



... where great minds are nurtured

ACADEMIC HANDBOOK
Session: 2018/2019

<http://science.utm.my>

Edition: 2018/2019

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Attention

All information in this version of the guide are true at time of publishing.

The Faculty of Science reserves the right to make amendments to the guide as needed without prior announcement. This Academic Guide is a reference for students from the 2018/2019 Session intake and remains valid until the end of their study. The synopses of courses offered by the Faculty of Science are only available in English, as per the language used in their instruction.

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DEAN'S FOREWORD

السلام عليكم ورحمة الله

The utmost gratitude to Allah S.W.T. for enabling the successful production of this Faculty of Science Academic Handbook.

On this occasion, I wish to express my sincerest congratulations and a well done to students who have been successfully chosen for study programs offered by the Faculty of Science in particular and UTM in general, for the 2018/2019 Academic Session.

This Academic Handbook contains basic information regarding the Faculty, its curriculum and course synopses for the Bachelor of Science Program, applicable for students admitted in the 2018/2019 session and onward until graduation. Students admitted for Semester I of the 2018/2019 Session constitutes the seventh group of students following the latest four-year study curriculum. This Handbook also describes the programs and courses offered at the Faculty of Science, the semester system and the handling of aforementioned study programs.

It is hoped this Academic Handbook can provide necessary information, especially to students, about the management of the Faculty, the procedures of its programs and the study courses offered. The Handbook will be useful for students as part of a learning plan for their studies, as well as being a reference for understanding the structure of courses or programs run by the Faculty of Science. In addition, this Academic Handbook explains the academic advisory system so that students and their assigned Academic Advisors may understand their respective roles more effectively.

On behalf of the Faculty, I would take this opportunity to express thanks to all staffs that were involved in the production of this 2018/2019 Academic Handbook.

Thank you. *Wassalam.*

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Dean

Faculty of Science, UTM

Faculty of Science's Management Team

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Mdm. Hamidah Mat Arif

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Mdm. Syahida Fadilla Moktar

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B.Sc. (UTM)

BACKGROUND OF UNIVERSITI TEKNOLOGI MALAYSIA

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

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

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

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

Currently, UTM's main campus is located on a land spanning 1,120 hectares in Skudai, Johor. It is situated about 18 km from Johor Bahru City centre. The branch campus is located at UTM International Campus, Jalan Semarak, Kuala Lumpur. The move from the original campus at Jalan Semarak, Kuala Lumpur, to the main campus in Skudai began in 1985 and proceeded in stages. At present, the Skudai campus houses five faculties and two faculty-level schools in UTM International Campus, Kuala Lumpur, as follows:

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

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

PHILOSOPHY, VISION, MISSION AND MOTTO OF UTM

PHILOSOPHY

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

VISION

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

MISSION

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

MOTTO

“KERANA TUHAN UNTUK MANUSIA”
In the Name of God for Mankind.

THE DEVELOPMENT CHRONOLOGY OF THE FACULTY OF SCIENCE

Year	Event
1972	<ul style="list-style-type: none">- The Science Service Unit teachings of Physics, Chemistry and Mathematics for the Engineering Faculties of Institut Teknologi Kebangsaan (ITK).- The Centre for Science and Humanities Studies, consisting of four departments (Physics, Chemistry, Mathematics and Humanities) was established.- A Diploma of Science and Education was initiated in cooperation with the Ministry of Education, Malaysia.
1978	<ul style="list-style-type: none">- The split of the Centre of Science and Humanities Studies resulted in the formation of the Centre of Science Studies (PPS), which consisted of three Departments (Physics, Chemistry and Mathematics).
1978	<ul style="list-style-type: none">- The Diploma of Science with Education was renamed as the Integrated Science with Education Course (ISP).
1979	<ul style="list-style-type: none">- Enrolment of the first batch of undergraduate students for the Bachelor of Science with Education program (SSP).
1980	<ul style="list-style-type: none">- The Department of Computer Science was established and placed under PPS.
1981	<ul style="list-style-type: none">- The Centre for Science Studies (PPS) was upgraded and renamed as the Faculty of Science (FS).
1982	<ul style="list-style-type: none">- The Education Department and the Department of Technical Science were transferred from the Centre of Humanities Studies into the Faculty of Science.
1983	<ul style="list-style-type: none">- The Bachelor of Computer Science Program was initiated.
1984	<ul style="list-style-type: none">- The Department of Computer Science separated from the Faculty of Science to form an independent faculty.
1986	<ul style="list-style-type: none">- The Bachelor of Science in Technology with Education (Civil, Electrical, Mechanical) was established.
1987	<ul style="list-style-type: none">- The Bachelor of Industrial Science (SSI) course was started. The programs offered were Industrial Chemistry, Industrial Physics and Industrial Mathematics.
1988	<ul style="list-style-type: none">- The Faculty of Science moved to Skudai.- The Bachelor of Computer Science with Education (SPK) was initiated, followed by the Diploma in Education.
1989	<ul style="list-style-type: none">- The Faculty officially started its postgraduate program in Chemistry, Physics and Mathematics.
1992	<ul style="list-style-type: none">- The Faculty started the Bachelor of Science in Technology with Education (Living Skills) course.
1994	<ul style="list-style-type: none">- 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: Departments of Chemistry, Physics and Mathematics.
1997	<ul style="list-style-type: none">- The Faculty started offering the Bachelor of Industrial Science (Biology) program.
1998	<ul style="list-style-type: none">- The Faculty started offering the Bachelor of Industrial Science (Material Physics) program.
1999	<ul style="list-style-type: none">- The Faculty started offering the Bachelor of Industrial Science (Health Physics) program.
2000	<ul style="list-style-type: none">- The Biology Department was established in the Faculty.

- 2002 - The Faculty of Science began offering a special program known as the Excellent Scientists Program (Pure Physics, Chemistry and Mathematics).
- 2003 - The enrolment of students for the Undergraduate Program was limited to only post-matriculation, post-STPM and diploma holders only.
- 2005 - The Faculty began offering Undergraduate Degree Programs in Pure Sciences (Biology, Chemistry, Physics and Mathematics).
- 2010 - Enrolment of students for the Bachelor of Science (Material Physics) and Bachelor of Science (Health Physics) was stopped.
- 2012 - The Department of Mathematics was renamed the Department of Mathematical Sciences.
- 2018 - UTM Synergy 4.0
The Biosciences Department previously from Faculty of Biosciences and Medical Engineering merged together with Faculty of Science.

VISION, MISSION, SLOGAN AND OBJECTIVES OF THE FACULTY

VISION

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

MISSION

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

SLOGAN

...Where great minds are nurtured.

OBJECTIVES

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

BUSINESS, STATEMENT OF OPPORTUNITY, CORE COMPETENCIES, CUSTOMER CHARTER

BUSINESS

To conduct teaching/learning, research and consultancy activities in the field of Science and Mathematics.

STATEMENT OF OPPORTUNITY

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

CORE COMPETENCIES

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

CLIENTS CHARTER

The Faculty of Science is committed to:

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

ORGANIZATIONAL STRUCTURE, ADMINISTRATION & MANAGEMENT

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

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

At present, the Faculty consists of four major divisions:-

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

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

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

UNDERGRADUATE PROGRAMS AND ADMISSION REQUIREMENTS

UNDERGRADUATE PROGRAMS OFFERED

The Faculty of Science offers eight (8) undergraduate programs as of the 2018/2019 Academic Session. The programs are:-

No.	Program Name	Program Code	Credits Norm to Graduate
1	Bachelor of Science (Chemistry)	SSCA	131
2	Bachelor of Science (Industrial Chemistry)	SSCC	131
3	Bachelor of Science (Mathematics)	SSCE	129
4	Bachelor of Science (Industrial Mathematics)	SSCM	132
5	Bachelor of Science (Physics)	SSCZ	131
6	Bachelor of Science (Industrial Physics)	SSCF	131
7	Bachelor of Science (Biology)	SSCG	132
8	Bachelor of Science (Industrial Biology)	SSCB	132

ENTRANCE REQUIREMENTS

Entrance into the Bachelor of Science programs is based on the candidate's qualification in the 'Sijil Tinggi Pelajaran Malaysia (STPM)', or 'Sijil Matrikulasi Kementerian Pelajaran Malaysia' or diploma, or the equivalent. The detailed entrance requirements can be obtained from the UTM's Prospectus or website (<http://www.utm.my>). Candidates with a certified diploma and other certified qualifications may be considered for credit transfer.



COURSE STRUCTURE AND GENERAL COURSE HANDLING

COURSE STRUCTURE

The Bachelor of Science curriculum was designed to provide relevant and up-to-date combinations of core and elective courses. The curriculum was devised with the intentions to strengthen the fundamentals of science and mathematics in the early stage of the program. Students must also undergo Industrial Training/Research Training for 10 weeks. Apart from that, the Bachelor of Industrial Science students are required to take three management courses.

Credit distribution for the Bachelor of Science Program is summarized by the following tables:-

a) Bachelor of Science (Pure) Program:-

No.	Classification	SSCZ		SSCA		SSCE		SSCG		
		Credit	%	Credit	%	Credit	%	Credit	%	
1	Fundamentals in Science and Mathematics	9	58	10	57.3	9	56.6	24	57.6	
2	Program Core	67		65		64		52		
3	Program Electives	33	25.2	33	25.2	33	25.6	33	25	
4	Compulsory University Courses	10	16.8	10	17.5	10	17.8	13	17.4	
	a. Humanities	8		8		8				8
	b. Language	2		2		3				3
	c. Co-curriculum	2		3		2				2
	d. Entrepreneurship									
	Total	131	100	131	100	129	100	132	100	

b) Bachelor of Science (Industrial) Program:-

No.	Classification	SSCF		SSCC		SSCM		SSCB		
		Credit	%	Credit	%	Credit	%	Credit	%	
1	Fundamentals in Science and Mathematics	9	58	10	57.3	9	58.0	24	57.6	
2	Program Core	67		65		67		52		
3	Program Electives	33	25.2	33	25.2	33	25.2	33	25	
4	Compulsory University Courses	10	16.8	10	17.5	10	16.8	13	17.4	
	a. Humanities	8		8		8				8
	b. Language	2		2		2				2
	c. Co-curriculum	2		3		2				2
	d. Entrepreneurship									
	Total	131	100	131	100	131	100	132	100	

GENERAL HANDLING OF COURSES

All studies for courses at the Bachelor of Science level are run using a semester system, and for each Academic Year the new student intake occurs on Semester I. The minimum period of study for all programs being offered are 4 academic years (8 semesters).

Students are required to complete the University's general courses consisting of courses in the Humanities, English Language, Co-Curriculum, Entrepreneurship and Foreign Language.

Additionally, final-year students must undertake one research study or Final Year Project (FYP) in a related field. They are required to submit a dissertation based on research topic or project. Supervision of the FYP will be carried out according to schedule between students and academic staff assigned as FYP Supervisors..

Students are required to undergo Industrial / Research Training (LI/LP) for a period of ten weeks, whether in the private or public sector, over the short semester in Year 3 of their study. The LI/LP experience aims to equip graduates with practical knowledge as well as exposing them to real working environments.

LI/LP Supervisors consisting of Faculty academic staff will make supervisory visits to each agency where Faculty students are assigned. The Faculty's supervisors then make a joint assessment with the agency's own supervisor in order to evaluate the performance of each student involved, before a Pass / Fail decision is recommended to the Industrial Training Committee of the Faculty of Science.

PROGRAM SPECIFICATION
BACHELOR OF SCIENCE (CHEMISTRY)

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 (SSCA)		
6. Professional or Statutory Body of Accreditation		Malaysian Ministry of Education Kementerian Pendidikan Malaysia		
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 : 4 years Maximum : 6 years		
Type of Semester	No. of Semesters		No. of weeks per semester	
	Full Time	Part Time	Full Time	Part Time
Normal	8		14	
Short	-		-	
12. Entry Requirement	<p>Fulfills University requirements and the following program requirements:</p> <p>STPM/ Matriculation/Science Foundation</p> <p>Minimum CGPA of 2.80 and passed with Grade B in Chemistry and Grade B- in ONE (1) of the following subjects : Biology/ Mathematics / Physics.</p> <p>DIPLOMA</p> <p>Minimum CGPA of 3.00 and passed with credits in Mathematics in the SPM/equivalent examination.</p>			

13. Program Educational Objectives (PEO)
<p>The objectives of B. Sc. (Chemistry) program are to provide the knowledge, skills, and attributes that should be achieved by the graduates for a successful carrier. The graduate should be able to:</p> <ol style="list-style-type: none"> 1. Become chemists who are competent, innovative and productive in addressing chemistry issues in chemical related industries. 2. Develop professionally with proficient soft skills to adapt to a range of contacts and audiences. 3. Demonstrate high standard of ethics, pure values and social responsibilities.

14. Program Learning Outcomes (PLO)			
Code	Intended Learning Outcomes	Teaching and Learning Methods	Assessment
(a) Technical Knowledge and Competencies			
PLO1 Fundamental knowledge (KW)	Ability to acquire knowledge of fundamental laws and principles of chemistry related to current application as well as knowledge in social science and personnel development. (C2)	Lectures, tutorials, laboratory works, directed reading, group discussion.	Examination, test, quiz, and laboratory report.
PLO2 Application of knowledge (AP)	Ability to apply, practice and analyze fundamental laws, principles of chemistry and chemical techniques using scientific methodologies related to chemical application. (C4)	Lectures, laboratory works, assigned reading, group discussion and problem solving assignments, hands-on instrumentations, chemistry related softwares.	Examination, test, quiz, assignment, laboratory report, oral presentation, group project, and computer simulation.
PLO3 Analyzing and experimental skills (PS)	Ability to plan, evaluate and demonstrate scientific studies and research related to chemistry. (C6, P6)	Lectures, laboratory works, assigned reading, group discussion and problem solving assignments, hands-on instrumentations, chemistry related softwares skills, research project, project presentation and report, research training.	Examination, test, quiz, assignment, and laboratory report, oral presentation, group project, computer simulation, research proposal, presentation, final year project report and research training supervisory report.
(b) Generic Skills			
PLO4 Communication Skills (CS)	Ability to present technical, scientific and chemical information and arguments clearly and correctly, in writing and orally to a range of audiences. (P4)	Group projects, Laboratory work, independent research, research training.	Oral presentation, written assignment, laboratory report, research project report, research training report.
PLO5 Thinking Skills (TH)	Ability to think critically and creatively in solving scientific problems. (P4)	Independent research projects, group research projects, research training.	Independent project report, individual assignment report and research training report.
PLO6 Scholarship (SC)	Ability to continuously seek new knowledge, skills and manage relevant information from various sources. (A3)	Final Year Project, individual assignment and laboratory works, research training.	Final year project report, written assignment and Laboratory report, research training report.

PLO7 Teamworking Skills (TW)	Ability to portray good interpersonal skills with high ability to work collaboratively as part of a team undertaking a range of different team roles. (A3)	Laboratory works, group assignments	Laboratory report, logbooks and group assignment report
PLO8 Adaptability (AD)	Ability to adapt, identify self-potential and be an agent of change in a new culture and environment. (A3)	Group assignment, laboratory work.	Group assignment report and laboratory report.
PLO9 Global Citizen (GC)	Ability to act with integrity, professionalism and good ethics in their profession and their obligation as a global citizen. (A3)	Lecture, Individual assignment, Laboratory work, Final Year Project and research training.	Laboratory report, individual assignment report, seminar presentation and final year project report
PLO10 Enterprising Skills (ES)	Ability to act with enterprising mindset, risk taker, innovative, effective, imaginative and resilience.(P2)	Lecture, Laboratory works and case studies and research training.	Written assignment, Final year report and research training report.

