the study of rapid reactions. For electrochemistry, the topics include electrolyte conductivity, theory on conductivity, activity, transport numbers, electrochemical cells, and electrode processes. Upon completion, students should be able to develop and apply knowledge and understanding of kinetics of reactions and electrochemistry, be able to write rate laws, reaction mechanisms, electrode processes and perform calculations involving kinetics and electrochemistry.





### **SSC 2423 INDUSTRIAL CHEMICAL PROCESS**

Pre-requisite: None

Introduces the basic principles involve in an industrial chemical process. Topics include key concepts in mass and energy balance and transfer, separation processes, design of distillation column and absorption tower and chemical transport. The kinetic of reactions, types of reactor design and process control and automation will also be discussed. Upon completion, students should be able to develop and apply knowledge in performing calculations in mass and energy transfer and balance in a chemical process, designing a distillation column and absorption tower, and describing the automation process.

### **SSC 2433 SYMMETRY AND MOLECULAR SPECTROSCOPY**

Pre-requisite: None

Introduces the basics of symmetry in association to molecular spectroscopy. The classification of molecules to their respective point group, and the representation brought upon by their character table, is discussed. The fundamental and principles of selected molecular spectroscopy and the contribution of molecular symmetry to the spectral output and interpretation are described. The selected molecular spectroscopies are rotational, vibrational (IR and Raman), electronic (absorption and emission) and spin resonance (ESR and NMR). Upon completion, students should be able to recognize symmetry elements and operations, classify molecules into their respective point group and be able to describe the underlying principles in selected molecular spectroscopy.

### **SSC 2443 CHEMICAL REACTIONS PROCESSES**

Pre-requisite: SSC 1403

Introduces the basic principles involve in a chemical process. It will examine some key concepts in dimensional analysis, mass and energy balance and transfer, chemical reactors and process control. For reactors, it will also cover the simple reactor design. Upon completion, the students should be able to apply knowledge in describing the process flow and control in a chemical industry and material and energy balance and transfer involve in a chemical process. The students should also be able to design a simple reactor.

### **SSC 2463 QUANTUM CHEMISTRY AND SPECTROSCOPY**

Pre-requisite: SSC 1403

Discusses the underlying principles of quantum mechanics as applied to spectroscopy. The spectroscopy types include microwave, vibrational, electronic, spin resonance, lasers and photoelectron. For each type, transition probabilities, thermal population of states, line widths, quantized energy levels and wavefunctions will be discussed. Upon completion, students should be able to explain the principles of quantum mechanics and to develop and apply the knowledge of quantum mechanics in spectroscopy.



### **SSC 2713 COORDINATION CHEMISTRY**

Pre-requisite: SSC 1703

Introduces the different types of ligands used in coordination chemistry and how their different modes of coordination lead to isomerism. The systematic way of naming metal complexes will also be outlined. The different ideas on bonding in metal complexes will be discussed and this will help students to understand the advantages and limitations of each theory. The substitution mechanistic pathways of metal complexes and its kinetics and how this mechanism is determined experimentally will be illustrated. The significant and important contributions of metal complexes in industries and biological systems will also be covered. Upon completion, students should be able to identify types of ligands and isomerism in coordination chemistry, name simple complexes, describe different bonding theories and their limitations, illustrate the mechanism in substitution reactions, apply spectroscopic techniques in characterization of coordination compounds and rationalize the importance of metal complexes in industry and biological systems

### **SSC 2831 ANALYTICAL CHEMISTRY PRACTICAL I**

Pre-requisite: None

Introduces students to the laboratory work related to classical and instrumental chemical analysis methods. Upon completion, students should be able to perform analytical measurements correctly and manipulate and present scientific data in a clear and logical way and produce a scientific report of their work.

### **SSC 2851 INORGANIC CHEMISTRY PRACTICAL II**

Pre-requisite: None

Introduces students to the proper techniques used in the synthesis and characterization of inorganic compounds. The laboratory experiments will illustrate some of the important features of coordination chemistry and they are related to the contents in Complex Chemistry. Emphasis is on the preparation of inorganic compounds and the methods by which they are identified and characterized. Compounds will be prepared and information obtained from a number of physical methods including IR spectroscopy, NMR spectroscopy and UV-visible spectroscopy. Upon completion, students should be able to assemble and use basic apparatus for experimental inorganic chemistry, analyze compounds using a number of physical method and write a clear and concise account of the experimental work undertaken and the deductions made from it.

### **SSC 2871 ANALYTICAL CHEMISTRY PRACTICAL II**

Pre-requisite: SSC 2203, SSC 2213, SSC 2831

Introduces students to the laboratory work related to chemical analysis using spectroscopic and electrochemical method. Upon completion, students should be able to perform analytical measurements correctly and manipulate and present scientific data in a clear and logical way and produce a scientific report of their work.



### **SSC 3223 ENVIRONMENTAL CHEMISTRY**

Pre-requisite: None

This course introduces the chemistry of the environment. Topics include ecology; biogeochemistry; bacteria; aquatic chemistry; characteristic of biological and chemical properties of water quality; water quality monitoring; water treatment; drinking water; sewer treatment; industrial effluent treatment system; atmospheric chemistry; meteorology; topography; air pollution control (particulate material, NO<sub>x</sub>, SO<sub>x</sub>, CO<sub>x</sub>, fog) and photochemistry. Current issues in legislation, Environmental Quality Act, solid waste management, toxic waste management and introduction to ISO 14000 series and the EIA will also be discussed. Upon completion, students should be able to explain and apply the fundamental concepts and techniques in environmental chemistry and evaluate the environmental problems and rationalize the impact of chemistry on the environment and its role in protecting the environment.

### **SSC 3243 SEPARATION METHODS**

Pre-requisite: None

The basic principles and instrumentation of separation methods in chemistry. The major separation methods used in chemical analysis, including extraction, chromatography and electrophoresis, will be discussed. Upon completion, students should be able to develop and apply knowledge in explaining the concepts and principles of separation methods, to select and perform separation methods according to needs and requirements

### **SSC 3253 FOOD ANALYSIS**

Pre-requisite: None

Designed to provide students with an understanding of the principles and procedures for the analysis of food and food-related products. It is divided into two broad parts. The first part includes discussions on the principles of key analytical techniques such as proximate analysis, classical techniques, and relevant modern instrumental techniques; whilst the second part discusses specific techniques for the analysis of particular groups of foods or components of foods. Sample preparation and data reporting is also included. Modern instrumental techniques such as spectroscopy, and separation techniques such as electrophoresis and chromatography, which are important in food analysis, are given due attention. Upon completion, students should be able to develop and apply knowledge in the instrumental analysis of food content and quality, be able to use various analytical methods in solving problems related to the determination of specific components in foods and be able to choose and use the most suitable analytical methods for specific types and components of food samples

### **SSC 3263 THERMAL ANALYSIS**

Pre-requisite: None

The principles and application of the main thermal analysis methods namely thermogravimetry (TG), differential thermal analysis (DTA), differential scanning calorimetry (DSC) and thermomechanical analysis (TMA) are introduced. Topics include instrumental systems and the various factors affecting the thermal analysis measurements. Upon completion, students should be able to interpret thermograms and apply the knowledge to the application of various thermal methods in chemical analysis.



### **SSC 3273 FORENSIC SCIENCE**

Pre-requisite: SSC 2203

This course introduces students to the basics of forensic science. Emphasis is on the examination and chemical analyses of trace evidence such as paints, glass, hair, fibers, ink, fire debris and contact evidence such as fingerprint, shopprint, tyreprint, toolmarks and other impression evidence. Detection and analyses of body fluids such as blood, saliva, semen and DNA will also be introduced. The role of forensic scientist in the laboratory as well as in court as an expert witness is also highlighted. Upon completion, students should be able to describe techniques used for forensic analyses of exhibits, to recognize appropriate samples collected at crime scene and to rationalize the legal and ethical aspects of forensic science.

### **SSC 3293 RADIOANALYTICAL CHEMISTRY**

Pre-requisite: SSC 1703, SSC 2203

This course introduces the students to the use of radiochemistry as a technique in analytical chemistry. Topics include the principles of radioactivity and sources of radioactive materials. The underlying criteria in the selection of radiotracers in experimental work will be highlighted. Several radioanalytical techniques in chemical analyses will be examined and discussed. Upon completion, students should be able to apply knowledge and understanding in describing the principles, experimental setup and the application of several techniques in radioanalytical chemistry.

### **SSC 3333 MACROMOLECULES CHEMISTRY**

Pre-requisite: SSC 1603, SSC 1703

This subject comprises of two parts, i.e. inorganic polymers and biopolymers. The objectives are to provide a thorough introduction to the fundamental chemistry of inorganic and organometallic polymers, as well as proteins and nucleic acids, to introduce fundamental concepts of inorganic polymers and bioinorganic polymers, to demonstrate the application of some inorganic polymers, and chemical reasoning to biological problems and the interdependency of chemical and biological thinking that lies at the heart of Biological Chemistry. Upon completion, students should be able to describe the role of chemistry in the preparation, reactivity, properties and processing of biomaterial and inorganic polymers

### **SSC 3353 CONSUMER CHEMISTRY**

Pre-requisite: None

Introduces students to the various consumer products that are chemical based or in need of chemical formulations. These products include foods, cosmetics, household products, pharmaceuticals and chemicals related to agriculture. Legislation and current concerns and issues will also be examined. Upon completion, students should be able to identify chemical formulations and functions of chemical components, formulate new products or make modifications on chemical based consumer products. Students should be able to develop and apply knowledge in understanding the importance of using safe chemicals for consumer products.



### **SSC 3473 SOLID STATE CHEMISTRY**

Pre-requisite: None

Introduces students to the fundamentals of solid state chemistry, emphasizing on structure, classifications, applications and synthesis. Topics include the characterization techniques of solid materials such as x-ray diffraction, electron microscopy and nuclear magnetic resonance. Physical properties including conductivity, magnetic and optical properties will also be covered. Upon completion, students should be able to develop and apply to describe different crystal system, packing and bonding, to identify and select characterization methods for solid materials and to explain structure-properties relationship of solids with regards to magnetic, optic and conductivity.

### **SSC 3483 CORROSION CHEMISTRY**

Pre-requisite: None

Introduces to the students the concept of corrosion. These include definition and importance of corrosion, the driving force for corrosion reactions, the rates of electrochemical reactions, rates of electrochemical corrosion reactions, characteristic forms of electrochemical corrosion, prevention and control of electrochemical corrosion and high temperature corrosion/oxidation and its control. Upon completion, students should be able to develop and apply knowledge to describe the electrochemical corrosion processes and its prevention. Students should also be able to rationalize the importance of corrosion effect in industrial application and our lives.

### **SSC 3493 SURFACE AND COLLOID CHEMISTRY**

Pre-requisite: None

Comprises two components, namely, surface chemistry and colloid chemistry. Students are introduced to the fundamental concept of all type of surfaces and interfaces, to understand the surface phenomenon such as physical and chemisorption process, classification of adsorption isotherm, capillary, wetting and spreading. For colloid chemistry, the course will discuss the classification of colloid, colloidal phenomena and colloidal stability. Upon completion, students should be able to develop and apply knowledge in describing several absorption models and the difference between physisorption and chemisorption and properties and stability of colloidal system.

### **SSC 3533 APPLICATION OF COMPUTERS IN CHEMISTRY**

Pre-requisite: None

This course introduces the principles of computational methods in chemistry problems. Emphasis is on the optimization and experimental design, handling of chemical structure information, molecular modeling, pattern recognition, and artificial intelligence. Upon completion, students should be able to develop and apply knowledge to interpret information obtained from computer analysis.

### **SSC 3543 MODELING AND COMPUTER SIMULATION IN CHEMISTRY**

Pre-requisite: None

Introduces to the students to the principles of modeling that includes coordinate system, potential energy surface and graphics. Topics include both the quantum mechanical as well as the molecular mechanical methods. The Monte Carlo simulation technique, QSAR and applications of modeling in molecular design are also covered. Upon completion, students should be able to develop and apply knowledge in modeling and computer simulation to solve chemistry problems.





### **SSC 3623 POLYMER CHEMISTRY**

Pre-requisite: None

Introduces the fundamental concepts in polymer chemistry. Key issues in structure, preparative methods of synthetic polymer, reaction mechanism and kinetics of polymerization will be examined. Also discussed is the characterization of polymers. Upon completion, the students should be able to develop and apply knowledge in naming and classifying of polymers, to write reaction scheme in the synthesis of polymers and apply the theory related to the mechanistics and kinetics of polymerization.

### **SSC 3643 APPLICATIONS OF SPECTROSCOPY**

Pre-requisite: None

Designed to expose the students to the various spectroscopic techniques for the characterization of organic compounds. Emphasis is on the basic theory and application of infrared, nuclear magnetic resonance, ultraviolet-visible and mass spectroscopic methods. Students will be trained to use a combination of all the methods in structural identification. Upon completion, the students should be able to demonstrate understanding in analyzing and interpreting spectra.

### **SSC 3653 ORGANIC SYNTHESIS**

Pre-requisite: SSC 1603

Discusses the inter-conversion of various functional groups and the formation of C-C bonds by using several reagents and reactions. Students will be introduced to the use of protective groups in the synthetic methodology. The retrosynthesis approach in organic synthetic will also be elaborated. Upon completion, the students should be able to plan synthetic strategy and pathway using both functional group inter-conversion and retrosynthesis methods.

### **SSC 3663 NATURAL PRODUCT CHEMISTRY**

Pre-requisite: None

Introduces students to the fundamental concepts of secondary metabolites such as terpenes, alkaloids, steroids and flavonoids. The reactions associated with these compounds will be examined. Also discussed is the biosynthetic pathway of natural products found in plants. The occurrences, classifications, structural confirmations, reactions and synthesis associated with these compounds will be further examined. Upon completion, students should be able to apply and demonstrate understanding of knowledge by outlining biosynthetic pathway of natural products, to recognize classes of terpenes, alkaloids and flavonoids, and to describe the reactions involving terpenes, alkaloids, steroids and flavonoid.

### **SSC 3673 INDUSTRIAL ORGANIC CHEMICALS**

Pre-requisite: None

Introduces the organic chemicals used in industries. The scope includes the organic chemicals used in industries, especially foods, pharmaceuticals, cosmetics and agro-based industries. The aspects of preparation or synthesis and analysis of some selected chemicals will be discussed. Industrial chemicals such as flavours and fragrances; vitamins; antioxidants; dyes & colouring materials; common drugs including antibiotics, anti-inflammatory, antipyretic, anticancer, antihypertensive and antidepressant etc.; soaps and detergents; insecticides; fungicides; pesticides will be covered. Basic knowledge and uses of phytochemicals from herbs and spices will be introduced. Upon completion, students should be able to recognize and classify the industrial organic chemical and to synthesize several industrial organic chemicals.





### **SSC 3683 BIOTECHNOLOGY**

Pre-requisite: SSC 1603

Introduces students to the fundamental concepts of microbiology relating to classifications of microorganisms, prokaryote and eukaryote. Topics include the industrial aspects of biotechnology such as the production of antibiotics, enzymes and amino acids. Bioremediation and bioleaching processes and other aspect of environmental biotechnology will also be examined. Upon completion, students should be able to demonstrate understanding and apply knowledge in describing the different classifications of microorganisms, industrial methods in the productions of antibiotics, enzymes and amino acids. The students should be able to apply knowledge gained in solving environmental problems.

### **SSC 3723 ORGANOMETALLIC CHEMISTRY**

Pre-requisite: None

The course teaches the chemistry of Organometallic Compounds. It includes the definition and classification of the compounds, 18-electron rule and its limitations, types of bonding and methods of preparation followed by characterization of organometallic compounds. The discussion continues with the types of reactions and application of organometallic compounds as catalysts and others; metal-carbonyl complexes: synthesis, structure, reactions and applications; clusters compounds and their structure and isolobal relationship; the bioinorganic compound: coenzym B12, and nitrogen fixation.

### **SSC 3743 MATERIALS CHEMISTRY**

Pre-requisite: SSC 1403

Introduces students to the various types of inorganic materials such as metallic hard materials (e.g. carbides, nitrides, borides, oxides, silicides), ceramics, and construction materials (e.g. lime, cement, and gypsum), silicate products (e.g. glass, zeolite). Their interactions, processing and characterization of selected inorganic materials will be discussed. Their applications and uses in various industries and daily activities will also be described. Upon completion, students should be able to develop and apply knowledge on the classification of materials and describe relationship between structure and properties of material with regards to their applications.

### **SSC 3753 CATALYTIC CHEMISTRY**

Pre-requisite: None

Introduces students to the role of catalysts in chemical and biological processes. The principles of catalysis; kinetics and reaction mechanism of catalyzed reactions and structural aspects of the catalysts will be highlighted. Emphasis is on the factors that influences catalyst reactivity in both homogenous and heterogenous catalysis. Different methods of preparation and characterization of catalytic material and the underlying principles with regards to industrial applications of catalysts will be described. Upon completion, students should be able to develop and apply knowledge in explaining the principles of catalysis in industrial processes, identify methods of preparing and characterizing catalysts such as supported metal catalyst, zeolites and metal oxides.



**SSU 3922 FINAL YEAR PROJECT I** •

Pre-requisite: None

The students will have the opportunity to conduct continuous scientific research activity in a chosen topic under a guidance of an academic staff. Students will be exposed and guided on how to do literature review and perform information retrieval as well as writing proposal. Upon completion, students should be able to write sound research proposal.

**SSU 3924 FINAL YEAR PROJECT II** •

Pre-requisite: SSU 3922

An extension of SSU 3922. Students will be presenting their project report in the form a seminar and thesis. Upon completion, students should be able to write research report in a clear and logical way as well as demonstrating good presentation skills.