15. Classification of Courses			
No.	Classification	Credit Hours	Percentage (%)
(i)	Basic Sciences and Mathematics	10	57.2
(ii)	Program core	65	
(iii)	Program Elective	33	25.2
(iv)	Compulsory university Courses		17.6
	• Humanity	10	
	• Language	8	
	• Co-curriculum	3	
	• Entrepreneurship	2	
	Total	131	100

For Science program please fill up the following classification. (Others please refer to the Statutory Body guidelines)			
	Classification	Credit hours	Percentage (%)
A.	Chemistry Courses		
	(a) Lectures	78	59.5
	(b) Laboratory/Workshop/Field	8	6.1
	(c) Research Training	5	3.8
	(d) Final Year Project	6	4.6
	Total credit hours for Part A	97	74.0
B.	Related Courses		
	(a) Mathematics	9	6.9
	(b) Humanities/Ethics	12	9.2
	(c) Co-curriculum	3	2.3
	(d) Language	8	6.1
	(e) Entrepreneurship	2	1.5
	Total credit hours for Part B	34	26.0
	Total credit hours for Parts A and B	131	100
16. Total credit hours to graduate			131 credit hours
17. Program structures and features, curriculum and award requirements			

The course is offered on full-time mode and is based on 2-Semesters Academic Session with several Courses 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 not less than 130 credit hours with minimum CPA of 2.00.
- Pass Research training (equivalent to 5 credit hours).
- Complete and pass the undergraduate project Final Year Project.

SEMESTER 1			SEMESTER 2		
Code	Name of Course	cr	Code	Name of Course	cr
UICI 1012	Islamic and Asian Civilization	2	SSCC 1413	Chemical Thermodynamics	3
SSCC 1014	Principles of Chemistry	4	SSCC 1841	Physical Chemistry Practical I	1
SSCC 1312	Laboratory Occupational Safety and Health	2	SSCC 1603	Organic Chemistry – Functional Groups	3
SSCC 1703	Inorganic Chemistry	3	SSCC 1821	Organic Chemistry Practical I	1
SSCC 1851	Inorganic Chemistry Practical I	1	SSCM 1033	Mathematical Methods II	3
SSCM 1023	Mathematical Methods I	3	ULAB 1122	Academic English Skills	2
			UHAS 1172	Malaysia Dynamics*	2
			UHAS1162/ UHAK 1022	Arts, Customs and Beliefs*	
			UHAK 1032	Introduction to Entrepreneurship	2
Total Credit Hours		15	Total Credit Hours		17
<p>*UHAS 1172 : Local Student *UHAS 1162 : Foreign Student</p>					
SEMESTER 3			SEMESTER 4		
Code	Name of Course	cr	Code	Name of Course	cr
SSCC 2613	Organic Chemistry – Biomolecules	3	ULAB 2122	Advanced Academic English Skills	2
SSCC 2891	Organic Chemistry Practical II	1	SSCC 2713	Coordination Chemistry	3
SSCC 2453	Chemical Kinetics and Electrochemistry	3	SSCC 2851	Inorganic Chemistry Practical II	1
SSCC 2841	Physical Chemistry Practical II	1	SSCC 2473	Molecular Spectroscopy	3
SSCM 1103	Statistics	3	SSCC 2243	Principles of Analytical Chemistry	3
SSCC 2312	Laboratory Safety and Management	2	SSCC 2861	Analytical Chemistry Practical I	1
UICL 2302	The Thought of Sciences and Technology	2	UHAK 1012	Graduate Success Attributes	2
Total Credit Hours		15	Total Credit Hours		15

SEMESTER 5			SEMESTER 6		
Code	Name of Course	cr	Code	Name of Course	cr
SSCC 3233	<i>Instrumental Analysis</i>	3	SSCC 3643	Application of Spectroscopy	3
SSCC 3871	Analytical Chemistry Practical II	1	SSCC 3463	Quantum Chemistry	3
SSCC 3323	Principles of Polymer Chemistry	3	SSCU 3623	Research Methodology and Information Retrieval	3
UKQA 2092	Science and Community	2	ULA* 1112	Language Skills Elective	2
ULAB 3162	English for Professional Purposes	2	Elective (Choose 6 credits)		
UHAK 2**2	Soft Skills Elective	2	SSCC 3533	<i>Applications of Computer Chemistry</i>	3
UKQE 3001	Extracurricular Experiential Learning	1	SSCC 3743	<i>Materials Chemistry</i>	3
			SSCC 3493	<i>Surface and Colloid Chemistry</i>	3
			SSCC 3243	<i>Separation Methods</i>	3
			SSCC 3693	<i>Metabolism of Biomolecules</i>	3
Total Credit Hours		14	Total Credit Hours		17
SHORT SEMESTER					
Code	Name of Course	cr			
SSCU 3915	Research Training (HW)	5			
Total Credit Hours		5			
SEMESTER 7			SEMESTER 8		
Code	Name of Course	cr	Code	Name of Course	cr
SSCU 4902	Undergraduate Project I	2	SSCU 4904	Undergraduate Project II	4
Elective (Choose 15 credits)			Elective (Choose 12 credits)		
SSCC 4233	<i>Analytical Electrochemistry</i>	3	SSCC 4263	<i>Thermal Analysis</i>	3
SSCC 4363	<i>Green Chemistry</i>	3	SSCC 4473	<i>Solid State Chemistry</i>	3
SSCC 4443	<i>Chemical Reactions Process</i>	3	SSCC 4653	<i>Organic Synthesis</i>	3
SSCC 4723	<i>Organometallic Chemistry</i>	3	SSCC 4603	<i>Medicinal Chemistry</i>	3
SSCC 4733	<i>Radiochemistry</i>	3	SSCC 4763	<i>Nanochemistry</i>	3
SSCC 4633	<i>Heterocyclic Chemistry</i>	3	SSCC 4773	<i>Inorganic and Organometallic Polymers</i>	3
			SSCC 4393	<i>Special Topics in Chemistry</i>	3
SSCC 4213	<i>Environmental Chemistry</i>	3	SSCC 4543	<i>Modeling and Simulation</i>	3
Total Credit Hours		17	Total Credit Hours		16

18. Mapping of Program Learning Outcomes to Courses											
		LEARNING OUTCOMES									
COURSES OFFERED		Fundamental Knowledge	Application of Chemistry knowledge	Analyzing and Experimental Skills	Communication	Thinking Skills	Scholarship	Team Working Skills	Adaptability	Global Citizen	Enterprising Skills
Code	Courses	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Core Courses											
SSCC 1014	Principles of Chemistry	✓	✓	✓							
SSCC 1312	Laboratory Occupational Safety and Health	✓	✓			✓					
SSCC 1703	Inorganic Chemistry	✓	✓								
SSCC 1851	Inorganic Chemistry Practical	✓	✓	✓		✓		✓			
SSCM 1023	Mathematical Methods I	✓	✓								
SSCC 1413	Chemical Thermodynamics	✓	✓								
SSCC 1841	Physical Chemistry Practical I	✓	✓	✓	✓	✓					
SSCC 1603	Organic Chemistry – Functional Groups	✓	✓								
SSCC 1821	Organic Chemistry Practical I	✓	✓	✓		✓		✓			
SSCM 1033	Mathematical Methods II	✓	✓								
SSCC 2613	Organic Chemistry – Biomolecules	✓	✓						✓		
SSCC 2891	Organic Chemistry Practical II	✓	✓	✓	✓			✓			
SSCC 2453	Chemical Kinetics and Electrochemistry	✓	✓						✓		
SSCC 2841	Physical Chemistry Practical II	✓	✓	✓	✓	✓					
SSCM 1103	Statistics	✓	✓								
SSCC 2312	Laboratory Safety and Management	✓	✓			✓					
SSCC 2713	Coordination Chemistry	✓	✓						✓		

SSCC 2851	Inorganic Chemistry Practical II	✓	✓	✓	✓			✓			
SSCC 2473	Molecular Spectroscopy	✓	✓						✓		
SSCC 2243	Principles of Analytical Chemistry	✓	✓						✓		
SSCC 2861	Analytical Chemistry Practical I	✓	✓	✓	✓	✓					
SSCC 3233	Instrumental Analysis	✓	✓				✓				
SSCC 3871	Analytical Chemistry Practical II	✓	✓	✓		✓		✓			
SSCC 3323	Principles of Polymer Chemistry	✓	✓				✓				
SSCC 3643	Application of Spectroscopy	✓	✓			✓					
SSCC 3463	Quantum Chemistry	✓	✓			✓					
SSCU 3623	Research Methodology and Information Retrieval	✓	✓		✓	✓	✓				
SSCU 3915	Research Training (HW)	✓	✓	✓	✓	✓	✓	✓	✓	✓	
SSCU 4902	Undergraduate Project I	✓	✓			✓	✓	✓			
SSCU 4904	Undergraduate Project II	✓	✓	✓	✓	✓	✓				
	Total	30	30	11	9	14	6	6	6	1	0
Elective Courses											
SSCC 3533	<i>Applications of Computer Chemistry</i>	✓	✓			✓					
SSCC 3743	<i>Materials Chemistry</i>	✓	✓			✓					
SSCC 3493	<i>Surface and Colloid Chemistry</i>	✓	✓			✓					
SSCC 3243	<i>Separation Methods</i>	✓	✓			✓					
SSCC 3693	<i>Metabolism of Biomolecules</i>	✓	✓			✓					
	TOTAL (Choose 2)	2	2	0	0	2	0	0	0	0	0
SSCC 4233	<i>Analytical Electrochemistry</i>	✓	✓				✓				
SSCC 4363	<i>Green Chemistry</i>	✓	✓				✓				
SSCC 4443	<i>Chemical Reactions Process</i>	✓	✓				✓				
SSCC 4723	<i>Organometallic Chemistry</i>	✓	✓				✓				
SSCC 4733	<i>Radiochemistry</i>	✓	✓				✓				
SSCC 4633	<i>Heterocyclic Chemistry</i>	✓	✓				✓				
SSCC 4213	<i>Environmental Chemistry</i>	✓	✓				✓				
	TOTAL (Choose 5)	5	5	0	0	0	5	0	0	0	0
SSCC 4263	<i>Thermal Analysis</i>	✓	✓							✓	
SSCC 4473	<i>Solid State Chemistry</i>	✓	✓							✓	
SSCC 4653	<i>Organic Synthesis</i>	✓	✓							✓	
SSCC 4603	<i>Medicinal Chemistry</i>	✓	✓							✓	

SSCC 4763	Nanochemistry	✓	✓							✓	
SSCC 4773	Inorganic and Organometallic Polymers	✓	✓							✓	
SSCC 4393	Special Topics in Chemistry	✓	✓							✓	
SSCC 4543	Modeling and Simulation	✓	✓							✓	
	Total (Choose 4)	4	4	0	0	0	0	0	0	4	0
University Courses											
UICI 1012	Islamic and Asian Civilizations (TITAS)					✓	✓			✓	
UHAS 1172	Malaysia Dynamics						✓			✓	
UHAS 1162	Arts, Custom and Belief of Malaysian						✓			✓	
UICL 2302	The Thought of Science and Technology					✓	✓			✓	
UHAK 1012	Graduate Success Attributes				✓		✓	✓			✓
UKQA 2092	Science and Community						✓	✓	✓	✓	
UHAK 2**2	Soft Skills Elective						✓	✓	✓		✓
ULA* 1112	Language Skills Electives				✓						
ULAB 1122	Academic English Skills				✓						
ULAB 2122	Advanced Academic English Skills				✓						
ULAB 3162	English for Professional Purposes				✓						
UHAK 1032	Introduction to Entrepreneurship										✓
UKQE 3001	Extracurricular Experiential Learning (ExCEL)				✓	✓	✓	✓	✓	✓	✓
	Total	0	0	0	6	3	7	4	3	5	4
	GRAND TOTAL	41	41	11	15	19	18	10	9	10	4

Key:

PO1 – PO3 = Technical Skills

PO4 – PO10 = Generic Skills

19. Our Uniqueness

- The program allows students to perform their research training at local or foreign organizations.
- Our laboratories are equipped with state of the art facilities and instruments.
- The program is recognized by Malaysian Institute of Chemistry (IKM).
- Established links with local and international research institutions and industries.
- The program allows student to transfer credit of certain equivalence courses offered by other universities locally and overseas.

20. Career Prospects and Career Paths

Graduates of the program can work as:

- chemists or scientists in government research institutions such as MARDI, Malaysia Palm Oil Board (MPOB), RRI, PRSS, AMREC, SIRIM and Malaysia Nuclear Agency (MNA).
- 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.
- academics or researchers in higher learning institutions, following pursuance of their degree qualifications to Masters or Ph.D. levels.
- quality control or quality assurance and marketing officers in agencies or industries in which sound knowledge of chemistry skills are required.

21. Cross Campus Program

Students are given the opportunity to enroll certain courses in participating universities locally and overseas. The grades and credits up to 1/3 of the total credits of the curriculum are transferable.

22. Professional Skills Program Certificate

Students must enroll in Professional Skills Program conducted by SPACE UTM. Four of such courses are: ISO 9001:2008, OSHE, How to manage your finance, and How to get yourself employed (HTGYE).

23. Facilities available

List of Facilities:

1. Research Laboratories
2. Glass Blowing Workshop
3. Biotechnology Laboratory
4. Macromolecule Laboratory
5. Chemical Store
6. Department of Chemistry Resource Center
7. Students Activity Room
8. Students Computer Room
9. Inorganic Chemistry Laboratory 1 & 2
10. Physical Chemistry Laboratory 1 & 2
11. Organic Chemistry Laboratory 1 & 2
12. Analytical Laboratory 1 & 2
13. Forensic Laboratory
14. Instrument Rooms

List of Instruments

1. Nuclear Magnetic Resonance Spectrometer (NMR)
2. Solid State Nuclear Magnetic Resonance Spectrometer
3. Gas Chromatography-Mass Spectrometry
4. Fourier Transform Infrared Spectrometers (FTIR)
5. Gel Permeation Chromatography
6. UV-Visible Spectrometers
7. Diffuse-Reflectance UV-Visible Spectrophotometer
8. High Performance Liquid Chromatography (HPLC)
9. Gas Chromatography (GC)
10. Atomic Absorption Spectrometer (AAS)
11. Scanning Electron Microscope (SEM)
12. Field Emission Scanning Electron Microscope (FESEM)
13. Transmission Electron Microscope (TEM)
14. Ion Chromatography
15. Capillary Electrophoresis Unit
16. Single point BET Surface Area Analyzer
17. Multipoint Surface Analyzer
18. Differential Scanning Calorimeter
19. Thermogravimetry Analyzer (TGA)
20. Voltammetric System
21. Fluorescence Spectrometer
22. Surface Adsorption/Desorption System
23. Total Organic Carbon Analyzer (TOC)
24. Flame Photometer
25. Electron Spin Resonance Spectrometer (ESR)
26. X-Ray Diffraction Spectrometer
27. Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)
28. Glove box

24. Support for Students and Their Learning

- (a) Support Personnel
- Academic Advisor
 - Counselor
 - Student Association (PESAT)

- (b) Infrastructure support
- Internet access (Wireless)
 - e-learning
 - Digital library
 - Cafeterias
 - Health care center
 - Sports and recreational areas
 - Smart classroom
 - Students activity room
 - Reading Stations

- (c) Financial support
- Perbadanan Tabung Pendidikan Tinggi Negara (PTPTN)
 - MARA
 - JPA and others.