**SINOPSIS KURSUS MATEMATIK**  
***SYNOPSIS OF MATHEMATICS***  
***COURSE***



**UNIVERSITI TEKNOLOGI MALAYSIA**

**Buku Panduan Akademik Fakulti Sains 09/10**  
**Academic Guide Book Faculty Of Science 09/10**





## **Sinopsis Kursus Program Ijazah Sarjana Muda Sains (Matematik)** **Synopsis of Bachelor of Science (Mathematics)**

### **SSH 1013 INTERMEDIATE MATHEMATICS**

Pre-requisite : None

This course serves as a prerequisite for more advanced subjects. Topics covered include parametric equations, functions, polar coordinates, vectors, complex numbers, and elementary logic. Students will learn how to define functions, and plot the graphs, using the Cartesian as well as polar coordinates, solve problems involving complex numbers and vectors, and basic logic theory.

### **SSH 1113 STATISTICS I**

Pre-requisite : None

The course is an introductory subject in statistics covering descriptive and inferential statistics. Basic definitions, statistical principles and the theory of probability, which bridge concepts and techniques, are included in descriptive statistics. Inferential statistics covers estimation procedures and hypothesis testing, the latter using the method of analysis of variance when more than two means are involved. Students will be trained in the use of computer software such as Microsoft Excel and SPSS.

### **SSH 1123 STATISTICS II**

Pre-requisite : SSH 1113

The course is about mathematical statistics course which covers set theory and probability, univariate and bivariate random variables, transformation of variables, mathematical expectation for univariate and bivariate random variables, Chebychev's Inequality, moment generating function for univariate and bivariate variables, order statistics, limiting distribution.

### **SSH 1313 COMPUTER PROGRAMMING**

Pre-requisite : None

This is the first course in computer programming. Topics include flowcharts, algorithms, basic syntax in C, process of compiling, pre-processing components, operators, loops, branches, data/variable types, strings, arrays, functions, pointer and structure.

### **SSH 1523 LINEAR ALGEBRA**

Pre-requisite : None

The course begin with the study of matrices and determinant. Starting with simple matrix operations, elementary row operation and inverses, and determinants of matrices. Solve the linear system using matrix inverse, Cramer's rule, Gauss and Gauss Jordan elimination method. Next, the focus is on the vector spaces, linear independence, spanning sets, bases, the rank of a matrix, orthogonal bases, and the Gram-Schmidt process. There follows a discussion of linear transformations and matrices, as well as the kernel and range. Finally, find the eigenvalues and eigenvectors and use them in diagonalization problem.



### **SSH 1713      CALCULUS I**

Pre-requisite : None

This course covers four main topics namely limits and continuity, differentiation techniques and its applications, integration techniques including improper integrals, and infinite sequences and series. The techniques of differentiation and integration concern with functions not included in the Matriculation programme. The part on infinite series includes power series and tests for convergence and divergence of series. Upon completion, the students would have acquired certain powerful tools of analysis.

### **SSH 1743      DIFFERENTIAL EQUATIONS**

Pre-requisite : SSH 1713

This is an introductory course on differential equations. Topics include first order ordinary differential equations (ODEs), linear second order ODEs with constant coefficients, the Laplace transform and its inverse, Fourier Series, and partial differential equations (PDEs). Students will learn how to classify and solve first order ODEs, use the techniques of undetermined coefficients, variation of parameters and the Laplace transform to solve ODEs with specified initial and boundary conditions, and use the technique of separation of variables and Fourier Series method to solve linear second order PDEs.

### **SSH 1783      CALCULUS II**

Pre-requisite : SSH 1713

A continuation of SSH 1713 and introduces calculus of several variables. Topics covered are functions of several variables, partial differentiation and multiple integration. Students learn to determine the domain and range, techniques of graph sketching, and limit & continuity, find (partial) derivatives and evaluate (double and triple) integrals, pertaining to a function of two and three variables. The use of cylindrical and spherical coordinates is also highlighted. Applications include finding the volume, mass, centre of gravity, and moment of inertia of a solid.

### **SSH 2113      STATISTICAL QUALITY CONTROL**

Pre-requisite : SSH 1113

This subject contains two parts that is Statistical Quality Control and Acceptance Sampling. The first part consists of 7 tools of quality control, variables and attributes control charts and process capability analysis. The Acceptance sampling part consists of single and double sampling plans and standard sampling MIL-Std 105D.

### **SSH 2123      DESIGN OF EXPERIMENTS**

Pre-requisite : SSH1113

Methods of designing experiments are intended for undergraduates with good algebra and have been introduced to basic statistics. Emphasize working with data and the understanding of the different methods of designing and analyzing of the data. Students will also undergo training in using data analysis packages, including, but not limited to, the SPSS and Microsoft Excel.





### **SSH 2143 INFERENTIAL STATISTICS**

Pre-requisite: SSH 1123

This course introduces the theory of inferential statistics. It is concerned with the frequentist approach to inference and covers point and interval estimation of parameters and hypothesis testing. Upon completion, the students should possess the ability to identify the properties of estimator and estimate their values, as well as to conduct hypothesis testing using appropriate tests.

### **SSH 2433 NUMERICAL ANALYSIS 1**

Pre-requisite : SSH 1713

This course discusses problem using numerical methods that involve non-linear equations, linear system, interpolation and curve fitting, numerical differentiation and integration, eigenvalue problem, ordinary differential equation and partial differential equation.

### **SSH 2523 MODERN ALGEBRA**

Pre-requisite : SSH 1523

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. The second part is a selected topic of Sylow Theorems and their applications.

### **SSH 2553 SET THEORY AND LOGIC**

Pre-requisite : None

Representation of sets and objects in a set. List (enumeration) and set construction method. Properties: membership, subsets, equality of sets, proper subsets and empty set. Elementary operations on sets: Intersection and union, universal set and complement of a set. Power set, subsets of the real numbers and intervals. Sentences and statements.

### **SSH 2623 REAL ANALYSIS**

Pre-requisite : None

A formal study of real numbers, subsets of the real line, functions, sequences and series. Functions of a single variable are studied with regards to types, limits, continuity, differentiability and integrability. Students learn to formulate and rigorously prove theorems on analysis using various kind of methods such as contradiction, induction, contrapositive etc. Prior knowledge of simple logic of truth is helpful for quick understanding but not essential.

### **SSH 2663 NUMBER THEORY**

Pre-requisite : None

This is an appreciation course in the subject, focusing on the basic topics which are within the grasp of students possessing sufficiently high maturity in mathematical reasoning. Topics include Properties of common divisor and Euclidean algorithms, primes and unique factorization theorem. Congruence, computation of mod inverses, solving congruence equations, Fermat's little theorem and Euler's theorem. Sum of squares. Counting results using the Mobius Inversion Formula, Pythagorean Triples and Quadratic Reciprocity. Although no sophisticated techniques are used, the students should appreciate the beauty and elegance of tools used in the subjects.





### **SSH 2673 DISCRETE MATHEMATICS**

Pre-requisite : SSH 1743

This course introduces the applications of discrete mathematics in the field of computer science. It covers sets, logic, proving techniques, combinatorics, functions, relations, graph theory and algebraic structures. These basic concepts of sets, logic functions and graph theory are applied to boolean algebra and logic networks while the advanced are applied to finite state machines coding theory.

### **SSH 2733 VECTOR ANALYSIS**

Pre-requisite : SSH 1783

Introduces calculus of vectors and comprises two major topics, namely vector differentiation and vector integration. Topics covered include vector-valued functions, vector differentiation, gradient, divergence & curl; applications to differential curves include unit tangent, normal & bi-normal vectors, curvature, torsion directional derivative and rate of change; applications to surfaces include normal vector. The part of vector integration covers line integral and surface integral, including Green's theorem, Gauss' theorem and Stokes' theorem. The approach will be rigorous, the emphasis is on developing an understanding of the concepts and tools as well as developing manipulative skills.

### **SSH 2743 PARTIAL DIFFERENTIAL EQUATIONS**

Pre-requisite : SSH 1743, SSH 1783

Linear and non-linear first order equations, Classification of linear second order equations, Wave, heat and Laplace equations in one, two and three-dimensional spaces. Selected non-homogeneous equations.

### **SSH 2753 COMPLEX VARIABLES**

Pre-requisite : SSH 1743

This course introduces calculus of functions of a single complex variable. Topics covered include the algebra and geometry of complex numbers, complex differentiation, complex integration, complex series including Taylor and Laurent series, the theory of residues with applications to the evaluation of complex and real integrals, and conformal mapping with applications in solving boundary value problems of science and engineering.

### **SSH 3123 MULTIVARIATE STATISTICAL ANALYSIS**

Pre-requisite : SSH 1123, SSH 1523

Presents major views and theories in multivariate statistical analysis. A main tool for the purpose in matrix algebra. Emphasis is on normal distribution, inferences about a mean vector, principal components, factor analysis and inference for structured covariance matrices and canonical correlation analysis. Students will embark on a small-scale project investigating multivariate data. It is expected that the students will gain skills dealing with multivariate data using the techniques taught.



### **SSH 3143      DECISION THEORY**

Pre-requisite : SSH 1113, SSH 1123

Introduces the basic problems and techniques of decision making and comprises two major parts. The first part covers basic principles and approaches in decision making. The second part explores the methods and applications of information that are used in making an optimal decision. Differences between the classical frequencies approach and Bayesian approach in making decision, identify prior distributions and likelihood functions, and combine these two entities to obtain posterior distributions, which will then be combined with loss function to obtain Bayesian estimators. Concepts of conjugate distributions, important definitions in decision theory, proving admissibility and inadmissibility of a decision, process of making an optimal decision, utility and reward, and sensitivity analysis related to an optimal decision. Analysis of subjective probabilities.

### **SSH 3163      STOCHASTIC PROCESSES**

Pre-requisite : SSH 1123

This course begins with a review of the basic probability theory and proceeds to discussing major stochastic processes, including Markov chains and continuous Markov chains, Poisson processes, 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.

### **SSH 3213      GENERALIZED LINEAR MODEL**

Pre-requisite : SSH 1123

This subject consists of two parts that is the theory of generalized linear model and the application of generalized linear model in regression model, one-factor analysis of variance and two-factor analysis of variance. SPSS statistical package is used to apply generalized linear model to the above models.

### **SSH 3243      SAMPLING TECHNIQUES**

Pre-requisite : None

This course introduces sampling methods used in sample surveys. The students are given a comprehensive account of sampling theory for use in sample surveys and include illustrations of how the theory is applied in practice. A prerequisite is familiarity with algebra, knowledge of probability for finite sample spaces and basic statistics. Topics include simple random sampling, sampling proportion and percentages, estimation of sample sizes, stratified random sampling, ratio estimators, systematic sampling, and cluster sampling.



### **SSH 3383 DISCRETE-EVENT SIMULATIONS**

Pre-requisite : None

Concepts of simulation, event, discrete-event, continuous event, system model and its types. Random, number generation. Stochastic processes. Computer implementation. Probability and Statistical tools: discrete/continuous distributions, Poisson process. Birth death processes. Queuing models: Markovian single and multiple servers, arrival, service and laws of conservation. Steady-state behaviour of finite population. Loss system with blocking, Erlang's B and C equations. Little's equation. Simulation model building, verification and validation. Data collection, parameter estimation, goodness-of-fit tests, multivariate and time-series input models. Measures of performances using point and interval estimation. Output analysis using confidence-interval estimation. Case studies on traffic system, material handling and network analysis.

### **SSH 3453 APPLIED NUMERICAL METHODS**

Pre-requisite : SSH 2433, SSH 1743

This course discusses the applications of the methods discussed in SSH 2413 (Computational numerical methods) in sciences, engineering, etc. Discussions include governing the mathematical model, solving the problem using suitable numerical methods and the explanation of solutions obtained.

### **SSH 3463 NUMERICAL ANALYSIS II**

Pre-requisite : SSH 2433

This course discuss problem using numerical methods that involve systems of nonlinear equations, ordinary differential equation (initial and boundary value problems) and partial differential equation.

### **SSH 3513 FIELDS AND RINGS THEORY**

Pre-requisite : None

Introduces the concepts of rings and fields. Topics include ring, integral domain, homomorphism, quotient ring, field, vector space, extension field and algebraic extension. Emphasis is given to both the subject matter and the structure of proofs.

### **SSH 3613 DIFFERENTIAL GEOMETRY**

Pre-requisite : SSH 1523, SSH 1743

Primarily introduces the principles of differential geometry. Curves and surfaces are studied using the tools of calculus. Topics include manifolds and geometric methods of mathematical physics.

### **SSH 3623 NON-EUCLIDEAN GEOMETRY**

Pre-requisite :None

This course is a survey of main concepts of Euclidean geometry with the emphasis on the axiomatic approach, constructions and logic of proof including historical aspects. A study of axioms of Euclidean geometry, inference rule, some basic theorems of Euclidean geometry and rigorous proofs will be offered. Non-Euclidean geometry is introduced. The similarities and differences between Euclidean and non-Euclidean geometries will be discussed.



### **SSH 3633 FUZZY SET THEORY**

Pre-requisite : SSH 2623, SSH 2523

The course starts with brief discussion on an overview of crisp sets. It then follows with basic definition and important terminologies which include - cut, Extension Principle, and operation on Fuzzy sets. Fuzzy Arithmetic on Fuzzy Numbers including Operations on Intervals and Fuzzy Numbers, Lattice of Fuzzy Numbers are also thoroughly highlighted. Fuzzy Relations and Fuzzy Graphs are also discussed. Lastly we deal with Fuzzy Analysis and Uncertainty Modelling. In General, the course provides on the general concepts of Fuzzy sets and its operations. The emphasis is also given for its applications in Uncertainty Modelling.

### **SSH 3653 APPLIED ABSTRACT ALGEBRA**

Pre-requisite : None

Introduces some basic applications of abstract algebra. Topics include applications of modern algebra in symbolic computations, finite fields, error correcting codes and basic elements of cryptology. Computer packages such as Maple will be used.

### **SSH 3673 FUNCTIONAL ANALYSIS**

Pre-requisite : SSH 2623

Metric spaces: open set, closed set, neighbourhood, convergence, Cauchy sequences, completeness. Normed spaces: 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. Banach Fixed Point Theorem: contraction mapping and Banach Fixed Point Theorem, error bound in iteration applications to linear equations, application to differential equations, application to integral equations.

### **SSH 3683 TOPOLOGY**

Pre-requisite : SSH 2623, SSH 3673

This course is an introduction to the basic concepts of modern topology: metric spaces, topological spaces connectedness, compactness, completeness, quotient spaces, manifolds, and classification of surfaces. While the course will emphasize the geometric aspects of topology, some applications to analysis will also be discussed. The material is very conceptual in nature, therefore it is all about proving abstract theorems, applying those theorems to examples, and finding counterexamples to false statements.

### **SSH 3753 FLUID MECHANICS**

Pre-requisite : SSH 1743, SSH 2733

Comprises two parts. The first part is concerned with fluid kinematics while the second part deals with the derivation and the solution of the equations of motion for inviscid and viscous fluids. Students learn to apply mathematical techniques to solve fluid flow problems.



### **SSH 3763 COMPUTATIONAL FLUID DYNAMICS**

Pre-requisite : SSH 3753, SSH 1313, SSH 2433

This subject discusses some numerical techniques of solving fluid flow problems, specifically those involving the Euler, potential and Navier-Stokes equations. The basic philosophy and ideas of computational fluid dynamics (CFD) are discussed. Emphasis is given on the formulation and derivation of appropriate equations together with their boundary conditions. The finite difference discretization is adopted, and the numerical computation and simulation will be carried out using available software or a programming language.

### **SSH 3783 QUANTUM MECHANICS**

Pre-requisite : SSH 1523, SSH 1743

This course introduces the basic of quantum mechanics. It cover the topic of the failure of classical mechanics and steps towards wave mechanics and Schrodinger equation. The concepts and formalism of quantum mechanics are applied to one dimensional problems, angular momentum, the hydrogen atom and electron spin and total angular momentum.

### **SSH 3793 CALCULUS OF VARIATIONS**

Pre-requisite : SSH 1713, SSH 1783

This course discusses mainly the extremals of functionals. Beginning with a review of similar concepts in functions of many variables, the concepts of functional and variational problems are introduced. Topics include analytically methods of solution (extremals of functionals) analytically and selected numerical methods. Upon completion, the students should be able to recognize functionals and variational problems, the necessary conditions for an extremum, the sufficient conditions for a weak and strong extremum, the sufficient conditons for a weak and strong extremum, have general idea of what calculus of variation is and know how to use the direct methods for finding the extremal of a functional.

### **SSH 3813 OPTIMAL CONTROL**

Pre-requisite : None

This course introduces the optimal control theory. The discussion includes definitions and classification of system control types. Topics include optimal control problems such as necessary and sufficient conditions using calculus of variation. Upon completion, students should exhibit understanding of the basic concepts and principles of mathematical control systems. The students should also be able to formulate state space equation, determine system characteristics and solve basic optimal control problem using variational approach and dynamic programming.

### **SSH 3843 OPTIMIZATION METHODS**

Pre-requisite: SSH 2733

Comprises two parts. The first part covers topics on unconstrained optimisation such as one-dimensional and n-dimensional search methods, interpolation method and gradient methods. The second part covers topics on constrained optimisation such as the Kuhn Tucker method, modified Hooke and Jeeves search method, complex method, penalty function methods, and the Sequential Unconstrained Minimization Technique (SUMT).