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

<p>1. Students performance in terms of:</p> <ul style="list-style-type: none"> ● KB/KS/KG –Pass/conditional pass/fail ● CPA – Cumulative point average ● Graduating students performance ● GOT – Graduate on time ● Completion rate ● Analysis of course performance <p>2. Employability</p> <ul style="list-style-type: none"> ● Exit survey ● Alumni survey ● Market survey <p>3 Lecturer’s performance</p> <ol style="list-style-type: none"> a. Teaching evaluation by students (e-PPP) b. Competency check-list for staff (CS). c. Annual staff appraisal (LPPT) 	<p>4. Curriculum review</p> <ul style="list-style-type: none"> ● 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) <p>5. Delivery system</p> <ul style="list-style-type: none"> ● Academic Quality Assurance Committee ● Customer Satisfaction Index (CSI) ● Employer Satisfaction Index (ESI) ● Anugerah Kualiti Naib Canselor (AKNC) audit ● Malaysian Quality Assurance (MQA) standard
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26. Regulation of Assessment

a. Summary of grades and marks

<i>Marks</i>	<i>Grade</i>	<i>Evaluation Points</i>
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
0 – 29	E	0

b. Role of External Examiners (Visiting Examiners)

Visiting Examiners are appointed by the Faculty Academic Committee to

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

27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		
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	per semester	Lecturer
Course outcome report	x	x	x	x	x	x	x	x	x	x	per semester	Lecturer
Final Year Project survey	x	x	x	x	x		x		x		per semester	Faculty
PO survey by final year students	x	x	x	x	x	x	x	x	x	x	per semester	Faculty
Research training survey			x	x	x	x	x	x	x		Per session	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	Once/ year	Director
Employer Survey	x	x	x	x	x	x	x	x	x	x	Once/ year	Director

BACHELOR OF SCIENCE (INDUSTRIAL CHEMISTRY)

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 (SSCC)			
6. Professional or Statutory Body of Accreditation	Malaysian Ministry of Education Kementerian Pendidikan Malaysia			
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-governing			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Minimum : 4 yrs Maximum : 6 yrs			
Type of Semester	No. of semester		No. of weeks per semester	
	Full Time	Part Time	Full Time	Part Time
Normal	8		14	
Short	-		-	
12. Entry Requirement	<p>Fulfills University requirements and the following program requirements:</p> <p>STPM/Matriculation/Science Foundation</p> <p>Minimum CGPA of 2.80 and passed with Grade B in Chemistry and Grade B- in ONE (1) of the following subject : Biology/Mathematics/Physics</p> <p>DIPLOMA</p> <p>Minimum CGPA of 3.00 and passed with credits in Mathematics in the SPM/equivalent examination.</p>			

13. Program Objectives

The objectives of the B.Sc. (Industrial Chemistry) program are to provide the knowledge, skills and attributes that should be achieved by the graduates for a successful career. The graduate should be able to:

1. Become chemists who are competent, innovative and productive in addressing chemistry issues in chemical related industries.
2. Develop professionally with proficient soft skills to adapt to a range of contacts and audiences.
3. Demonstrate high standard of ethics, pure values and social responsibilities.

14. Program Learning Outcomes (PLO)			
Code	Intended Learning Outcomes	Teaching and Learning Methods	Assessment
(a) Technical Knowledge and Competencies			
PLO1 Fundamental knowledge (KW)	Ability to acquire knowledge of fundamental laws and principles of chemistry related to current application as well as knowledge in social science and personnel development. (C2)	Lectures, tutorials, laboratory works, directed reading, group discussion.	Examination, test, quiz, and laboratory report.
PLO2 Application of knowledge (AP)	Ability to apply, practice and analyze fundamental laws, principles of chemistry and chemical techniques using scientific methodologies related to chemical application. (C4)	Lectures, laboratory works, assigned reading, group discussion and problem solving assignments, hands-on instrumentations, chemistry related softwares.	Examination, test, quiz, assignment, laboratory report, oral presentation and group project.
PLO3 Analyzing and experimental skills (PS)	Ability to plan, evaluate and demonstrate scientific study related to industrial chemistry. (C6, P6)	Lectures, laboratory works, assigned reading, group discussion and problem solving assignments, hands-on instrumentations, chemistry software and research project. Research Proposal, project presentation and report.	Examination, test, quiz, assignment, and laboratory report, group project, computer simulation, project proposal, presentation, final year project report and Industrial supervisor report.
(b) Generic Skills			
PLO4 Communication Skills (CS)	Ability to present technical, scientific and chemical information and arguments clearly and correctly, in writing and orally to a range of audiences. (P4)	Group projects, Laboratory work, independent research, industrial training.	Oral presentation, written assignment, laboratory report, research project report, industrial training report.
PLO5 Thinking Skills (TH)	Ability to think critically and creatively in solving scientific problems. (P4)	Independent research projects, group research projects, industrial training.	Independent project report, individual assignment report and industrial training report.
PLO6 Scholarship (SC)	Ability to continuously seek new knowledge, skills and manage relevant information from various sources. (A3)	Final Year Project, individual assignment and laboratory works, industrial training.	Final year project report, written assignment and Laboratory report, industrial training report.

PLO7 Teamworking Skills (TW)	Ability to portray good interpersonal skills with high ability to work collaboratively as part of a team undertaking a range of different team roles. (A3)	Laboratory works, group assignments	Laboratory report, logbooks and group assignment report
PLO8 Adaptability (AD)	Ability to adapt, identify self-potential and be an agent of change in a new culture and environment. (A3)	Group assignment, laboratory work.	Group assignment report and laboratory report.
PLO9 Global Citizen (GC)	Ability to act with integrity, professionalism and good ethics in their profession and their obligation as a global citizen. (A3)	Lecture, Individual assignment, Laboratory work, Final Year Project and industrial training.	Laboratory report, individual assignment report, seminar presentation and final year project report
PLO10 Enterprising Skills (ES)	Ability to act with enterprising mindset, risk taker, innovative, effective, imaginative and resilience.(P2)	Lecture, Laboratory works and case studies and industrial training.	Written assignment, Final year report and industrial training report.

15. Classification of Courses			
No.	Classification	Credit Hours	Percentage (%)
1	Basic Sciences and Mathematics	10	57.2
2	Program core	65	
3	Program Elective	33	25.2
4	Compulsory university courses <ul style="list-style-type: none"> • Humanity • English Language • Co-curriculum • Entrepreneurship 	10 8 3 2	17.6
	Total	131	100%
For Science program please fill up the following classification. (Others please refer to the Statutory Body guidelines)			
A.	Classification	Credit Hours	Percentage (%)
	Chemistry Courses		
	(a) Lecture	75	52.3
	(b) Laboratory/Workshop/Field	8	6.1
	(c) Industrial Training	5	3.8
	(d) Final Year Project	6	4.6
	Total credit hours for Part A	94	71.7
B.	Related Courses		
	(a) Mathematics	6	4.6
	(b) Humanities/Ethics	12	9.2
	(c) Co-Curriculum	3	2.3
	(d) English	8	6.1
	(e) Entrepreneurship	2	1.5
	(f) Management	6	4.6
	Total credit hours for Part B	37	28.3
	Total credit hours for Parts A and B	131	100%

16. Total credit hours to graduate	131 credit hours
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17. Program structures and features, curriculum and award requirements

The course is offered on full-time mode and is based on 2-Semesters Academic Session with several courses 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 not less than **130** credit hours with minimum CPA of 2.00.
- Pass Industrial Training (equivalent to 5 credit hours).
- Complete and pass the undergraduate project Final Year Project.

SEMESTER 1			SEMESTER 2		
Code	Name of Course	cr	Code	Name of Course	cr
UICI 1012	Islamic and Asian Civilization	2	ULAB 1122	Academic English Skills	2
SSCC 1014	Principles of Chemistry	4	SSCC 1413	Chemical Thermodynamics	3
SSCC 1312	Laboratory Occupational Safety and Health	2	SSCC 1841	Physical Chemistry Practical I	1
SSCC 1703	Inorganic Chemistry	3	SSCC 1603	Organic Chemistry – Functional Groups	3
SSCC 1851	Inorganic Chemistry Practical I	1	SSCC 1821	Organic Chemistry Practical I	1
SSCM 1023	Mathematical Methods I	3	SHAD 1033	Principles of Management	3
			UHAS 1172	Malaysia Dynamics*	2
			UHAS1162/ UHAK1022	Arts, Customs and Beliefs of Malaysian*	2
			UHAK1032	Introduction to Entrepreneurship	2
Total Credit Hours		15	Total Credit Hours		17
<p>*UHAS 1172 : Local Student *UHAS 1162 : Foreign Student</p>					
SEMESTER 3			SEMESTER 4		
Code	Name of Course	cr	Code	Name of Course	cr
SSCC 2613	Organic Chemistry – Biomolecules	3	ULAB 2122	Advanced Academic English Skills	2
SSCC 2891	Organic Chemistry Practical II	1	SSCC 2713	Coordination Chemistry	3
SSCC 2453	Chemical Kinetics and Electrochemistry	3	SSCC 2851	Inorganic Chemistry Practical II	1
SSCC 2841	Physical Chemistry Practical II	1	SSCC 2473	Molecular Spectroscopy	3
SSCC 2312	Laboratory Safety and Management	2	SSCC 2243	Principles of Analytical Chemistry	3
SSCM 1103	Statistics	3	SSCC 2861	Analytical Chemistry Practical I	1
UICL 2302	The Thought of Sciences and Technology	2	UHAK1012	Graduate Success Attributes	2

Total Credit Hours			15	Total Credit Hours			15
SEMESTER 5				SEMESTER 6			
Code	Name of Course	cr	Code	Name of Course	cr		
SSCC 3233	Instrumental Analysis	3	UKQE 3001	Extracurricular Experiential Learning (ExCEL)	1		
SSCC 3871	Analytical Chemistry Practical II	1	SSCC 3423	Industrial Chemical Process	3		
SSCC 3213	Environmental Chemistry	3	SSCU 3623	Research Methodology and Information Retrieval	3		
SHAS 1043	Organizational Behaviors	3	UKQA2092	Science and Community	2		
ULAB 3162	English for Professional Purposes	2	ULA* 1112	Language Skills Elective	2		
UHAK 2**2	Soft Skills Elective	2	Elective (Choose 6 credits)				
			SSCC 3643	<i>Application of Spectroscopy</i>	3		
			SSCC 3353	<i>Consumer Chemistry</i>	3		
			SSCC 3493	<i>Surface and Colloid Chemistry</i>	3		
			SSCC 3243	<i>Separation Methods</i>	3		
			SSCC 3533	<i>Applications of Computer in Chemistry</i>	3		
			SSCC 3463	<i>Quantum Chemistry</i>	3		
Total Credit Hours			14	Total Credit Hours			17
SHORT SEMESTER							
Code	Name of Course	cr					
SSCU 3905	Industrial Training (HW)	5					
Total Credit Hours			5				
SEMESTER 7				SEMESTER 8			
Code	Name of Course	cr	Code	Name of Course	cr		
SSCU 4902	Undergraduate Project I	2	SSCU 4904	Undergraduate Project II	4		
Elective (Choose 15 credits)			Elective (Choose 12 credits)				
SSCC 4273	<i>Forensic Science</i>	3	SSCC 4753	<i>Catalytic Chemistry</i>	3		
SSCC 4323	<i>Principles of Polymer Chemistry</i>	3	SSCC 4253	<i>Food Analysis</i>	3		
SSCC 4663	<i>Natural Products Chemistry</i>	3	SSCC 4673	<i>Industrial Organic Chemistry</i>	3		
SSCC 4483	<i>Corrosion Chemistry</i>	3	SSCC 4303	<i>Oleochemistry</i>	3		
SSCC 4683	<i>Biotechnology</i>	3	SSCC 4423	<i>Liquid Crystal</i>	3		
SSCC 4793	<i>Inorganic Energy Materials</i>	3	SSCC 4383	<i>Special Topics in Industrial Chemistry</i>	3		
SSCC 4333	<i>Petrochemistry</i>	3	SSCP 3433	<i>Quality Control</i>	3		
SSCC 4293	<i>Radioanalytical Chemistry</i>	3					
SHAC 1023	<i>Cost Accounting</i>	3					
Total Credit Hours			17	Total Credit Hours			16

18. Mapping of Program Learning Outcomes to Courses											
COURSES OFFERED		LEARNING OUTCOMES									
		Fundamental Knowledge	Application of Chemistry	Analyzing and Experimental	Communication Skills	Thinking Skills	Scholarship	Team Working Skills	Adaptability	Global Citizen	Enterprising Skills
Code	Courses	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Core Courses											
SSCC 1014	Principles of Chemistry	✓	✓	✓							
SSCC 1312	Laboratory Occupational Safety and Health	✓	✓			✓					
SSCC 1703	Inorganic Chemistry	✓	✓								
SSCC 1851	Inorganic Chemistry Practical	✓	✓	✓		✓		✓			
SSCM 1023	Mathematical Methods I	✓	✓								
SSCC 1413	Chemical Thermodynamics	✓	✓								
SSCC 1841	Physical Chemistry Practical I	✓	✓	✓	✓	✓					
SSCC 1603	Organic Chemistry – Functional Groups	✓	✓								
SSCC 1821	Organic Chemistry Practical I	✓	✓	✓		✓		✓			
SHAD 1033	Principles of Management	✓									
SSCC 2613	Organic Chemistry – Biomolecules	✓	✓						✓		
SSCC 2891	Organic Chemistry Practical II	✓	✓	✓	✓			✓			
SSCC 2453	Chemical Kinetics and Electrochemistry	✓	✓						✓		
SSCC 2841	Physical Chemistry Practical II	✓	✓	✓	✓	✓					
SSCM 1103	Statistics	✓	✓								
SSCC 2312	Laboratory Safety and Management	✓	✓			✓					
SSCC 2713	Coordination Chemistry	✓	✓						✓		
SSCC 2851	Inorganic Chemistry Practical II	✓	✓	✓	✓			✓			

SSCC 2473	Molecular Spectroscopy	✓	✓						✓		
SSCC 2243	Principles of Analytical Chemistry	✓	✓						✓		
SSCC 2861	Analytical Chemistry Practical I	✓	✓	✓	✓	✓					
SSCC 3233	Instrumental Analysis	✓	✓				✓				
SSCC 3871	Analytical Chemistry Practical II	✓	✓	✓		✓		✓			
SSCC 3213	Environmental Chemistry	✓	✓				✓				
SSCC 3423	Industrial Chemical Process	✓	✓					✓			
SHAS 1043	Organizational Behaviors	✓									
SSCU 3623	Research Methodology and Information Retrieval	✓	✓		✓	✓	✓				
SSCU 3905	Industrial Training	✓	✓	✓	✓	✓	✓	✓	✓	✓	
SSCU 4902	Undergraduate Project I	✓	✓		✓	✓	✓				
SSCU 4904	Undergraduate Project II	✓	✓	✓	✓	✓	✓				
	Total	30	28	11	9	12	6	7	6	1	0
Elective Courses											
SSCC 3643	<i>Application of Spectroscopy</i>	✓	✓			✓					
SSCC 3353	<i>Consumer Chemistry</i>	✓	✓			✓					
SSCC 3493	<i>Surface and Colloid Chemistry</i>	✓	✓			✓					
SSCC 3243	<i>Separation Methods</i>	✓	✓			✓					
SSCC 3533	<i>Applications of Computer in Chemistry</i>	✓	✓			✓					
SSCC 3463	<i>Quantum Chemistry</i>	✓	✓			✓					
SSCC 4273	<i>Forensic Science</i>	✓	✓				✓				
SSCC 4323	<i>Principles of Polymer Chemistry</i>	✓	✓				✓				
SSCC 4663	<i>Natural Products Chemistry</i>	✓	✓				✓				
SSCC 4483	<i>Corrosion Chemistry</i>	✓	✓				✓				
SSCC 4683	<i>Biotechnology</i>	✓	✓				✓				
SSCC 4793	<i>Inorganic Energy Materials</i>	✓	✓				✓				
SSCC 4333	<i>Petrochemistry</i>	✓	✓				✓				
SSCC 4293	<i>Radioanalytical Chemistry</i>	✓	✓				✓				
SHAC 1023	<i>Cost Accounting</i>	✓	✓				✓				
	TOTAL (Choose 5)	5	5	0	0	0	5	0	0	0	0
SSCC 4753	<i>Catalytic Chemistry</i>	✓	✓							✓	
SSCC 4253	<i>Food Analysis</i>	✓	✓							✓	
SSCC 4673	<i>Industrial Organic Chemistry</i>	✓	✓							✓	