### **SSH 3713 MATHEMATICAL MODELLING**

Pre-requisite : None

Introduces the basic principles of mathematical modelling. Emphasis is on some underlying general concepts related to mathematical modelling and differential equations. These include topics in first and second-order differential equations, mathematical models and numerical methods, systems of differential equations, nonlinear systems and phenomena, eigen-values and boundary value problems. Upon completion, students should exhibit the ability to analyze resulting models by making use of both classical and numerical mathematical techniques and the essential knowledge and basic skills of mathematical modelling in describing, comprehending and predicting the behaviour of various physical, biological, mechanical processes and as well as other relevant dynamical systems

Sinopsis Kursus Program Ijazah Sarjana Muda  
Sains (Matematik Industri)  
Synopsis of Bachelor of Science (Industrial Mathematics)

### **SSH 1013 INTERMEDIATE MATHEMATICS**

Pre-requisite : None

This course serves as a prerequisite for more advanced subjects. Topics covered include parametric equations, functions, polar coordinates, vectors, complex numbers, and elementary logic. Students will learn how to define functions, and plot the graphs, using the Cartesian as well as polar coordinates, solve problems involving complex numbers and vectors, and basic theory.

### **SSH 1113 STATISTICS I**

Pre-requisite : None

The course is an introductory subject in statistics, covering descriptive and inferential statistics. Basic definitions, statistical principles and the theory of probability, which bridge concepts and techniques, are included in descriptive statistics. Inferential statistics covers estimation procedures and hypothesis testing, the latter using the method of analysis of variance when more than two means are involved. Students will be trained in the use of computer software such as Microsoft Excel and SPSS.

### **SSH 1123 STATISTICS II**

Pre-requisite : SSH 1113

This course is about mathematical statistics which covers set theory and probability, univariate and bivariate random variables, transformation of variables, mathematical expectation for univariate and bivariate variables, order statistics, limiting distribution.

### **SSH 1313 COMPUTER PROGRAMMING**

Pre-requisite : None

This is the first course in computer programming. Topics include flowcharts, algorithms, basic syntax in C, process of compiling, pre-processing components, operators, loops, branches, data/variable types, strings, arrays, functions, pointer and structure.





### **SSH 1523 LINEAR ALGEBRA**

Pre-requisite : None

The course begins with the study of matrices and determinant. Starting with simple matrix operations, elementary row operation and inverses, and determinants of matrices. Solve the linear system using matrix inverse, Cramer's rule, Gauss and GaussJordan elimination method. Next, the focus is on the vector spaces, linear independence, spanning sets, bases, the rank of a matrix, orthogonal bases, and the Gram-Schmidt process. There follows a discussion of linear transformations and matrices, as well as the kernel and range. Finally, find the eigenvalues and eigenvectors and use them in diagonalization problem.

### **SSH 1713 CALCULUS I**

Pre-requisite : None

This course covers four main topics namely limits and continuity, differentiation techniques and its applications, integration techniques including improper integrals, and infinite sequences and series. The techniques of differentiation and integration concern with functions not covered in the Matriculation programme. The part on infinite series includes power series and tests for convergence and divergence of series. Upon completion, the students would have acquired certain powerful tools of analysis.

### **SSH 1743 DIFFERENTIAL EQUATION**

Pre-requisite : SSH 1713

This is an introductory course on differential equations. Topics include first order ordinary differential equations (ODE), linear second order ODEs with constant coefficients, the Laplace transform and its inverse, Fourier series, and partial differential equations (PDEs). Students will learn how to classify and solve first order ODEs, use the techniques of undetermined coefficients, variation of parameters and the Laplace transform to solve ODEs with specified initial and boundary conditions, and use the technique of separation of variables to solve linear second order PDEs.

### **SSH 1783 CALCULUS II**

Pre-requisite : SSH 1713

A continuation of SSH 1713 and introduces calculus of several variables. Topics covered are functions of several variables, partial differentiation and multiple integration. Students learn to determine the domain and range, techniques of graph sketching, and limit & continuity, find (partial) derivatives and evaluate (double and triple) integrals, pertaining to a function of two and three variables. The use of cylindrical and spherical coordinates is also highlighted. Applications include finding the volume, mass, centre of gravity, and moment of inertia of a solid.

### **SSH 2113 STATISTICAL QUALITY CONTROL**

Pre-requisite : SSH 1113

This subject contains two parts that is Statistical Quality Control and Acceptance Sampling. The First part consists of 7 tools of quality control, variables and attributes control charts and process capability analysis. The Acceptance Sampling part consists of single and double sampling plans and standard sampling MIL-Std 105D.



### **SSH 2123 DESIGN OF EXPERIMENTS**

Pre-requisite : SSH 1113

Methods of designing experiments are intended for undergraduates with good algebra and have been introduced to basic statistics. Emphasize working with data and the understanding of the different methods of designing and analyzing of the data. Students will also undergo training in using data analysis packages, including, but not limited to, the SPSS and Microsoft Excel.

### **SSH 2143 INFERENTIAL STATISTICS**

Pre-requisite : SSH 1123

This course introduces the theory of inferential statistics. It is concerned with the frequentist approach to inference and covers point and interval estimation of parameters and hypothesis testing. Upon completion, the students should possess the ability to identify the properties of estimator and estimate their values, as well as to conduct hypothesis testing using appropriate tests.

### **SSH 2353 C++ NUMERICAL PROGRAMMING**

Pre-requisite : SSH 1313

Software structures, concepts, and conventions that support C++ object-oriented programming. Identification of class structure, problem partitioning, and abstraction. Components of object-oriented language to algorithmic program design: objects, methods and events. Program control, abstraction of data, variable types, arrays, functions and pointers. Scientific problem modelling and simulation, and graphical-user interface design for data visualization. Case studies and software design for data visualization. Case studies and software development projects on selected problems in numerical methods, graph theory and discrete-event simulations.

### **SSH 2413 COMPUTATIONAL NUMERICAL METHOD**

Pre-requisite : SSH 1743

This subject discuss problem solving using numerical methods that involve non-linear equation, linear system, interpolation, numerical differentiation and integration, Eigenvalues problems, ordinary differential equation and partial differential equation. Discussions include development of algorithm for each method and solution using computer, (emphasize on the application of Maple, MatLab, Mathematica, Fortran, C++, etc.

### **SSH 2623 REAL ANALYSIS**

Pre-requisite : None

A formal study of real numbers, subsets of the real line, functions, sequences and series. Function of a single variable are studied with regards to types, limits, continuity, differentiability and integrability. Students learn to formulate and rigorously prove theorems on analysis using various kind of methods such as contradiction, induction, contrapositive etc. Prior knowledge of simple logic of truth is helpful for quick understanding but not essential.



### **SSH 2673 DISCRETE MATHEMATICS**

Pre-requisite : None

This course introduces the applications of discrete mathematics in the field of computer science. It covers sets, logic, proving techniques, combinatorics, functions, relations, graph theory and algebraic structures. These basic concepts of sets, logic functions and graph theory are applied to boolean algebra and logic networks while the advanced concepts of functions and algebraic structures are applied to finite state machines and coding theory.

### **SSH 2743 PARTIAL DIFFERENTIAL EQUATION**

Pre-requisite : SSH 1743, SSH 1783

Linear and non-linear first order equations, Classification of linear second order equations, Wave, heat and Laplace equations in one, two and three-dimensional spaces. Selected non-homogeneous equations.

### **SSH 2753 COMPLEX VARIABLES**

Pre-requisite : SSH 1743

This course introduces calculus of functions of a single complex variable. Topics covered include the algebra and geometry of complex numbers, complex differentiation, complex integration, complex series including Taylor and Laurent series, the theory of residues with applications to the evaluation of complex and real integrals, and conformal mapping with applications in solving boundary value problems of science and engineering.

### **SSH 2783 CALCULUS VECTOR**

Pre-requisite : SSH 1783

Vector valued Function: Definition of Vector valued Function, position vector and graph, vector differentiation, unit tangen vector, unit normal vector, unit binormal vector, curvature, radius of curvature, and torsion. Del operator, gradient, divergence, curl, normal vector to the surface, directional derivative, rate of change. Line Integral: line integral in two and three dimension, work, Green Theorem, potential function and Conservative force field. Surface Integral: surface integral for vector function, Gauss Theorem, and Stokes Theorem.

### **SSH 2813 OPERATIONAL RESEARCH**

Pre-requisite : SSH 1523

Introduces the basic methodology of Operational Research (OR),. Mainly deals with Linear Programming (LP) and related topics such as duality, sensivity analysis, Transportation Problem, and Integer Linear Programming. Besides manual calculations, students learn how to use computer packages to solve and analyse problems.

### **SSH 3113 TIME SERIES**

Pre-requisite : SSH 1123, SSH 1523

This course covers a wide range of methods for descriptive analysis, modelling, decomposition and forecasting involving both time and frequency domains. Methods include plotting, trend fitting, estimation of seasonal and cyclical effects, stationary time series probbility modelling, Box-Jenkins approach and forecasting.



### **SSH 3123      MULTIVARIATE STATISTICAL ANALYSIS**

Pre-requisite : SSH 1123, SSH 1523

Presents major views and theories in multivariate statistical analysis. A main tool for the purpose is matrix algebra. Emphasis is on normal distribution, inferences about a mean vector, principal components, factor analysis and inference for structured covariance matrices, and canonical correlation analysis. Students will embark on a small-scale project investigating multivariate data. It is expected that the students will gain skills dealing with multivariate data using the techniques taught.

### **SSH 3143      DECISION THEORY**

Pre-requisite : SSH 1123

Introduces the basic problems and techniques of decision making and comprises two major parts. The first part covers basic principles and approaches in decision making. The second part explores the methods and applications of information that are used in making an optimal decision. Differences between the classical frequencies approach and Bayesian approach in making decision, identify prior distributions and likelihood functions, and combine these two entities to obtain posterior distributions, which will then be combined with loss function to obtain Bayesian estimators. Concepts of conjugate distributions on prior and posterior distributions, important definitions in decision theory, proving admissibility and inadmissibility of a decision, process of making an optimal decision, utility and reward, and sensitivity analysis related to an optimal decision. Analysis of subjective probabilities.

### **SSH 3163      STOCHASTIC PROCESSES**

Pre-requisite : SSH 1123

This course begins with a review of the basic probability theory and proceeds to discussing major stochastic processes, including Markov chain and continuous Markov chain, Poisson processes, renewal theory. Applications to inventory problems, equipment replacement and queueing theory are also dealt with through examples. Upon completion, students should be able to recognise the relevance of mathematical techniques presented in solving real-world problems, apply the techniques, and demonstrate knowledge of various random processes.

### **SSH 3243      SAMPLING TECHNIQUES**

Pre-requisite : None

This course introduces sampling methods used in sample surveys. The students are given a comprehensive account of sampling theory for use in sample surveys and include illustrations of how the theory is applied in practice. A prerequisite is familiarity with algebra, knowledge of probability for finite sample spaces and basic statistics. Topics include simple random sampling, sampling proportion and percentages, estimation of sample sizes, stratified random sampling, ratio estimators, systematic sampling, and cluster sampling.



### **SSH 3383 DISCRETE-EVENT SIMULATIONS**

Pre-requisite : None

Concepts of simulation, event, discrete-event, continuous event, system model and its types. Random number generation. Stochastic processes. Computer implementation. Probability and Statistical tools: discrete/continuous distributions, Poisson process. Birth death processes. Queuing models: Markovian single and multiple servers, arrival, service and laws of conservation. Steady-state behaviour of finite population. Loss system with blocking, Erlang's B and C equations. Little's equation. Simulation model building, verification and validation. Data collection, parameter estimation, goodness-of-fit tests, multivariate and time-series input models. Measures of performances using point and interval estimation. Output analysis using confidence-interval estimation. Case studies on traffic system, material handling and network analysis.

### **SSH 3453 APPLIED NUMERICAL METHOD**

Pre-requisite : SSH 2413, SSH 1743

This course discusses the applications of the methods discussed in SSH 2413 Computational numerical method in sciences, engineering, etc. Discussions include governing the mathematical model, solving the problem using suitable numerical methods and the explanation of solutions obtained.

### **SSH 3713 MATHEMATICAL MODELLING**

Pre-requisite : SSH 1743

Introduces the basic principles of mathematical modelling. Emphasis is on some underlying general concepts related to mathematical modelling and differential equations. These include topics in first and second-order differential equations, mathematical models and numerical methods, systems of differential equations, nonlinear systems and phenomena, eigenvalues and boundary value problems. Upon completion, students should exhibit the ability to analyze resulting models by making use of both classical and numerical mathematical techniques and the essential knowledge and basic skills of mathematical modelling in describing, comprehending and predicting the behaviour of various physical, biological, mechanical processes and as well as other relevant dynamical systems.

### **SSH 3723 ADVANCED MATHEMATICAL MODELLING**

Pre-requisite : SSH 1743, SSH 3713

This course introduces the use of mathematical tools in the modelling of problems in physical, social, biological and environmental sciences. It explores the interrelations between mathematics and applied problems from such areas. Modelling and simulation of case studies in the areas mentioned are also discussed in details.

### **SSH 3753 FLUID MECHANICS**

Pre-requisite : None

Comprises two parts. The first part is concerned with fluid kinematics while the second part deals with the derivation and the solution of the equations of motion for inviscid and viscous fluids. Students learn to apply mathematical techniques to solve fluid flow problems.





### **SSH 3793      CALCULUS OF VARIATIONS**

Pre-requisite : SSH 1713, SSH 1783

This course discusses mainly the extremals of functionals. Beginning with a review of similar concepts in functions of many variables, the concepts of functional and variational problems are introduced. Topics include analytical methods of solution (extremal of functionals) analytically and selected numerical methods. Upon completion, the students should be able to recognize functionals and variational problems, the necessary conditions for an extremum, the sufficient conditions for a weak and strong variation is and know how to use the direct methods for finding the extremal of a functional.

### **SSH 3813      OPTIMAL CONTROL**

Pre-requisite : None

This course introduces the optimal control theory. The discussion includes definitions and classification of system control types. Topics include optimal control problems such as necessary and sufficient conditions using calculus of variation. Upon completion, students should exhibit understanding of the basic concepts and principles of mathematical control systems. The students should also be able to formulate state space equation, determine systems characteristics and solve basic optimal control problem using variational approach and dynamic programming.

### **SSH 3823      ADVANCED OPERATIONAL RESEARCH**

Pre-requisite : None

The course comprises of two main topics: inventory analysis and queuing systems. Inventory analysis covers development and analysis of deterministic models and probabilistic models. The concept of Material Requirements Planning (MRP) and Just in Time (JIT) is also introduced. Analysis of queuing systems covers various steady-state mathematical formulae and basic simulation. The models include machine repair model, queues in series, and queues with priorities.

### **SSH 3843      OPTIMIZATION METHODS**

Pre-requisite : SSH 1713, SSH1783

Comprises two parts. The first part covers topics on unconstrained optimisation such as one-dimensional and n-dimensional search methods, interpolation method and gradient methods. The second part covers topics on constrained optimisation such as the Kuhn Tucker method, modified Hooke and Jeeves search method, complex method, penalty function methods, and the Sequential Unconstrained Minimization Technique (SUMT).

### **SSH 3863      FINANCIAL MATHEMATICS**

Pre-requisite : None

Begins with a review of elementary probability (probability space, random variables, distributions, independence, conditional independence) that will be discussed. This course also introduces students to financial market, time value of money and interest rates, financial market instruments, pricing of forwards/futures, arbitrage, random process, simple random walks and Cox-Ross-Rubinstein (Binomial Option Price) stock model, European call and put option, portfolio, hedging, discrete Black-Scholes formula, martingales, Markovian property, stopping time, American options, Brownian motion, stochastic integral, stochastic differential equations, geometric Brownian motion and Black-Scholes formula.





**SINOPSIS KURSUS UMUM FAKULTI**  
***SYNOPSIS OF FACULTY'S***  
***GENERAL COURSE***



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### **SSU 2612 HISTORY OF NOBEL PRIZE WINNERS**

Introduction, definition of science and research. The history and development of science in some civilizations. The history of science and Nobel Laureate figures in chemistry, physics and mathematics. Introduction to the historical discovery, fields and research culture of science figures.

### **SSU 2623 RESEARCH METHODOLOGY & INFORMATION RETRIEVAL**

Introduction, research philosophy and objective, literature study and review, choosing and defining research problems, choosing research designs, instrumentation/measurement, data collection and analysis, preparing research proposals, writing research reports. Systematic technical report writing: Instruction, planning and order, writing, revising, language. Types of technical reports. Computer usage and report format. Public speaking: Preparation, technique and presentation aids. Techniques for saving and retrieving information in printed and electronic forms, information source: original, additional, bibliography and references, Abstracts, Index, search strategies: literature study, data base, CD-ROM and so on.

### **SSU 2915 INDUSTRIAL TRAINING**

Students are required to undergo Industrial Training (I) in selected local industries or government bodies for 10 weeks. At the end of their training, students are required to submit a written report on their work. The evaluation of the subject is based on the Industrial Supervisor's report, the Faculty Supervisor's report, the student's Log Book write-up and written report. To be eligible for Industrial training, a student must have obtained the following:

- (i) A total credit count of at least 40 credit hours, and
- (ii) Is of Good Standing (KB) in Semester I of Year 2, or was on Probationary Standing (KS) only once prior to Industrial Training.  
Student will not be permitted to undergo Industrial Training, if
  - (i) their total credit count is less than 40, or
  - (ii) they were on Probationary Standing (KS) twice consecutively.

### **SSU 3922 UNDERGRADUATE PROJECT I**

This subject is the first part of the Final Year Project. Each student will be assigned a topic and a supervisor at the beginning of Semester I of Year 3. The student will be introduced to laboratory work/written research assignments related to the project proposed by the supervisor. The students will also be trained to make a literature survey. At the end of the semester, each student is required to write a satisfactory progress report to be allowed to take SSU 3924 in the following semester. The evaluation of this subject will be based on the progress report, evaluation by the supervisor, and a possible oral presentation as required. Only students of Good Standing (KB) in the previous semester are allowed to register for SSU 3922.