SSCC 4303	<i>Oleochemistry</i>	✓	✓							✓	
SSCC 4423	<i>Liquid Crystal</i>	✓	✓							✓	
SSCC 4383	<i>Special Topics in Industrial Chemistry</i>	✓	✓							✓	
SSCP 3433	<i>Quality Control</i>	✓	✓							✓	
	Total (Choose 4)	4	4	0	0	0	0	0	0	4	0
University Courses											
UICI 1012	Islamic and Asian Civilizations (TITAS)					✓	✓			✓	
UHAS 1172	Malaysian Dynamics						✓			✓	
UHAS 1162	Arts, Custom and Belief of Malaysian						✓			✓	
UICL 2302	The Thought of Science and Technology					✓	✓			✓	
UHAK 1032	Introduction to Entrepreneurship										✓
UHAK 1012	Graduate Success Attributes				✓		✓	✓			✓
UKQA 2092	Science and Community						✓	✓	✓	✓	
UHAK 2**2	Soft Skills Elective						✓	✓	✓		✓
ULA* 1112	Language Skills Elective				✓						
ULAB 1122	Academic English Skills				✓						
ULAB 2122	Advanced Academic English Skills				✓						
ULAB 3162	English for Professional Purposes				✓						
UKQE 3001	Extracurricular Experiential Learning (ExCEL)				✓	✓	✓	✓	✓	✓	✓
	TOTAL	0	0	0	6	3	7	4	3	5	4
	GRAND TOTAL	41	39	11	15	15	18	11	9	10	4

Key:

PO1 – PO3 = Technical Skills
PO4 – PO10 = Generic Skills

19. Our Uniqueness

- The program is specially tailored to suit the current industrial needs.
- This program allows student to do their industrial placement at local or foreign companies.
- This program is recognized by professional body; Malaysian Institute of Chemistry.
- Established links with local and international industries.
- The program allows student to do transfer credit of certain equivalence courses offered by other universities locally and overseas.
- Our laboratories are equipped with state of the art facilities and instruments.

20. Career Prospects and Career Paths

Graduates of the program can work as

- chemists or scientists in government research institutions such as MARDI, Malaysia Palm Oil Board (MPOB), RRI, PRSS, AMREC, SIRIM, Jabatan Kimia Malaysia and Malaysian Nuclear Agency (Nuclear Malaysia).

- 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.
- academics or researchers in higher learning institutions, following pursuance of their degree qualifications to Masters or PhD levels.
- quality control or quality assurance and marketing officers in agencies or industries in which sound knowledge of chemistry skills are required.

21. Cross Campus Program

Students are given the opportunity to enroll certain courses in participating universities locally and overseas. The grades and credits up to 1/3 of the total credits of the curriculum are transferable.

22. Professional Skills Program Certificate

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 Facilities:

1. Inorganic Chemistry Laboratory 1 & 2
2. Physical Chemistry Laboratory 1 & 2
3. Organic Chemistry Laboratory 1 & 2
4. Analytical Laboratory 1, 2, & 3
5. Instrument Rooms (10)
6. Research Laboratories (10)
7. Glass Blowing Workshop
8. Biotechnology Laboratory
9. Macromolecule Laboratory
10. Chemical Store
11. Department of Chemistry Resource Center
12. Students Activity Room
13. Students Computer Room

List of Instruments

1. Nuclear Magnetic Resonance Spectrometer (NMR)
2. Solid State Nuclear Magnetic Resonance Spectrometer
3. Gas Chromatography-Mass Spectrometry (GC-MS)
4. Fourier Transform Infrared Spectrometers (FTIR)
5. Gel Permeation Chromatography (GPC)
6. UV-Visible Spectrometers
7. Diffuse-Reflectance UV-Visible Spectrophotometer
8. High Performance Liquid Chromatography (HPLC)
9. Gas Chromatography (GC)
10. Atomic Absorption Spectrometer (AAS)
11. Scanning Electron Microscope (SEM)
12. Field Emission Scanning Electron Microscope (FESEM)
13. Transmission Electron Microscope (TEM)
14. Ion Chromatography (IC)
15. Capillary Electrophoresis Unit
16. Single Point BET Surface Area Analyzer
17. Multipoint Surface Analyzer
18. Differential Scanning Calorimeter (DSC)
19. Thermogravimetry Analyzer (TGA)

- 20. Voltammetric System
- 21. Fluorescence Spectrometer
- 22. Surface Adsorption/Desorption System
- 23. Total Organic Carbon Analyzer (TOC)
- 24. Flame Photometer
- 25. Electron Spin Resonance Spectrometer (ESR)
- 26. X-Ray Diffraction Spectrometer
- 27. Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)
- 28. Glove Box

24. Support for Students and Their Learning

- (a) Support Personnel
 - Academic Advisor
 - Counselor
 Student Association (PESAT)
- (b) Infrastructure support
 - Internet access (Wireless)
 - e-learning
 - Digital library
 - Cafeterias
 - Health care center
 - Sports and recreational areas
 - Smart classroom
 - Students activity room
 - Reading Stations
- (c) Financial support
 - Perbadanan Tabung Pendidikan Tinggi Negara (PTPTN)
 - MARA
 - JPA and others.

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

- | | |
|--|--|
| <ul style="list-style-type: none"> 1. Students performance in terms of: <ul style="list-style-type: none"> ● KB/KS/KG –Pass/conditional pass/fail ● CPA – Cumulative point average ● Graduating students performance ● GOT – Graduate on time ● Completion Rate ● Analysis of course performance 2. Employability <ul style="list-style-type: none"> ● Exit survey ● Alumni survey ● Market survey 3. Lecturer’s performance <ul style="list-style-type: none"> d. Teaching evaluation by students (e-PPP) e. Competency check-list for staff (CS). f. Annual staff appraisal (LPPT) | <ul style="list-style-type: none"> 4. Curriculum review <ul style="list-style-type: none"> ● 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 <ul style="list-style-type: none"> ● Academic Quality Assurance Committee ● Customer Satisfaction Index (CSI) ● Employer Satisfaction Index (ESI) ● Anugerah Kualiti Naib Canselor (AKNC) audit ● Malaysia Quality Assurance (MQA) standards |
|--|--|

26. Regulation of Assessment

(a) Summary of grades and marks

<i>Marks</i>	<i>Grade</i>	<i>Evaluation Points</i>
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
0 – 29	E	0

(b) Role of External Examiners (Visiting Examiners)

Visiting Examiners are appointed by the Faculty Academic Committee to

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

27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10		
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	per semester	Lecturer
Course outcome report	x	x	x	x	x	x	x	x	x	x	per semester	Lecturer
Final Year Project survey	x	x	x	x	x		x		x		per semester	Faculty
PO survey by final year students	x	x	x	x	x	x	x	x	x	x	per semester	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/ year	Head of Dept.
Employer Survey	x	x	x	x	x	x	x	x	x	x	Once/year	Head of Dept.

SYNOPSIS OF CHEMISTRY COURSES

SSCC 1014 – Principles of Chemistry

This course provides an introduction to the chemical and physical aspects of inorganic and organic molecules. The emphasis is on basic principles of atomic and molecular electronic structure, chemical bonding, state of matters, thermochemistry, acid-base and redox equilibria, chemical kinetics, electrochemistry and organic chemistry. Introductory experimentation in chemistry is also included throughout the course that emphasizes development of fundamental laboratory skills and techniques.

SSCC 1312 – Laboratory Occupational Safety and Health

The emphasis of this subject is to inculcate awareness culture for an improved safety and health working attitudes on the students. The fundamental concept and theory related to laboratory organization and design, material, human, chemical managements, safe practices in laboratories, storage, inventory control and international standard for documentation will be introduced, discussed, with actual case scenarios. Students are expected to be able to construct, plan, defend, suggest, evaluate and criticise various angles of the subject and apply them in related cases or incidents. Understanding Factories and Machinery Act 1967 and Occupation and al Safety and Health Act 1994 is a must.

SSCC 1703 – Inorganic Chemistry

This course introduces the basic concepts of inorganic chemistry, focusing largely on the structure, reactivity and periodicity of inorganic substances of the main group elements. The course also teaches the systematic survey of the descriptive inorganic chemistry of the main group elements, including industrial applications and practical uses of important classes of inorganic compounds.

SSCC 1851 – Inorganic Chemistry Practical I

This course introduces the basic concepts and skills in inorganic chemistry practical. The experiments are focused on physicochemical properties of elements and compounds of Group IA, Group IIA, Aluminium, Nitrogen, Sulphur and Halogen. This course also exposes students to basic skill of handling chemicals and preparing solution.

SSCC 1413 – Chemical Thermodynamics

The course is an introduction to chemical thermodynamics, and provides an understanding of the basic principles, laws and theories of physical chemistry that are required for chemistry. You will use mathematical equations to describe physical phenomena and solve problems quantitatively. The course begins with a topic on Gases, which include the properties and equation of states of ideal and real gas, virial equation and principle of corresponding states. The next topic will emphasize on Chemical Thermodynamics: Basic concepts of thermodynamics – State functions, heat, enthalpy, internal energy, Gibbs free energy, Helmholtz free energy, heat capacity, First, Second and Third Laws of thermodynamics and Zeroth law of thermodynamics. Topics on Chemical Equilibria will focus on chemical potential and phase equilibria which include the phase rule and phase diagram of single component system. The final topic will cover Solutions: Compositions, partial molar quantities, ideal solutions, ideally dilute solutions and non-ideal solutions.

SSCC 1841 - Physical Chemistry Practical I

This course is designed to increase and strengthen students' understanding on the concepts and principles in Chemical Thermodynamics through experiments conducted in the laboratory. The experiments selected for the course illustrate concepts explored in the Chemical Thermodynamics lecture, enable students to test the relation of theories with experiments, learn experimental methods used by physical chemist, develop laboratory skills and the ability to work independently, learn how to effectively present scientific results and appreciate the limitations inherent in both theoretical treatments and experimental measurements.

SSCC 1603 – Organic Chemistry-Functional Groups

This course discusses the fundamental concepts of functional groups in organic compounds. These include aliphatic and aromatic hydrocarbons, alcohols, phenols, organohalogen compounds, ethers, epoxides, aldehydes, ketones and carboxylic acids. In each topic, the students will be introduced to the structures of the functional groups and the nomenclatures (common names and IUPAC names). Physical properties, preparations, reactions and visual tests will also be discussed. Inter-conversion of the related functional groups and their reaction mechanisms are also included.

SSCC 1821 - Organic Chemistry Practical I

This course 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.

SSCC 2613 - Organic Chemistry-Biomolecules

This course introduces the classifications, synthesis and reactions of biomolecules such as carbohydrates, peptides, proteins and lipids. It will also emphasise on the three-dimensional structures and fundamental concepts of stereochemistry. Infrared spectroscopy is included as a technique in characterizing the functional groups of compounds.

SSCC 2891 - Organic Chemistry Practical II

This course introduces students to the techniques and knowledge required in the preparation of isomeric compounds, derivative of glucose, azo dyes and the isolation, purification and reaction of lipid. Students will be exposed to the infrared spectroscopic technique as a tool to determine the functional groups of the synthetic and isolated compounds.

SSCC 2453 - Chemical Kinetics and Electrochemistry

This course discusses the fundamental and application of chemical kinetics and electrochemistry. The chemical kinetics includes the rate and mechanism of reactions, order of reactions, rate laws and the comparison of theories with experiments for simple gas reactions, reactions in solution, complex reactions, homogeneous catalysis, chain reactions and rapid reactions. The electrochemistry includes the electrolyte conductivity, theory on conductivity, activity, transport numbers, electrochemical cells and electrode processes and kinetics.

SSCC 2841 - Physical Chemistry Practical II

This course is designed to increase and strengthen students' understanding on the concepts and principles in Chemical Kinetics and Electrochemistry through experiments conducted in the laboratory. The experiments selected for the course illustrate concepts explored in the Chemical Kinetics and Electrochemistry lecture, enable students to test the relation of theories with experiments, learn experimental methods used by physical chemist, develop laboratory skills and the ability to work independently, learn how to effectively present scientific results and appreciate the limitations inherent in both theoretical treatments and experimental measurements.

SSCC 2312 - Laboratory Safety and Management

The emphasis of this subject is to inculcate and immerse fundamental concept and theory related to laboratory organization, management of resources, inventory control, budgeting, contracts, laboratory design, product specifications, material sourcing, vendors, and auditing. All management systems are based on local and global market needs based on selected industries. Students are expected to be able to construct, plan, defend, suggest, evaluate and criticise various angles of the subject and apply them in related cases. Quality Laboratory System. Accreditation process and validation process will be highlighted. Common QMS systems such as ISO17025, ISO 9001, 9002, 45000, 22000, series, HACCP, SEDEX, RSPO, MESTI, subcontracting analysis processes such as HALAL, KOSHER analysis, and other related issues will be discussed. Lab Information Management System (LIMS) will also be introduced.

SSCC 2713 – Coordination Chemistry

This course 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 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 are illustrated. The electronic spectra and colour properties of the metal complexes will be explained. Spectroscopic characterization techniques of coordination compounds are also covered.

SSCC 2851 – Inorganic Chemistry Practical II

The emphasis of this course is to provide the students with an appreciation for the synthesis and characterizations of coordination compounds. It is also aimed to provide the students with a degree of competence in the laboratory skills required for accurate and precise chemical analysis. The experiments selected for this course include developing skills in the synthesis and isolation of coordination compounds or metal complexes with different kinds of ligands followed by characterization by conventional methods such as gravimetry, titrimetry and melting point, including

characterization techniques used by coordination chemists such as UV-visible, NMR and FTIR spectroscopies. The principles of the spectroscopic methods are described and discussed with respect to their respective spectral outputs and interpretation obtained from the as-synthesized coordination compounds.

SSCC 2473 - Molecular Spectroscopy

The emphasis of this course is to expose the students to the fundamental principles of molecular spectroscopy focusing on molecular energy levels and their interaction with electromagnetic radiation, spectral outputs and their interpretation in relation to molecular structure. The branches of spectroscopy covered include rotational spectroscopy, vibrational spectroscopy (IR and Raman), electronic spectroscopy (absorption and emission) and spin resonance spectroscopy (NMR and ESR). The general spectrometer components and the requirements for high resolution spectrum of FTIR and FT NMR will be discussed to represent the practical aspects of this subject.

SSCC 2243 - Principles of Analytical Chemistry

This course provides a basic introduction to quantitative chemical analysis, with emphasis on classical chemical methods. The course introduces general analytical techniques that include sampling, sample preparation, data analysis and method validation; and classical analytical methods that include gravimetric and volumetric techniques. The volumetric method will emphasize on acid-base, precipitation, complexometric and redox titrations.

SSCC 2861 - Analytical Chemistry Practical I

The course introduces students to Good Laboratory Practices in classical (wet chemistry) methods. Experiments are designed to complement the topics covered in Principles of Analytical Chemistry (SSCC 2243), which include gravimetric and volumetric techniques. Part of the course consists of a short laboratory project.