### **SSU 3924 UNDERGRADUATE PROJECT II**

This subject is the second part of the Final Year Project and is a continuation of SSU 3922. The subject is an extension of the laboratory work/written research assignments from SSU 3922. At the end of the semester, each student is required to present their findings and submit a dissertation to the faculty on a certified date. Evaluation of the subject is based on oral presentation and submitted dissertation.



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### **UHS 1152 ETHNIC RELATIONSHIP**

This course discusses the basic sociological concepts on culture and ethnic relations. It focuses on the development of ethnic relations in Malaysia from the sociology, history and constitution perspectives. It also aims to develop skills in understanding and making sense of the Malaysian society thus enabling the students to contribute to the country's development. Among the topics covered in the course are issues on globalisation, government policies and strategies in the context of national solidarity and development, multi-ethnic relations for the Islamic perspectives and cultures.

### **UHB 1412 ENGLISH FOR ACADEMIC COMMUNICATION**

This subject prepares students for the skills needed to perform academic tasks, such as taking notes from written and oral texts, producing academic assignments and giving oral presentation related to their academic assignments. Through these tasks, students will practice various skills such as looking for information from various sources (print, internet, etc.), extracting information from different text types, making notes of information obtained, expanding notes into coherent extended texts and presenting information as well as giving viewpoints in an oral presentation. The tasks assigned will be in the form of individual and group work projects that develop students' skills in time management, project management, team work and group interaction.

### **UHB 2422 ADVANCED ENGLISH FOR ACADEMIC COMMUNICATION**

This subject prepares students for advanced academic communication in English with emphasis on oral communication skills. Students will be assigned projects that require them to look for and extract relevant information from various sources. In the process of completing the projects assigned, students will put into practice various skills developed in the earlier subject as well as skills in collecting data through interviews and questionnaire survey, intergrading and presenting information (in oral and written form), time management and group interaction. The various oral activities such as presenting a proposal of the project, giving a briefing on progress of the report and presenting the completed report are designed to build students' oral communication skills and confidence in expressing themselves, i.e. skills that are much needed in their studies and career.

### **UHS 2122 CRITICAL AND CREATIVE THINKING**

The aim of the course is to develop students' understanding of the concept, theory and practice of critical and creative thinking. Attention is on critical and creative thinking techniques as well as obstacles of both thinking methods. Both thinking methods help students to make decisions or solve problems whether in groups or individually.

### **UHS 3102 ENTREPRENEURSHIP AND ENTERPRISE DEVELOPMENT**

This course is designed to expose students to the concept of entrepreneurship and entrepreneurs and the skills needed to prepare a good business plan. In addition to exposing the students to the characteristics of successful entrepreneurs, various skills to successfully run and manage entrepreneurial ventures, techniques of identifying, evaluating and choosing business opportunities, procedures to form a business, planning, funding and business supports available in Malaysia will also be discussed. Finally, students will be guided to prepare a business plan after they have learned the fundamentals of a good business plan (following a chosen model). In general, the focus is on instilling entrepreneurial features among the students and developing the required skills to manage a business enterprise.





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### **ULT 1022 ISLAMIC AND ASIAN CIVILISATIONS**

The course familiarizes students with the Islamic and Asian Civilizations. It discusses the science of civilization that embraces an introductory to science and civilization, the interactions of various civilizations (Malay, Chinese and Indian); Islam in the Malay Civilization, and its role in establishing the Malaysian civilization, contemporary issues on the Islamic and Asian Civilization, Islam Hadhari and nation building. At the end of the course, students will be extensively exposed to the history, principles, values and fundamental aspects of civilization studies in Malaysia as well as able to strengthen the integrity of Malaysian as citizens of a multi-racial country who have a high tolerance towards others. Throughout the learning process, some aspects of generic skills namely team working, communication skills and ethics will be emphasized.

### **ULT 2122 ISLAMIC INSTITUTIONS**

The course exposes students to the comprehensiveness of Islam via its distinctive institutions. It discusses various institutions including family, social, education, economy, legislative and jurisdiction, enforcement and politics. The discussion will be focused on the concepts of family, its internalizing and implementation, the concept of society and social responsibility, Islamic philosophy and educational system, concepts of Islamic economics, insurance and banking, the concept and characteristics of law and legislation, the position of Islamic law in the Malaysia constitution, witness, allegation, evidence and demonstration, wilayah al-Qhada'. Wilayah al-Hisbah and al-Masalim, including the concepts of Islamic politics and its dominion. At the end of the course, students are able to understand the concepts and roles of various Islamic institutions which can be an alternative solution to overcome the problem of Ummah. Students are also able to work in teams and be equipped with communication and problem solving skills.

### **ULT 2132 ISLAMIC AND CURRENT ISSUES**

The course acquaints students with various topics on current issues and Islamic approaches to overcome problems and to encounter challenges. The topics comprise discussion on globalization, clash of Eastern and Western civilizations, moral decadence, ethical issues in science and technology, economic issues, development and environmental issues, post-modernism, governance and administration, issues that challenge the credibility of Islam as well as fundamentalism and extremism. Issues pertaining to the ethnic relations and ethnic chauvinism and the current challenges of Muslim people will also be discussed. At the end of the course students will be able to explain the Islamic views pertaining to current issues and to provide answers and alternatives to problems by referring to Islamic principles. They are also able to work in teams and be equipped with communication and problem solving skills.





SENARAI STAF AKADEMIK  
FAKULTI  
*LIST OF ACADEMIC STAFF  
OF THE FACULTY*



UNIVERSITI TEKNOLOGI MALAYSIA

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## JABATAN FIZIK/ DEPARTMENT OF PHYSICS

Jawatan/Post:

Nama/Name

Ketua Jabatan/Head of Department:

**Prof. Dr. Noriah Bidin**, B.Sc (Hons), Dip.Ed. (UKM), M.Sc. (Loughborough), Ph.D (UTM).

Profesor/Professors:

**Dr. Ahmad Termizi Ramli**, B.Sc (Hons) (Leeds), M.Sc (Salford), Dip. (Swansea), Ph.D (Wales).

**Dr. Husin Wagiran**, B.Sc, Dip.Ed (UKM), M.Sc (Surrey), Ph.D (Aston), MIFM.-Timbalan Dekan (Akademik)

**Dr. Jalil Ali**, B.Sc (Hons), M.Sc (Malaya), Ph.D (UTM), MIFM.

**Dr. Md. Rahim Sahar**, B.Sc (UKM), M.Sc (Kent), Ph.D (Warwick), MASS, MMSS.

**Dr. Nooruddin Ibrahim**, B.Sc (Malaya), M.Sc, Ph.D (London).

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**Dr. Samsudi Sakrani**, B.Sc (UKM), M.Tech (West London), Ph.D (Aston), MASS.-Dekan

**Dr. Yussof Wahab**, B.Sc (UKM), M.Sc (Bristol), Ph.D (Nottingham).

Profesor Madya/Associate Professors:

**Dr. Abd. Rani Abd. Hamid**, B.Sc (Hons) (UKM), M.Sc, Ph.D (Lancaster), MASS.

**Dr. Ahmad Radzi Mat Isa**, B.Sc (Hons) (Malaya), M.Sc (Southampton), Ph.D (Reading).

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**Dr. Mohamad Khairi Saidin**, B.Sc (Hons) (UKM), Ph.D (Durham), MASS, IEEE.

**Dr. Rashdi Shah Ahmad**, B.Sc (Houston), M.Sc (UTM), Ph.D (Hokkaido).-Timbalan Dekan Keusahawanan (BIP).

**Dr. Rosli Hussin**, B.Sc (Hons) (UKM), M.Sc (West London), Ph.D (Warwick), MASS.

**Sabirin Hj Ikhsan**, Sarjana Fizik (ITB), M.Sc (Surrey).- Kontrak.

**Dr. Wan Muhamad Saridan Wan Hassan**, B.Sc.Ed (Hons) (UTM), M.Sc (California), Ph.D (Aberdeen).-Pengarah Unit Perlindungan Sinaran

**Dr. Yusof Munajat**, B.Sc (Hons) (UKM), M.Sc (W. London), Ph.D (UTM).

**Dr. Zulkafli Othaman**, B.Sc.Ed (Hons) (UTM), M.Sc (Oregon), Ph.D (Bath), MIFM, MASS.



*Pensyarah Kanan/ Senior Lecturers:*

- Dr. Amiruddin Shaari, B.Sc (U.S.A), M.Sc (California State), Ph.D (Liverpool).
- Dr. Hazri Bakhtiar, B.Sc, M.Sc, Ph.D (Metz France).
- Dr. Mohd Nor Md. Yusof, B.Sc (Hons), Dip.Ed. (UKM), M.Sc (Portsmouth), Ph.D (Warwick).
- Dr. Wan Nurulhuda Wan Shamsuri, B.Sc (Salford), M.Sc, PhD (UTM), MASS.
- Dr. Zuhairi Ibrahim, B.Sc (Hons), M.Sc (Essex), PhD (UTM).