SSCC 3233 - Instrumental Analysis

This course introduces the principles, instrumentation and application of spectroscopic and chromatographic methods used in analytical chemistry. Emphasis is on ultraviolet-visible (UV-Vis) spectroscopy, fluorescence spectroscopy, mass spectrometry, atomic absorption spectroscopy and emission spectroscopy, liquid chromatography and gas chromatography.

SSCC 3871 – Analytical Chemistry Practical II

The subject introduces students to laboratory work related to instrumental methods of analysis. Experiments complement topics in Instrumental Analysis (SSCC 3233) that include techniques in ultra violet-visible spectroscopy, atomic absorption spectroscopy, fluorescence spectroscopy, and atomic flame emission photometry.

SSCC 3213/SSCC 4213 - Environmental Chemistry

The subject will focus on the fundamental concepts of environmental studies and sustainability. Emphasis will be given on sustaining the ecosystem, biodiversity, natural resources and environmental quality through understanding the various processes in natural water system and industrial processes and the water and wastewater treatment practices. The sustainability theme is expanded to air pollution and global climate and its proposed solutions. Awareness and practical application of green technology will also be discussed.

SSCC 3423 Industrial Chemical Process

This course is designed to discuss the basic principles involved in chemical industrial processes. It involves dimensional analysis, material and energy balance, basic unit operations, basic separation processes and process control. Dimensional analysis stresses on the basic units, dimensions, conversions of units which usually applied in scientific and engineering calculations. Material and energy balance discuss the fundamental calculations in non-reactive and reactive systems as well as recycle, bypass and purge on chemical processes. Basic unit operations and separation processes include type of reactors, heat exchanger, distillation, absorption and filtration processes. Process control discusses the process flow, flow-diagram and automation in chemical industries.

SSCC 3643 – Application of Spectroscopy

This course discusses the theory and application of infrared (IR), nuclear magnetic resonance (NMR), ultraviolet (UV) spectroscopies and mass spectrometry (MS) for structural determination of organic compounds. In addition, elemental analysis for determination of molecular formula and index of hydrogen deficiency will be discussed.

SSCC 3353 - Consumer Chemistry

Introduces students to various consumer products that are chemically 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.

SSCC 3493 – Surface and Colloid Chemistry

This course introduces the fundamentals and application of surface and colloid chemistry. The fundamental concept of different types of surfaces and interfaces are discussed to better understand surface phenomenon including physical and chemisorption processes, classification of adsorption isotherm, capillary rise, wetting and spreading. For colloidal and emulsion systems, the course discusses the classification, mechanism of formation, stability and colloidal phenomena. The course will enable students to develop and apply knowledge in describing several absorption models and colloidal systems.

SSCC 3243 - Separation Methods

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

SSCC 3533 - Application of Computer in Chemistry

This course introduces the application of computer methods in chemistry. Topics discussed include regression analysis, multivariate calibration, pattern recognition, experimental design and optimisation, handling of chemical structures, chemical databases, molecular modelling, and artificial intelligence. Applications of these methods in data analysis, structural searching, prediction of properties and drug design are discussed.

SSCC 3463 - Quantum Chemistry

The emphasis of this course is to expose the students to the fundamental principles and techniques of quantum chemistry in the description of atom and molecule in terms of electronic structure and properties. This course is introduced by discussing wave particle behaviour of electron, Schrodinger wave equations and its applications to a particle in a box, harmonic oscillator, rigid rotor, hydrogen atom, and hydrogen like atoms. It continued further on the combination of atoms to form molecules; valence bond and molecular orbital theories; Huckel approximation; approximate techniques: variation and perturbation.

SSCC 4273 – Forensic Science

This course introduces forensic science and the legal aspects. The roles of forensic scientist as crime scene investigator to laboratory analyst and finally as an expert witness in court are highlighted. Forensic analyses of paints, glass, hairs & fibres, fire debris and explosives, question document, drugs of abuse, blood, semen and saliva are covered in this course.

SSCC 3323 - Principles of Polymer Chemistry

This course introduces the basic principles of polymers as materials with characteristic mechanical and physical properties which are controlled by the structure and the methods of synthesis. Topics covered in the course are nomenclatures, polymer synthesis, reaction of monomers to form polymers by chain-growth and step-growth polymerisations, polymerisation mechanisms and kinetics related to degree of polymerization and molecular weight control and molecular distributions. Physical aspect of polymer (polymer structures, morphology, amorphous state and glass-transitions temperature T_g , crystalline state and crystalline melting temperature, T_m) are discussed. The inter-related molecular weights and molecular weight distributions on morphologies and their effects on the processing and final properties of polymers will be emphasized, as well as the structure-properties relation that influenced the overall properties of a polymer. A short special topic on current trendy polymeric materials and current issues is also discussed.

SSCC 3743 - Materials Chemistry

This course intended to give an overall introduction to the importance of materials and how chemistry controls its properties. Types of materials include metals, semiconductors, superconductors, ceramics, glass, composites, polymers and nanomaterials. The different types of bonding exist in materials in terms of bonding such as ionic,

covalent, metallic, van der Waals and H-bond are explained. The general properties of materials such as mechanical, electrical, optical and thermal will be discussed. The relationship between the structures of materials with respect to their physicochemical properties will be examined. The synthesis, processing, fabrication and application of industrial materials are highlighted. Various characterization techniques of solid materials shall be discussed.

SSCC 3693 – Metabolism of Biomolecules

This course discusses the metabolism of biomolecules such as carbohydrates, lipids and proteins. Discussion includes catabolism and anabolism for each biomolecules. Production of ATP from biomolecules based on Chemiosmotic theory will be discussed. Inborn errors of metabolism related to specific biomolecules will be highlighted.

SSCC 4663 - Natural Products Chemistry

This course introduces the fundamental concepts of natural products chemistry. The biosynthetic pathway of the secondary metabolites such as terpenes, flavonoids and alkaloids will be discussed. Isolation, classification and structural identification of terpenes, flavonoids and alkaloids will be covered. Reaction and synthesis associated with these compounds will be further examined.

SSCC 4483 - Corrosion Chemistry

This course introduces the concept of corrosion, importance of corrosion, the driving force for corrosion reactions, thermodynamic and kinetics of corrosion. This will include characteristic forms of electrochemical corrosion, prevention and control of electrochemical corrosion and high temperature corrosion/oxidation. Pourbaix diagram is introduced to better understand concept of corrosion in various metals. Butler Volmer Equation and Tafel plot will be used to discuss the kinetics of corrosion process. The concept of cathodic inhibition, sacrificial anode, coating and design will be discussed.

SSCC 4683 - Biotechnology

This course aims to give chemistry major students an understanding of the multidisciplinary nature of biotechnology. It includes understanding some of the basic principles of microbiology, biochemistry and engineering aspects of bioprocesses. The course mainly focuses on industrial and environmental aspects of Biotechnology where chemist can play an important role. Introduction to microbiology will be taught to familiarize students with the terms commonly used in Biotechnology. Topics include classification of microorganisms; prokaryotic and eukaryotic cells; biomolecules, DNA as genetic material, bacterial growth and metabolism, microbial culture systems in bioreactors: batch, fed batch and continuous systems, and cell immobilisation. Some insights into industrial biotechnology: production of antibiotics, amino acids; organic acids, solvents and enzymes. While environmental biotechnology touches on bioremediation, sewage system and wastewater treatment processes and metal recovery. Also a brief introduction on animal cloning and stem cells technology as a special interest topic.

SSCC 4793 - Inorganic Energy Materials

This course introduces how in inorganic chemistry, many active researches are directed towards materials used in conventional energy applications, as well as materials and material combinations for possible future energy systems. In both these areas, control and fundamental understanding of the chemistry are of paramount importance for the design of new energy-related materials.

SSCC 4333 - Petrochemistry

This course discusses the preparation and the processing of basic petrochemicals, which are crucial in the petroleum industry. These petrochemicals include olefin and aromatic chemicals, together with its derivatives. The preparation of carbon dioxide, hydrogen, ammonia and other gaseous, will also be discussed.

SSCC 4293 - Radioanalytical Chemistry

This course focuses on the principles of radioactivity and their applications in analytical chemistry including use of radiotracers in quantitative work. Error in techniques used will also be covered. Some of the analytical approaches discussed are isotope dilution analysis; radiometric titrations including selection of radiotracers. Some techniques of using radiotracers such as liquid scintillation techniques, its principles and applications will be discussed. Other related techniques include radioimmunoassay, neutron activation analysis, radiocarbon dating and geological chronology, radiochromatography and Mossbauer spectroscopy. Some industrial applications in industry will also be covered.

SSCC 4753 – Catalytic Chemistry

This course introduces students to the role of catalysts in chemical and biological processes. Kinetics and reaction mechanism of catalysed reactions and structural aspects of catalysts will be highlighted. Emphasis is on the factors that influence catalysts reactivity in both homogeneous and heterogeneous catalysis. Different methods of preparation and characterization of catalytic materials and the underlying principles with regard to industrial application of the catalyst will be discussed. 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 catalysts, zeolites and metal oxides.

SSCC 4253 - Food Analysis

This course is designed to provide students with an understanding of the principles and procedures for the analysis of chemical components of food. Introduction of food chemistry, food regulations, international standards and guidelines, sample handling and preparation of data collection, reporting and analysis of data are included. Sample local case will also be studied. Key analytical and separation techniques will also be discussed, including food microbiological testing, proximate analysis, rapid techniques and relevant modern techniques. Students will also be exposed to industrial practices in handling food analysis, according to Food Act 1983, Food Analyst Act 2011 and Regulations, Industrial Code of Practices (ICOP), CODEX, AOAC, AOCS, APHA, etc. At the end of the course, students are expected to fully understand and apply the knowledge in real scenario and its application in various food and food related industries.

SSCC 4673 - Industrial Organic Chemistry

The course is intended to expose the students to organic chemicals in industries. The scope includes the organic chemicals used in foods, pharmaceuticals, cosmetics, agro-based industries, petroleum and polymers. The synthesis and analysis of some selected chemicals will be discussed. The course will involve industrial chemicals such as flavours and fragrances; vitamins; antioxidants; dyes and colouring materials; common drugs including antibiotics, anti-inflammatory, anticancer, antihypertensive and antidepressant; soaps and detergents; insecticides, fungicides and pesticides. Basic knowledge and uses of phytochemicals from herbs and spices will be introduced. In addition, general industrial chemicals for petroleum and polymers will be included.

SSCC 4303 - Oleochemistry

This course covers the production of oleochemicals derived from environmentally resources of natural plants and animals. Students will be introduced to the oils and fats, sources of commercial and alternative oleochemical raw materials. The application of the major oleochemicals products in various industries as well as the environmental issues related to the production of oleochemicals will be discussed.

SSCC 4423 – Liquid Crystal

Liquid crystals are beautiful, mysterious and extremely useful. This particular course describes the fascinating state of condensed matter between crystalline solid and isotropic liquids, exhibiting rheological behavior similar to those of liquids and anisotropic physical properties of a crystalline solid. This course covers the introduction of mesophase types, structures and chemistry of liquid crystals emphasized together with the chemical structure of mesogenic building blocks, thermodynamical behavior and physical of thermotropic liquid crystals, their polymers, physical nature and the behavior of lyotropic liquid crystals and finally the applications and uses of liquid crystals in spectroscopies and display technology.

SSCC 4383 – Special Topics in Industrial Chemistry

This lecture course is intended for chemistry students who have an interest in the industrial chemistry field. Lectures will briefly cover the early history and general characteristics of the chemical industry. The chemistry behind everyday products produced from industrial chemicals will also be highlighted. Economic, social and environmental aspects of industrial chemical production will also be discussed. Green approaches to industrial chemistry will also be considered. Students will be expected to independently research some aspects of the chemical industry and present their findings.

SSCC 4233 - Analytical Electrochemistry

This course is designed to provide students with an understanding of the principles of analytical electrochemistry. Fundamental aspects of electrode reactions and structure of the interfacial region and application of electrode reactions to electrochemical characterization are included. Major electroanalytical techniques will be discussed including potentiometry, amperometry, polarography, cyclic voltammetry, pulse and differential pulse voltammetry, square

wave voltammetry, and stripping analysis. Introduction to the principles of chemical and biochemical sensors will also be discussed.

SSCC 4363 - Green Chemistry

This course introduces students to the principles and application of Green Chemistry, which was developed based on historical cases and current research. Topics include evaluation methods for environmental and human health impact, alternative reagents in designing safer reactions and chemicals, green chemical synthesis, green chemical products, and economic advantages to Green Chemistry. Real-world cases in green chemistry will be used to illustrate the goals of Green Chemistry.

SSCC 4443 – Chemical Reactions Process

This course is designed to prepare students to formulate and solve material and energy balances on chemical process systems. It lays the foundation for courses in thermodynamics, unit operations, kinetics and process dynamics. It introduces the engineering approach to solving process-related problems - breaking a process down into its components, establishing the relations between known and unknown process variables, assembling the information needed to solve for the unknowns using a combination of experimentation, empiricism and the application of natural laws to obtain the desired solution.

SSCC 4723 - Organometallic Chemistry

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 type 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. Organolanthanide and organoactinide chemistry. The application of bioorganometallic compound: coenzyme B12, and nitrogen fixation.

SSCC 4733 - Radiochemistry

The course is focussed on the fundamentals of nuclear structure and physico- chemical properties in radioactivity. The mass-energy relationship presented in this course includes the binding energy of nuclear reactions - energetic of nuclear reactions, cross-section and types of reactions. Radioactivity phenomena as explained in rates of nuclear decay, determination of half lives and growth of radioactive products are covered. Quantitative aspect of this course will be discussed under units of radioactivity, detection of radiation and instrumentation in radiochemistry. The study of the interaction of radiation with matter is included. Basic principles of nuclear reactors are also presented along with applications of radionuclides in chemistry and other related areas. Some aspects of nuclear energy generation, nuclear fuel reprocessing and nuclear waste disposal will also be discussed.

SSCC 4633 – Heterocyclic Chemistry

This course discusses the fundamental concepts of heterocyclic and heteroaromatic compounds which include six membered heteroaromatic: pyridine and derivatives; Five membered heteroaromatic: pyrrole, furan and thiophene; Fused-ring heterocyclic: Indole, Quinoline and isoquinoline. In each topic, the students will be introduced to the structures, properties, reactivity, synthesis, and reactions of these heterocyclic compounds.

SSCC 4263 – Thermal Analysis

This course is designed to provide students with an understanding of the principles and application of thermal analysis methods. Key thermal analysis methods such as Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC) are discussed, including instrumental system, factors affecting measurements, and the effect of sample properties on thermograms. Other thermal analysis methods discussed include microthermal analysis, thermomechanical analysis and dilatometry. Discussions will also cover interpretation of thermograms and application of the thermal analysis methods.

SSCC 4473 – Solid State Chemistry

This course exposes students to solid state chemistry beginning with introduction to simple crystals structures, symmetry, lattices and units cells, crystalline solids, and lattice energy. Following this, the main topic discussed include X-ray Diffraction and its use in solving single crystal structures; various preparative methods in solid states; bonding in solids states and electronic properties and electronic conductivity in simple metals, semiconductors and doped semiconductors; defects and non-stoichiometry; ionic conductivity in solids, solid electrolytes; non-stoichiometric compounds and electronic properties of non-stoichiometric oxides; application of physical techniques

in characterization of inorganic solids; optical properties of solids; magnetic and dielectric properties of materials; phase diagram and its interpretation; relationship between structure, physicochemical and mechanical properties of materials including zeolites and related structures.

SSCC 4653 – Organic Synthesis

This course discusses the interconversion of various functional groups and the formation of C-C bonds; which represent two crucial areas in organic synthesis. Students will be introduced to the use of protecting groups and oxidation/reduction in the synthetic methodology. The retrosynthesis approach in organic synthesis will also be elaborated. Specific topic on carbonyl functionalities will be discussed which highlight the related condensation reactions. Further discussion on rearrangement, pericyclic, asymmetric synthesis and metal-catalysed reactions will be emphasized. Throughout the course, the usefulness of the synthetic methods will be related with their applications in various research and industry. Upon completion, the students should be able to plan synthetic strategy and pathway using both functional interconversion and C-C bond formation.

SSCC 4603 – Medicinal Chemistry

This course discusses the general principles of medicinal chemistry with emphasis on the molecular interaction of drugs with biological systems. The functional groups commonly found in drugs are reviewed with respect to their nomenclature and chemical reactivity. The absorption and metabolism characteristics are then related to the physicochemical properties of these functional groups. The theories and principles of drug-receptor interactions and drug design are presented, as well as the general principles of drug metabolism. To illustrate current drug developments, this course will utilize examples from chemical biology, bioorganic chemistry and drug design.

SSCC 4763 – Nanochemistry

The primary objective of this course is to provide a broad foundation of nanochemistry in the field of nanotechnology, so that students are prepared to continually learn about this emerging field. New era about nanomaterials is coming because of special physicochemical and magnetic properties of materials underlying nanoscale. This course mainly introduces novel nanomaterials and instrumental methods for materials analysis. Introduction to nanosynthesis and nanotechnology, the chemistry of nanofabrication; top-down (Lithography, laser ablation, ball-milling) and bottom-up (Metal reduction, sol-gel, hydrothermal, SAM and CVD), preparation methods for highly porous materials, surface modifications, characterization of nanomaterials. (UV, TEM, SEM, XRD), perspectives of nanochemistry in environmental applications. Based on this knowledge, students can have ideas about controlling physicochemical properties of nanomaterials to solve the problems specifically in the environmental treatments.

SSCC 4773 - Inorganic and Organometallic Polymer

The course is intended to give an understanding of the basic principles of inorganic and organometallic polymers. It will emphasise on the physical properties, chemical synthesis, the characterisation and practical applications of the polymers. All the major inorganic and organometallic polymers such as polyphosphazenes, polysilanes, polysiloxanes, polyferrocenes and other polymers will be dealt with.

SSCC 4393 – Special Topics in Chemistry

This lecture course is intended for chemistry students who have an interest in the solid acid-base catalysis field. Lectures briefly cover the early history and general application of acid-base catalysis. This course is also designed to prepare students to understand the chemistry behind acid-base catalysis includes preparation, modification and structure of acid-base catalyst, determination of acidic and basic properties on the solid surface and its utilization. The utilization of acid-base catalyst will be focused on the isomerization, alkylation, acylation, aldol addition and condensation, Knoevenagel condensation, Michael addition, Tishchenko reaction, esterification and transesterification, hydrolysis, cracking, hydrogenation and dehydrogenation. Students are expected to distinguish the solid acid catalysis and solid base catalysis and its reaction mechanism.

SSCC 4543 – Modeling and Simulation

This course is to provide an introduction to some of the techniques used to illustrate how it can be used to study physical, chemical and biological phenomena in chemistry. Molecular modellers use quantum mechanics, molecular mechanics, minimisation, simulations, conformational analysis and other computer-based method for understanding and predicting the behaviour of molecular systems. Emphasis is to train students to be able to study organic/inorganic chemistry related problems via computational tools. Wide variety of methods will be focused that can be used, either individually or in combination to select compounds with targeted properties that shall assist in chemistry application.

SSCU 3623 - Research Methodology and Information Retrieval

This course teaches the students the principles of research methodology and information retrieval. Topics include research philosophy and objectives, literature study and review, choosing and defining research problems and design, preparing and writing research proposals, technical report writing (the elements of technical writing), types of technical report writing, dissertation writing, public speaking (preparation and presentation) and information retrieval (search strategies). Presentation of assignment is also an important component in this course.

SSCU 4902 – Undergraduate Project I

The Undergraduate Project I is the first part of the students' final year project. The final year project gives the students the opportunity to demonstrate what they have learned throughout the course. In the Undergraduate Project I, students are required to identify a project (research) and a supervisor in an agreeable field of chemistry. Apart from an initial briefing session on the Undergraduate Project I and laboratory safety requirement, there are no formal lectures to attend. Teaching consists of regular individual/small group meetings between student and supervisor to discuss the progress of the project. Survey/review activities, construct research methodology, built-up results and discussion (if manageable and sufficient data are obtained), anticipate the expected results (if no data were obtained), and write the conclusion and references.

SSCU 4904 – Undergraduate Project II

The Undergraduate Project II is an extension of the Undergraduate Project I. Students are required to complete the experimental work of the project identified during the Undergraduate Project I and document their findings. The students document the finding of their research in the form of project proceeding and final year project report. The students will be assessed based on the report and proceeding submitted, project presentation, attendance and laboratory work.

SSCU 3905 – Industrial Training

Students enrolled in this program are required to undergo industrial training either at a local industry/company or abroad to gain working experience from the industry. The industrial training gives the students the opportunity to acquire technical knowledge and practical skills not taught in classrooms. Through the industrial training, students will also have the opportunity to work with industrial workers and professionals, which will enable them to improve their communication skills and team working. The students will be supervised by both faculty and industry staff. The students will be assessed based on the final report submitted to the faculty at the end of the training as well as the reports from both supervisors.

SSCU 3915 – Research Training

Students enrolled in this program are required to undergo research training either at a local research centres/institutes or abroad. The research training enables the students to experience chemistry research in real world setting, whereby the equipment, instrumentation and work conducted are generally more advanced. The students will be exposed to a different research environment and has the opportunity to interact with researchers in different fields. Both faculty and the research centers/institutes staff will supervise the students. The students will be assessed based on the final report submitted to the faculty at the end of the training as well as the reports from both supervisors.

PROGRAM SPECIFICATION

BACHELOR OF SCIENCE (MATHEMATICS)

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 (SSCE)		
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 : 4 yrs Maximum : 6 yrs		
Type of Semester	No. of Semesters		No. of weeks per semester	
	Full Time	Part Time	Full Time	Part Time
Normal	8		14	
Short				
12. Entry Requirement		Fulfill all university requirements and the following programme requirements: <u>STPM/MATRICULATION/SCIENCE FOUNDATION</u> 1. Minimum CGPA of 2.80 and passed with Grade B in Mathematics and Grade B- in ONE (1) of the following subjects : Chemistry/Physics/ Biology		

13. Programme Educational Objectives (PEO)

The objectives of the BSc (Mathematics) program are to provide the knowledge, skills and attributes that should be achieved by the graduates for a successful career. It is therefore anticipated that, graduates of the program will

1. become competent professionals in mathematics working in related sectors notably in teaching, research and development of new knowledge.
2. progress professionally with proficient soft skills.
3. have high standard of ethical conduct, positive outlook, and societal responsibilities.

14. Programme Learning Outcomes (PO)

	Intended Learning Outcomes	Teaching and Learning Methods	Assessment
(a) Technical Knowledge and Competencies			
PLO1 Fundamental Knowledge (KW)	Ability to acquire current knowledge on fundamental mathematical concepts, theories and techniques. (C2,P2,A2)	Lectures, tutorials, directed reading.	Examinations, quizzes, tests, assignments.
PLO2 Application of Knowledge (AP)	Ability to apply mathematical knowledge and techniques efficiently to solve and analyze mathematical and	Lectures, tutorials, projects group/individual), directed reading, computer-based exercises.	Examinations, quizzes, tests, computing output, presentations, and reports.

	statistical problems. (C4,P4,A3)		
PLO3 Analysing and experimental skills (PS)	Ability to evaluate, propose and demonstrate appropriate methods to solve problems in Mathematical Sciences. (C6,P6,A3)	PSM, research training, service learning.	Project presentations, project reports, research training reports and survey.
(b) Generic Skills			
PLO4 Communication Skills (CS)	Ability to effectively present scientific knowledge and opinion to wide range of audience. (P4)	Active learning, projects (PSM, Group/individual), research training.	Written assignments, oral presentations, project reports, learning portfolio, research training survey.
PLO5 Thinking Skills (TH)	Ability to think critically and creatively in solving scientific problems. (P4)	Active learning, projects (PSM, Group/individual), research training.	Oral presentations, project reports, research training survey.
PLO6 Scholarship (SC)	Ability to continuously seek new knowledge, skills and manage relevant information from various sources. (A3)	Active learning, projects (PSM, Group), research training.	Oral presentations, project reports, peer evaluation, research training survey.
PLO7 Team working Skills (TW)	Ability to exercise good interpersonal and team working skills to work collaboratively as part of a team. (A3)	Active learning, projects (PSM, Group/individual), professional development courses (Degree ++), research training.	Written assignments, oral presentations, project reports, learning portfolio, research training survey.
PLO8 Adaptability (AD)	Ability to adapt, identify self-potential and be an agent of change in a new culture and environment. (A3)	Active learning, group projects, service learning, co-curricular activities, group work.	Oral presentations, project reports, peer evaluation, research training reports and survey.
PLO9 Global Citizens (GC)	Ability to act with integrity, professionalism and good ethics in their profession and their obligation as a global citizen. (A3)	PSM, co-curricular activities, group work, research training.	PSM reports, learning portfolio, research training reports and survey.
PL10 Enterprising Skills (ES)	Ability to act with enterprising mindset, risk taker, innovative, effective, imaginative and resilience. (P2)	Lectures, assignments, case studies, PSM, seminar, workshop, co-curricular activities, group work.	Written assignments, oral presentations and PSM reports.

15. Classification of Subjects			
No.	Classification	Credit Hours	Percentage(%)
i.	Basic Sciences and Mathematics	9	56.6
ii.	Programme Core	64	

iii.	Programme Electives	33	25.6
iv	Compulsory University Subjects <ul style="list-style-type: none"> • Humanity • English Language • Co-curriculum • Entrepreneurship 	10 8 2 2	17.8
Total		129	100
For Science program please fill up the following classification. (Others please refer to the Statutory Body guidelines)			
No	Classification	Credit Hours	Percentage(%)
A	Mathematics Courses		
	(a) Lecture	95	73.6
	(b) Research Training	5	3.9
	(c) Final Year Project	6	4.7
	Total Credit Hours for Part A	106	82.2
B	Related Courses		
	(a) Humanities	10	7.8
	(b) Co-curriculum	3	2.3
	(c) English	6	6.2
	(d) Entrepreneurship	2	1.6
	Total Credit Hours for Part B	23	17.8
Total Credit Hours for Part A and B		129	100

16. Total credit hours to graduate	129 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 courses 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 not less than 129 credit hours with minimum CPA of 2.0.
- Pass research training.
- Complete and pass the undergraduate final year project.

SEMESTER I			SEMESTER 2		
Code	Name of Course	cr	Code	Name of Course	cr
UICI 1012	Islamic and Asian Civilization	2	SSCM 1033	Mathematical Methods II	3
SSCM 1012	Introduction to Mathematics Program	2	SSCM 1313	Computer Programming	3
SSCM 1023	Mathematical Methods I	3	SSCM 1523	Linear Algebra	3
SSCM 1103	Statistics	3	SSCM 1703	Differential Equations I	3
SSCM 1303	Computer Literacy	3	ULAB 1122	Academic English Skills	2
SSCP 1143/ SSCC 1003	Mechanics / Principles of Chemistry	3	UHAS 1172	Malaysia Dynamics*	2

			UHAS1162/ UHAK1022	Arts, Customs and Beliefs*	2
			UHAK1032	Introduction to Entrepreneurship	
Total Credit Hours		16	Total Credit Hours		18
*UHAS 1172 : Local Students *UHAS 1162 : Foreign Student					
SEMESTER 3			SEMESTER 4		
Code	Name of Course	cr	Code	Name of Course	cr
SSCM 2103	Mathematical Statistics	3	ULAB 2122	Advanced Academic English Skills	2
SSCM 2423	Numerical Methods I	3	SSCM 2043	Mathematical Methods III	3
SSCM 2773	Differential Equations II	3	SSCM 2613	Advanced Calculus	3
SSCM 2793	Vector Calculus	3	SSCM 2803	Mathematical Modelling I	3
SSCM 3533	Set Theory and Logic	3	SSCM 2833	Linear Programming	3
UICL 2302	Scientific and Technological Thinking	2	UHAK 1012	Graduate Success Attributes	2
Total Credit Hours		17	Total Credit Hours		16
SEMESTER 5			SEMESTER 6		
Code	Name of Course	cr	Code	Name of Course	cr
SSCM 3703	Partial Differential Equations	3	UKQE3001	ExCEL	1
UKQA 2092	Science and Community	2	ULA* 1112	Foreign Language Elective	2
ULAB 3162	English for Professional Purpose	2	SSCM 3423	Numerical Methods II	3
UHAK 2**2	Soft Skills Elective	2	SSCU 3623	Research Methodology & Information Retrieval	3
Electives (Choose 6 credits)			Elective (Choose 6 credits)		
SSCM 2673	Discrete Mathematics	3	SSCM 3353	C++ Programming	3
SSCM 3503	Complex Variables	3	SSCM 3553	Fields & Rings Theory	3
SSCM 3523	Modern Algebra	3	SSCM 3543	Number Theory	3
SSCM 3793	Calculus of Variations	3	SSCM 3673	Functional Analysis	3
			SSCM 3753	Fluid Mechanics	3
Total Credit Hours		15	Total Credit Hours		15
SHORT SEMESTER					
Code	Name of Course	cr			
SSCU 3915	Research Training (HW)	5			
Total Credit Hours		5			
SEMESTER 7			SEMESTER 8		
Code	Name of Course	cr	Code	Name of Course	cr
SSCU 4902	Undergraduate Project I	2	SSCU 4904	Undergraduate Project II	4
Elective (Choose 12 credits)			Elective (Choose 12 credits)		
SSCM 4163	Stochastic Process	3	SSCM 3153	Inferential Statistics	3
SSCM 4633	Fuzzy Set Theory	3	SSCM 4623	Non-Euclidean Geometry	3
SSCM 4653	Applied Abstract Algebra	3	SSCM 4733	Dynamical Systems	3
SSCM 4683	Topology	3	SSCM 4783	Quantum Mechanics	3
SSCM 4763	Computational Fluid Dynamics	3	SSCM 4813	Optimal Control	3
Total Credit Hours		14	Total Credit Hours		13

18. Mapping of Programme Learning Outcomes to Subjects											
COURSES OFFERED		LEARNING OUTCOMES									
		Fundamental Knowledge and Competencies			Generic Skills						
		Fundamental Knowledge	Application of Knowledge	Analyzing and Experimental Skills	Communication Skills	Thinking skills	Scholarship	Team Working Skills	Adaptability	Global Citizen	Enterprising Skill
Code	Course Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
Core Courses											
SSCM1012	Introduction to Mathematics Program	✓						✓			
SSCM1023	Mathematical Methods I	✓	✓								
SSCM1103	Statistics	✓	✓								
SSCM1303	Computer Literacy	✓	✓				✓				
SSCP1143	Mechanics	✓	✓								
SSCC1003	Principles of Chemistry	✓	✓								
SSCM1033	Mathematical Methods II	✓	✓								
SSCM1313	Computer Programming	✓	✓			✓					
SSCM1523	Linear Algebra	✓	✓								
SSCM1703	Differential Equations I	✓	✓								
SSCM2103	Mathematical Statistics	✓	✓								
SSCM2423	Numerical Methods I	✓	✓								
SSCM2793	Vector Calculus	✓	✓								
SSCM2773	Differential Equations II	✓	✓								
SSCM3533	Set Theory and Logic	✓	✓			✓					
SSCM2043	Mathematical Methods III	✓	✓								
SSCM2613	Advanced Calculus	✓	✓								
SSCM2803	Mathematical Modelling I	✓	✓					✓			
SSCM2833	Linear Programming	✓	✓						✓		
SSCM3703	Partial Differential Equations	✓	✓								
SSCM3423	Numerical Methods II	✓	✓			✓					
SSCU3623	Research Methodology & Information Retrieval				✓		✓				
SSCU3915	Research Training (HW)			✓					✓	✓	
SSCU4902	Undergraduate Project I			✓	✓		✓				
SSCU4904	Undergraduate Project II			✓	✓		✓				
Elective Courses											