*Pensyarah/Lecturers:*

- Abd. Rahim Omar, B.Sc (Hons), M.Sc (WMU).
- Abdul Rashid Abdul Rahman, B.Sc, M.Sc (Sheffield).
- Dr. Asiah Yahya, B.App.Sc (CIAE, Australia), M.Sc (Swansea), Ph.D (UTM).
- Dr. Jasman Zainal, B.Sc, M.Sc (USM), Ph.D (UMIST).
- Khaidzir Hamzah, B.Sc.Eng. (London), M.Sc (UTM).
- Masleeyati bte Yusof, B.Sc, M.Sc (UKM) - CB.
- Mohamed Noor Muhammad, B.Sc (Hons) (Birmingham), M.Sc (London).
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- Muhammad Zaki Hj Yaakob, B.Sc (Hons) (UKM), M.Sc (Sussex).
- Ramli Arifin, B.Sc (Hons) (UKM), Dip.Ed, M.Sc (UTM) - CB.
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- Roslinda bte Zainal, B.Sc (Hons), M.Sc (UTM) -CB
- Suhaili Zakaria, B.Sc (UKM), M. Sc (Wales)-CB.
- Suhairul Hashim, B.Sc (UKM), M.Sc (Surrey)-CB.
- Dr. Yaacob Mat Daud, B.Sc (Hons) (UKM), M.Sc, Ph.D (Kent).

*Tutor/Tutors:*

- Abdul Rahman Tamuri, B.Sc (UTM)-CB.
- Nor Ezzaty Ahmad, B.Sc. (USM)
- Siti Sarah bt Safaai, B.Sc (UTM)
- Norehan Mohd Nor, B.Sc (UTM).



## **JABATAN KIMIA/ DEPARTMENT OF CHEMISTRY**

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Nama/*Name*

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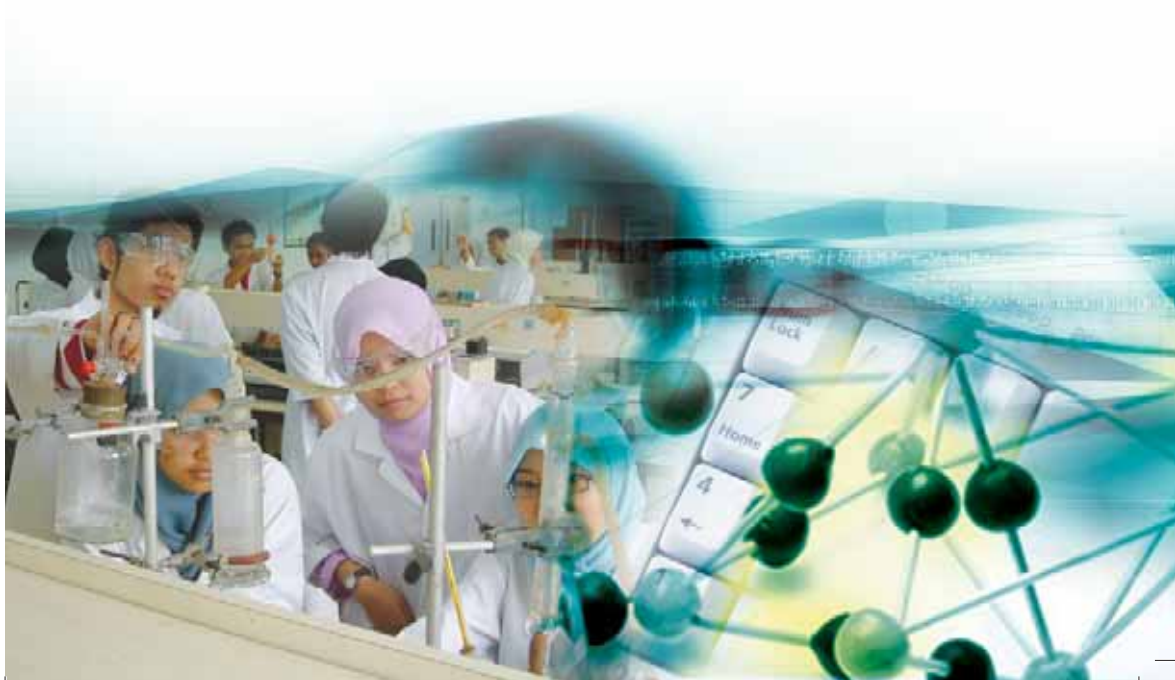


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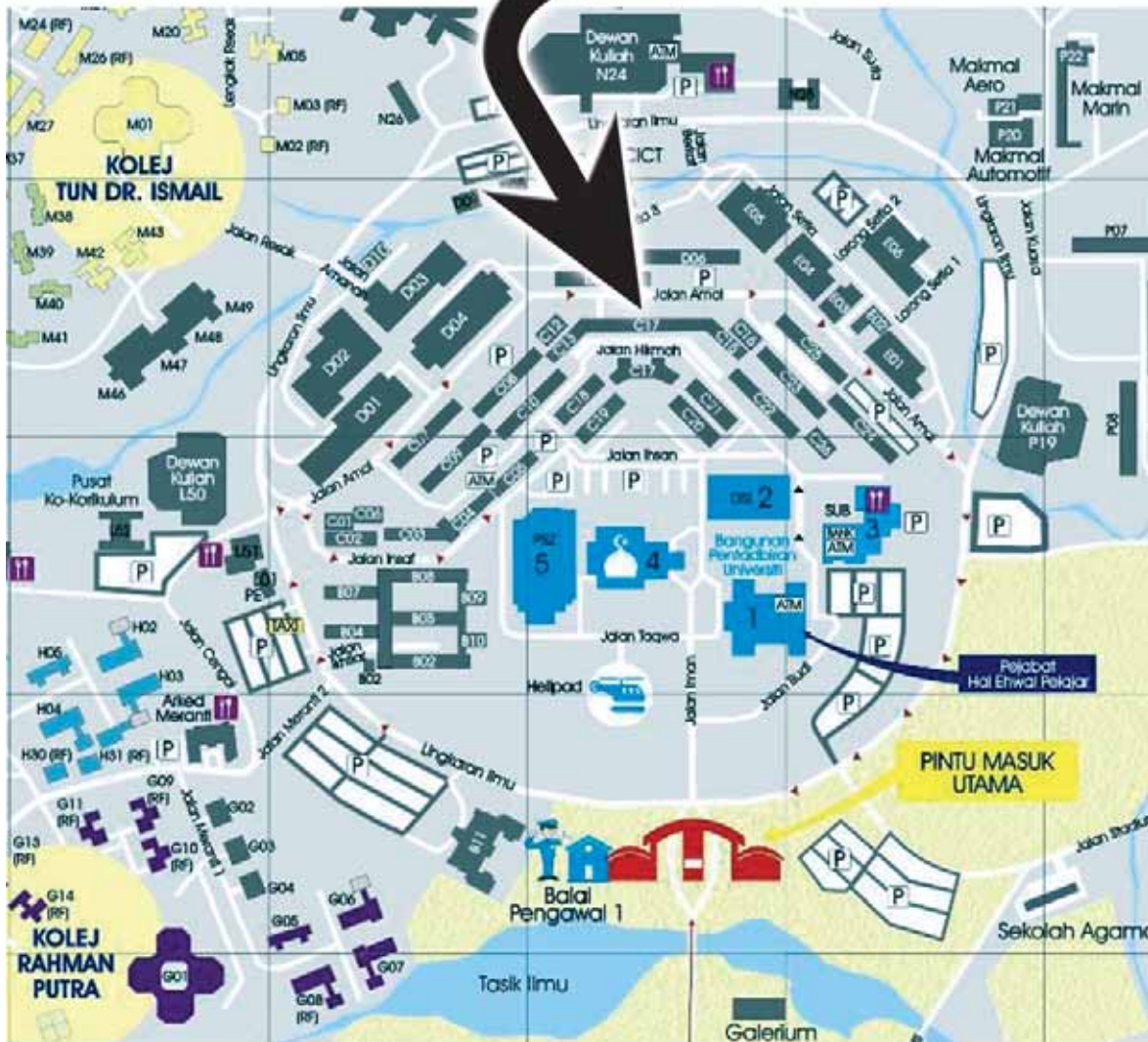




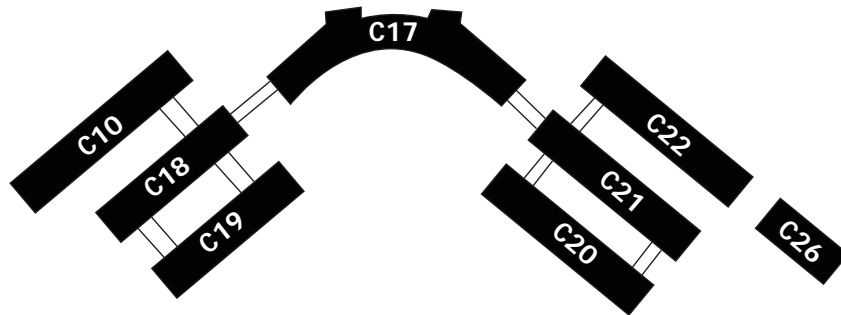


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