SSCM3503	Complex Variables	✓	✓		✓						
SSCM2673	Discrete Mathematics	✓	✓		✓						
SSCM3793	Calculus of Variations	✓	✓		✓						
SSCM3523	Modern Algebra	✓	✓		✓						
SSCM3353	C++ Programming	✓	✓			✓					
SSCM3553	Fields and Rings Theory	✓	✓			✓					
SSCM3543	Number Theory	✓	✓			✓					
SSCM3673	Functional Analysis	✓	✓			✓					
SSCM3753	Fluid Mechanics	✓	✓		✓						
SSCM4633	Fuzzy Set Theory	✓	✓					✓			
SSCM4653	Applied Abstract Algebra	✓	✓								
SSCM4683	Topology	✓	✓								
SSCM4763	Computational Fluid Dynamics	✓	✓								
SSCM4163	Stochastic Process	✓	✓					✓			
SSCM4783	Quantum Mechanics	✓	✓				✓				
SSCM4623	Non-Euclidean Geometry	✓	✓								
SSCM3153	Inferential Statistics	✓	✓								
SSCM4813	Optimal Control	✓	✓				✓				
SSCM4733	Dynamical Systems	✓	✓				✓				
University Courses											
UICI1012	Islamic and Asian Civilizations (TITAS)				✓						
UICI2302	Science & Technological Thinking				✓						
UHAS1172	Malaysia Dynamics									✓	
UHAS 1162/ UHAK1022	Arts, Custom and Belief of Malaysian									✓	
ULA* 1112	Foreign Language Elective					✓					
ULAB1122	Academic English Skills						✓				
ULAB2122	Advanced Academic English Skills					✓					
ULAB3162	English for Professional Purposes							✓			
UKQA2092	Science and Community						✓		✓		
UHAK1202	Graduate Success Attributes					✓					
UHAK 2**2	Soft Skill Elective								✓		
UHAK1032	Introduction to Entrepreneurship										✓
UKQE3001	ExCEL										

19. Programme Uniqueness

- The special program is designed to produce excellent young and talented mathematicians.
- Established links with local and international faculties/schools of mathematics for possible overseas research training.
- A BSc in Mathematics programme which offers a research training at research laboratories either locally or overseas.

- This programme allows the transfer of credits of equivalent courses offered by participating local or overseas institutions.
- 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

- Academicians and researchers in institutions of higher learning.
- Researchers at R&D departments in government-linked companies (GLC) or multinationals.
- Financial executives in financial institutions.
- Administrative officers in government establishments or private sectors.
- Sales and marketing executives.

21. Cross Campus Program

Students are given the opportunity to enroll certain courses at participating universities either locally or abroad. The grades and credits of up to 1/3 of the total credits of the curriculum are transferable.

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

14. Computer Lab 1
15. Computer Lab 2
16. Computer Lab 3
17. Computer Lab 4
18. Smart Classroom
19. Resource Centre

24. Support for Students and their learning

- Two week induction programme for orientation and introductory study skills
- Student Handbook and Module Guides
- 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 (e-PPP)
 - Competency check-list for staff (CV)
 - Annual staff appraisal (e-LPPT)
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 interpretation

Marks	15.1.1.1 Grade	15.1.1.2 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 academic committee

27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by
	PLO 1	PL O2	PL O3	PL O4	PL O5	PL O6	PL O7	PL O8	PL O9	PL O10		
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
PLO survey by final year students	x	x	x	x	x	x	x	x	x	x	End of sem	Faculty
Research 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/years	Head of Dept
Employer Survey	x	x	x	x	x	x	x	x	x	x	Once/years	Head of Dept

BACHELOR OF SCIENCE (INDUSTRIAL MATHEMATICS)

1. Awarding Institution	Universiti Teknologi Malaysia		
2. Teaching Institution	Universiti Teknologi Malaysia		
3. Programme Name	Bachelor of Science in Industrial Mathematics		
4. Final Award	Bachelor of Science(Industrial Mathematics)		
5. Programme Code	TS34 (SSCM)		
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 : 4 yrs Maximum : 6 yrs		
Type of Semester	No. of Semesters		No. of weeks per semester
	Full Time	Part Time	Full Time Part Time
Normal	8		14
Short			
12. Entry Requirement	Fulfil all university requirements and the following program requirements: <u>STPM/MATRICULATION/SCIENCE FOUNDATION</u> Minimum CGPA of 2.80 and passed with Grade B in Mathematics and Grade B- in ONE (1) of the following subjects : Chemistry/Physics/ Biology <u>IPLOMA</u> Minimum CGPA of 3.00 and passed with credits in Mathematics in the SPM/equivalent examination.		

13. Programme Educational Objectives (PEO)

The objectives of the BSc (Industrial Mathematics) program are to provide the knowledge, skills and attributes that should be achieved by the graduates for a successful career. It is therefore anticipated that, graduates of the program will

1. be mathematically competent professionals capable of dealing with qualitative and quantitative problems in related industries.
2. be able to assume productive roles and positions in planning, decision making, analysis and supervision of work in the industrial and public sectors.
3. exhibit team working and leadership skills with effective communication and desirable interpersonal skills.
4. pursue life-long learning, enabling them to identify, adapt and seize business opportunities.

14. Programme Learning Outcomes(PO)

Code	Intended Learning Outcomes	Teaching and Learning Methods	Assessment
(a) Technical Knowledge and Competencies			
PO1	Ability to acquire knowledge on fundamental mathematical concepts,	Lectures, tutorials, directed reading.	Examinations, quizzes, tests, assignments.

Fundamental Knowledge of Mathematics	theories and techniques related to current issues. (C2,P2,A2)		
PO2 Application of Mathematical Knowledge and Computational Techniques and Analysis	Ability to apply the mathematics knowledge and techniques efficiently to solve mathematical and statistical problems and do convincing analysis on the results obtained. (C4,P4,A3)	Lectures, tutorials, projects (Undergraduate Project(PSM), group/individual), directed reading, computer-based exercises, industrial training.	Examinations, quizzes, tests, computing output, presentations, project reports, industrial training reports.
PO3 Discrimination and organization of Mathematical Concepts	Ability to evaluate, propose and demonstrate appropriate methods to solve applied problems in Mathematical Sciences and the industry through the reorganization of mathematical knowledge and techniques.(C6,P6,A3)	Lectures, projects (PSM, group/individual), directed reading, computer-based learning, problem-based learning, industrial training.	Examinations, quizzes, tests, computer output, presentations, project reports, industrial training reports.
b) Generic Skills			
PO4 Critical Thinking and Problem Solving	Ability to understand, extract, analyse and identify problems from a variety of sources and develop approaches based on the mathematical knowledge to solve problems. (P4)	Active learning, projects (PSM, Group/individual), industrial training.	Written assignments, oral presentations, project reports, learning portfolio, industrial training reports.
PO5 Communication Skills	Ability to convey ideas and clearly and effectively in both written and oral form to a range of audiences. (P4)	Active learning, projects (PSM, Group/individual), industrial training.	Oral presentations, project reports, industrial training reports.
PO6 Team Working	Ability to adapt and work collaboratively as part of a team. (A3)	Active learning, projects (PSM, Group), industrial training.	Oral presentations, project reports, peer evaluation, industrial training report.
PO7 Life-long learning and Information Management	Ability to seek independent study and demonstrate the awareness for continuous personal and professional development. (A3)	Active learning, projects (PSM, Group/individual), professional development courses, industrial training.	Written assignments, oral presentations, project reports, learning portfolio, industrial training report.
PO8 Leadership	Ability to demonstrate leadership, to take actions and to influence others in order to achieve common goals. (A3)	Active learning, group projects, service learning, co-curricular activities, group work.	Oral presentations, project reports, peer evaluation.
PO9 Ethics and Integrity	Ability to adapt ethical values and integrity in the context of their profession and obligations to society. (A3)	PSM, co-curricular activities, group work, industrial training.	PSM reports, learning portfolio, industrial training report.

P10 Entrepreneurship	Acquire awareness of business, entrepreneurship and career opportunities. (P2)	Lectures, assignments, case studies, PSM, seminar, workshop, co-curricular activities, group work.	Written assignments, oral presentations, PSM reports, examination, industrial training report.
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15. Classification of Courses			
No.	Classification	Credit Hours	Percentage (%)
i.	Basic Science and Mathematics	9	58.9
ii.	Programme Core	67	
iii.	Programme Electives	33	25.6
iv	Compulsory University Courses	10	15.5
	• Humanity	6	
	• English Languages	2	
	• Co-Curriculum	2	
	• Entrepreneurship		
15.2 Total		129	100

For Science programme please fill up the following classification. (Others please refer to the Statutory Body guidelines)

No	Classification	Credit Hours	Percentage
A	Mathematics Courses		
	(a) Lectures	98	76
	(b) Industrial Training	5	3.9
	(c) Undergraduate projects	6	4.7
	Total credit hours for Part A	109	84.5
B	Related Courses		
	(a) Humanities/Ethics	10	7.8
	(b) Co-curriculum	2	1.5
	(c) English Languages	6	4.7
	(d) Entrepreneurship	2	1.5
Total credit hours for Part B	20	15.5	
Total credit hours for Part A and B		129	100

16. Total credit hours to graduate	126 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 not less than 126 credit hours with minimum CPA of 2.0.
- Pass research training.
- Complete and pass the undergraduate final year project.

SEMESTER I			SEMESTER 2		
Code	Name of Course	cr	Code	Name of Course	cr
UICI 1012	Islamic and Asian Civilization	2	SSCM 1033	Mathematical Methods II	3
SSCM 1002	Introduction to Industrial Mathematics Program	2	SSCM 1313	Computer Programming	3
SSCM 1023	Mathematical Methods I	3	SSCM 1523	Linear Algebra	3
SSCM 1103	Statistics	3	SSCM 1703	Differential Equations I	3
SSCM 1303	Computer Literacy	3	ULAB 1122	Academic English Skills	2
SSCP 1143/ SSCC 1003	Mechanics / Principles of Chemistry	3	UHAS 1172	Malaysia Dynamics*	2
			UHAS 1162/ UHAK 1022	Arts, Customs and Beliefs*	2
			UHAK 1032	Introduction to Entrepreneurship	
Total Credit Hours		16	Total Credit Hours		18
*UHAS 1172 : Local Students *UHAS 1162 : Foreign Student					
SEMESTER 3			SEMESTER 4		
Code	Name of Course	cr	Code	Name of Course	cr
SSCM 2103	Mathematical Statistics	3	SSCM 2043	Mathematical Methods III	3
SSCM 2423	Numerical Methods I	3	SSCM 2613	Advanced Calculus	3
SSCM 2773	Differential Equations II	3	SSCM 2803	Mathematical Modelling I	3
SSCM 2793	Vector Calculus	3	SSCM 2833	Linear Programming	3
SSCM 3533	Set Theory and Logic	3	UHAK 1012	Graduate Success Attributes	2
UICL 2302	Scientific and Technological Thinking	2	ULAB 2122	Advanced Academic English Skills	2
Total Credit Hours		17	Total Credit Hours		16
SEMESTER 5			SEMESTER 6		
Code	Name of Course	cr	Code	Name of Course	cr
SSCM 3133	Statistical Quality Control	3	UKQE3001	ExCEL	1
SSCM 3803	Mathematical Modelling II	3	ULA* 1112	Foreign Language Elective	2
ULAB 3162	English for Professional Purposes	2	UKQA2092	Science and Community	2
UHAK 2**2	Soft Skills Elective	2	SSCM 3103	Design of Experiments	3
			SSCM 3423	Numerical Methods II	3
Electives (Choose 6 credits)			Elective (Choose 6 credits)		
SSCM 2673	Discrete Mathematics	3	SSCM 3123	Multivariate Analysis	3
SSCM 3143	Decision Theory	3	SSCM 3153	Inferential Statistics	3
SSCM 3703	Partial Differential Equations	3	SSCM 3353	C++ Programming	3
SSCM 3793	Calculus of Variations	3	SSCM 3753	Fluid Mechanics	3
SSCM 3883	Multi-Objective Decision Making	3	SSCM 3843	Optimization Methods	3
SHAD 1043	Organizational Behavior	3	SHAF 1013	Principles of Marketing	3
Total Credit Hours		16	Total Credit Hours		17

SHORT SEMESTER					
Code		Name of Course		cr	
SSCU 3915		Industrial Training (HW)		5	
Total Credit Hours				5	
SEMESTER 7			SEMESTER 8		
Code		Name of Course		cr	
SSCU 4902		Undergraduate Project I		2	
SSCU 4904		Undergraduate Project II		4	
Elective (Choose 12 credits)			Elective (Choose 12 credits)		
SSCM 3503		Complex Variables		3	
SSCM 3523		Modern Algebra		3	
SSCM 4113		Time Series		3	
SSCM 4163		Stochastic Process		3	
SSCM 4763		Computational Fluid Dynamics		3	
SSCM 4823		Scheduling		3	
SHAD 1033		Principles of Management		3	
Total Credit Hours				14	
Total Credit Hours				13	

18. Mapping of Programme Learning Outcomes to Courses											
COURSES OFFERED		LEARNING OUTCOMES									
		Fundamental Knowledge and Competencies			Generic Skills						
		Fundamental Knowledge	Application of Knowledge	Analyzing and Experimental Skills	Communication Skills	Thinking Skills	Scholarship	Team working Skills	Adaptability	Global Citizen	Enterprising Skills
Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Core Courses											
SSCM1002	Introduction to Industrial Mathematics Program	✓						✓			
SSCM1023	Mathematical Methods I	✓	✓								
SSCP 1143	Mechanics	✓	✓								
SSCC1003	Principles of Chemistry	✓	✓								
SSCM1103	Statistics	✓	✓								
SSCM1303	Computer Literacy	✓	✓				✓				
SSCM1033	Mathematical Methods II	✓	✓								
SSCM1313	Computer Programming	✓	✓			✓					
SSCM1523	Linear Algebra	✓	✓								
SSCM1703	Differential Equations I	✓	✓								

SSCM2103	Mathematical Statistics	✓	✓							
SSCM2423	Numerical Methods I	✓	✓							
SSCM2773	Differential Equations II	✓	✓							
SSCM2793	Vector Calculus	✓	✓							
SSCM3533	Set Theory and Logic	✓	✓			✓				
SSCM2043	Mathematical Methods III	✓	✓							
SSCM2613	Advanced Calculus	✓	✓							
SSCM2803	Mathematical Modelling I	✓	✓					✓		
SSCM2833	Linear Programming	✓	✓						✓	
SSCM3133	Statistical Quality Control	✓	✓			✓				
SSCM3803	Mathematical Modelling II	✓	✓		✓					
SSCM3103	Design of Experiments	✓	✓			✓				
SSCM3423	Numerical Methods II	✓	✓							
SSCU3905	Industrial Training (HW)			✓					✓	✓
SSCU4902	Undergraduate Project I			✓	✓		✓			
SSCU4904	Undergraduate Project II			✓	✓		✓			
Elective Courses										
SSCM3143	Decision Theory	✓	✓		✓					
SSCM2673	Discrete Mathematics	✓	✓		✓					
SSCM3703	Partial Differential Equations	✓	✓		✓					
SSCM3793	Calculus of Variations	✓	✓		✓					
SSCM3883	Multi-Objective Decision Making	✓	✓		✓					
SSCM3123	Multivariate Analysis	✓	✓			✓				
SSCM3353	C++ Programming	✓	✓			✓				
SSCM3843	Optimization Methods	✓	✓			✓				
SSCM3153	Inferential Statistics	✓	✓							
SSCM3753	Fluid Mechanics	✓	✓		✓					
SSCM3523	Modern Algebra	✓	✓		✓					
SSCM3503	Complex Variables	✓	✓		✓					
SSCM4113	Time Series	✓	✓					✓		
SSCM4163	Stochastic Process	✓	✓					✓		
SSCM4763	Computational Fluid Dynamics	✓	✓							
SSCM4823	Scheduling	✓	✓					✓		
SSCM4863	Financial Mathematics	✓	✓				✓			
SSCM4213	Generalized Linear Model	✓	✓							
SSCM4813	Optimal Control	✓	✓				✓			
SSCM4833	Discrete Event Simulation	✓	✓							
SSCM4243	Sampling Techniques	✓	✓				✓			
SHAS1113	Principles of Marketing									

SHAD1043	Organizational Behaviour											
SHAD1033	Principles of Management											
CORE UNIVERSITY COURSES												
UICI1012	Islamic and Asian Civilizations (TITAS)				✓							
UICL2302	Science Technology & Human				✓							
UHAS1172	Malaysia Dynamics										✓	
UHAS 1162/ UHAK1022	Arts, Custom and Belief in Malaysian (International Students)										✓	
UHAK 1032	Introduction to Entrepreneurship											✓
UHAK 1012	Graduate Success Attributes					✓						
UHAK 2**2	Soft Skills Electives									✓		
ULAB 1122	Academic English Skills						✓					
ULAB 2122	Advanced Academic English Skills					✓						
ULAB 3162	English for Professional Purposes								✓			
ULA* 1112	Foreign Language Elective					✓						
UKQA 2092	Science and Community							✓			✓	
UKQE 3001	ExCEL											

<p>19. Programme Uniqueness</p> <ul style="list-style-type: none"> • This special program is designed to produce excellent young and talented industrial mathematicians. • Established links with international centres for industrial mathematics for possible overseas industrial training. • The only B.Sc in Industrial Mathematics program in the country which offers a one-semester industrial training either locally or overseas. • This program allows the transfer of credits of equivalent courses offered by participating local or overseas institutions. • 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.

<p>20. Career Prospects and Career Path</p> <p>Graduates of this programme can work as</p> <ul style="list-style-type: none"> • Quality assurance manager, production control engineer and planning officer in industries such as manufacturing, telecommunications and oil & gas. • Statisticians, operations research analysts, sales and marketing executives in service industries. • Financial executives in financial institutions. • Administrative officers in public and private sectors. • Academicians and researchers in academic and research institutions.
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21. Cross Campus Program

Students are given the opportunity to enrol certain courses at participating institutions either locally or abroad. The grades and credits of up to 1/3 of the total credits of the curriculum are transferable.

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

20. Computer Lab 1
21. Computer Lab 2
22. Computer Lab 3
23. Computer Lab 4
24. Smart Classroom
25. 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 program 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
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	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10		
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
FUndergraduate 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/ years	Head of Dept
Employer Survey	x	x	x	x	x	x	x	x	x	x	Once/ years	Head of Dept

SYNOPSIS OF MATHEMATICS COURSES

SSCM 1002 - Introduction to Industrial Mathematics Programme

Mathematics is among the most fascinating of all intellectual disciplines, the purest of all art forms, and the most challenging of games. It is a study of quantity, space, and change. Mathematicians seek out patterns, formulate new conjectures, and establish truth by rigorous deduction from appropriately chosen axioms, definitions and theorems. Mathematics is applied as an essential tool in many fields, including natural sciences, engineering, medicine, and the social sciences. Applied mathematics, the branch of mathematics concerned with application of mathematical knowledge to other fields, inspires and makes use of new mathematical discoveries and sometimes leads to the development of entirely new mathematical disciplines, such as statistics and operational research. Industrial mathematics is one of the strands of applied mathematics aimed at industries. The study of mathematics is not only exciting, but important: mathematicians have an opportunity to make a lasting contribution to society by helping to solve problems in such diverse fields as medicine, management, economics, government, computer science, physics, psychology, engineering, and social science. This course aims at exposing students to this wonderful world of mathematics. The course also enhances conceptual understanding in elementary mathematics such as indices, logarithm, radicals, trigonometry, vectors, complex numbers and mathematical induction. Upon completion, the students would have acquired some firm basic tools to pursue further mathematics.

SSCC 1003 – Principles of Chemistry

This course strengthens principles of chemistry knowledge before proceeding to more specialized and higher levels chemistry subjects. The first part of this course exposes students to fundamentals of atoms and molecules and concepts which are known to be the main sources of chemical processes. The formation of chemical bonding, structure of molecules and properties of compounds are discussed. The second part of this course concentrates on stoichiometry and the relation between reacted species in reactions. The last part of this course strengthens student in terms of fundamental knowledge of organic chemistry and introduces students the ideas of green chemistry concept.

SSCM 1012 – Introduction to Mathematics Programme

Mathematics is among the most fascinating of all intellectual disciplines, the purest of all art forms, and the most challenging of games. It is a study of quantity, space, and change. Mathematicians seek out patterns, formulate new conjectures, and establish truth by rigorous deduction from appropriately chosen axioms, definitions and theorems. Mathematics is applied as an essential tool in many fields, including natural sciences, engineering, medicine, and the social sciences. Applied mathematics, the branch of mathematics concerned with application of mathematical knowledge to other fields, inspires and makes use of new mathematical discoveries and sometimes leads to the development of entirely new mathematical disciplines, such as statistics and operational research. Industrial mathematics is one of the strands of applied mathematics aimed at industries. The study of mathematics is not only exciting, but important: mathematicians have an opportunity to make a lasting contribution to society by helping to solve problems in such diverse fields as medicine, management, economics, government, computer science, physics, psychology, engineering, and social science. This course aims at exposing students to this wonderful world of mathematics. The course also enhances conceptual understanding in elementary mathematics such as indices, logarithm, radicals, trigonometry, vectors, complex numbers and mathematical induction. Upon completion, the students would have acquired some firm basic tools to pursue further mathematics.

SSCM 1023 – Mathematical Methods I

The course revises and extends Matriculation and STPM topics such as differentiation and integration towards hyperbolic and trigonometric inverses. Applications in computing arc length and area of surfaces of revolution are also included. Other topics covered are improper integrals, parametric equations, polar coordinates, and multivariable functions. This later topic serves as an introduction to three dimensional calculus which students will learn in Mathematical Methods II. The chapter will merely be devoted to sketching surfaces and finding limits of two variable functions. It is hoped that upon completion of the course, students should have acquired some firm basic tools to pursue further mathematics.

SSCM 1033 – Mathematical Methods II

This course is a continuation of SSCM 1023. Four main topics are covered, namely sequences and series, partial derivatives and its applications, and multiple integrals. Students will learn how to recognize the appropriate test of convergence for sequence and series, find partial derivatives and evaluate double and triple integrals. The use of cylindrical and spherical coordinates is also highlighted. Applications include finding the area, volume, mass, centre of gravity and moments of inertia of a solid.

SSCM 1103 - Statistics

The course is an introduction to statistics, reviewing some descriptive statistics which includes probability and random variables. Then, the topic of sampling distributions and inferential statistics which include estimation procedures and hypothesis testing is covered. The latter using the method of analysis of variance when more than two means are involved. Also, simple linear regression and contingency table are introduced. Students will be trained in the use of computer software such as Microsoft Excel and SPSS.

SSCP 1143 – Mechanics

This course mainly discusses motion of a body or a system. Beginning with the basic and derived physical quantities and vector as mathematical tool, various types of motion such linear, free-fall, projectile, circular, rotational and simple harmonic motions are described. Other topics such as equilibrium, elasticity, gravitation and fluids mechanics illustrate the application of a body in motion under the influence of a force.

SSCM 1303 – Computer Literacy

This course introduces the Internet, LaTeX, mathematical packages and programming for prospective mathematics majors. Students learn the efficient use of spreadsheets: Microsoft Word Math Add-Ins for writing and solving mathematical equations and Microsoft Excel for analysing data. In addition, SPSS, a statistical package that is popular in social science analysis is introduced. An introduction to R, an open-sourced statistical package in which some basic programming is presented.

SSCM 1313 – Computer Programming

This course will provide the basic programming skill in Computer C++ Programming. Topics include flowcharts, algorithms, basic syntax in C++, procession of compiling, pre-processing components, operators, loops, branches, data/variable types, strings, arrays, functions, pointer and structure. Students will learn to write an efficient and maintainable programs using Microsoft Visual C++ software. The lectures are supplemented with the non-trivial lab exercises.

SSCM 1523 – Linear Algebra

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

SSCM 1703 – Differential Equations I

This is an introductory course on differential equations. It provides students with basic concepts and theories as well as analytical tools for solving ordinary differential equations (ODEs). Topics include first order ODEs, linear ODEs with constant coefficients, and Laplace transforms.

SSCM 2043 – Mathematical Method II

This course is a continuation of SSCM 1023 and SSCM 1033. This course comprises of three parts. The first part is concerned with even, odd, periodic and orthogonal functions, its properties, Fourier series of periodic. The second discuss about partial differential equations (PDE). Linear and nonlinear first order equations. Classification of linear second order equations. Heat equations in one—dimensional and d'Alembert. The last part deals with complex

variables. This part of the course introduces calculus of functions of a single complex variables. Topics covered include the algebra and geometry of complex numbers, complex differentiation and complex integration.

SSCM 2103 – Mathematical Statistics

The 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 random variables, Chebychev's Inequality, moment generating function for univariate and bivariate variables, order statistics, limiting distribution. Upon completion students should be able to understand the mathematical concepts behind the statistical methods.

SSCM 2423 – Numerical Method I

This course discusses various numerical methods that can be used to solve problems involving non-linear equations, linear systems, interpolation and curve fitting, numerical differentiation and integration, eigenvalue problems, ordinary differential equations and partial differential equations.

SSCM 2613 – Advanced Calculus

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

SSCM 2673 – Discrete Mathematics

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.

SSCM 2773 – Differential Equations II

This course continues the Differential Equations I course, with the focus on second order ordinary differential equations with variable coefficients and systems of first order equations. Analytical solution methods, and qualitative approach to autonomous systems will be introduced. To further strengthen students' notions on mathematics, basic theory of linear systems and first order IVPs also are covered. Upon completion students should be able to demonstrate understanding of the theoretical concepts and select and use appropriate techniques for finding solutions to second order differential equations and systems of linear first order differential equations.

SSCM 2793 - Vector Calculus

Vector valued Function: Definition of vector valued function, position vector and graph, vector differentiation and Integration, unit tangent vector, unit normal vector, unit bi normal vector, curvature, radius of curvature, torsion and Frenet-Serret formulas. 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's Theorem, potential function and conservative force field. Surface Integral: surface integral for scalar functions, surface area, surface integral for vector functions, Gauss's Theorem, and Stokes's Theorem.

SSCM 2803 – Mathematical Modelling I

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.

SSCM 2833 – Linear Programming

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

SSCM 3123 – Multivariate Statistical Analysis

This is an introduction to the theoretical and practical techniques in multivariate analysis. We focus on analyses used when several quantitative measurements are made on each individual/object in one or more samples; the measurements as variables and to the individuals or objects as observations. The theoretical links between multivariate techniques and corresponding univariate techniques, where appropriate is highlighted. Also, selected multivariate techniques are introduced. The course also covers relevant multivariate methods in R statistical programming software.

SSCM 3133 – Statistical Quality Control

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

SSCM 3143 – Decision Theory

This course 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. The course also covers 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 appropriate posterior distributions, which will then be combined with selected loss functions 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 are also part of the course.

SSCM-3153 – Inferential Statistics

This course introduces the theory of inferential statistics. It is concerned with the frequentist approach to inference covering point and interval estimation of parameters and hypothesis testing. Properties of estimators such as unbiasedness and sufficiency are applied to estimators of parameters of various distributions. Test of statistical hypotheses include certain best test, uniformly most powerful tests, likelihood ratio tests and chi-square tests.

SSCM 3423 – Numerical Methods II

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

SSCM 3353 – C++ Programming

Concepts of visual programming using C++ for mathematical modelling and simulation. Understanding simulation, its design and implementation. Understanding primary classes in Microsoft Foundation Classes libraries and its graphical interfaces to the kernel. Creating the skeleton program for text and graphics applications. Producing buttons, edit boxes, static boxes, list view windows, menus and images. Applications in problems in curve drawing, numerical methods, graph theory, linear algebra and image processing.

SSCM 3503 – Complex Variables

This course is a continuation of the chapter on Complex Variables in Mathematical Methods III course (SSCM 2043). This course contains further topics on Complex Variables such as 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.

SSCM 3523 – Modern Algebra

This course consists of two parts. The first part includes introduction to groups, types of groups, isomorphism 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.

SSCM 3533 – Set Theory & Logic

Introduces axiomatic set theory and elementary logic. Since set theory and logic form the foundation of mathematics and are greatly intertwined, informal approach to sets are first reviewed to gather vocabulary for a study of logic. The logic parts include propositional algebra and predicate calculus, arguments and methods of proof. Set theory includes the basic axioms and definitions. Basic laws are derived rigorously using methods of logic. Further topics for introducing modern advanced mathematics include properties of numbers, sets and relations, equivalence relations, functions and cardinality.

SSCM 3543 – Number Theory

Number Theory is one of the oldest branches of mathematics, and yet it is very much an alive subject, with discoveries made every day. This course is intended to focus on the topics that relate specifically to the natural numbers. The goal of this course is to develop the student's ability with abstract concepts. Familiar properties of the counting numbers are studied, relationships are discovered, and deductive reasoning is used to verify consistency of these relationships. In the process, students gain insight into the nature of mathematical reasoning, especially common techniques of proof.

SSCM 3523 – Modern Algebra

This course consists of two parts. The first part includes introduction to groups, types of groups, isomorphism 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.

SSCM 3553 – Fields & Ring Theory

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

SSCU 3623 – Research Methodology and Data Retrieval

This course teaches the students on principles of research methodology and information retrieval. Topics include research philosophy and objectives, literature study and review, choosing and defining research problems and design, preparing and writing research proposals, technical report writing (the elements of technical writing), types of technical report writing, dissertation writing, public speaking (preparation and presentation) and information retrieval (search strategies). Presentation of assignment is also an important component in this course.

SSCM 3673 – Functional Analysis

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.

SSCM 3703 – Partial Differential Equation

This course discusses the method for solving second order partial differential equations (PDE). Discussion begins with derivation of the heat, Laplace and wave equations. It continues with classification and method of solving the equation by reducing to canonical form for variable coefficients equations and solving one-dimensional wave equation using the method of d'Alembert solution. The method of separation of variables will be employed to solve heat, Laplace and wave equations in various coordinate systems. The solution for the nonhomogeneous equations and the nonhomogeneous boundary conditions will also be considered.

SSCM 3753 – Fluid Mechanics

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.

SSCM 3793 – Calculus of Variations

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 (extremals of functionals) analytically and selected numerical methods. Upon completion, the students should be able to locate and identify extremizing functions as solutions to variational problems, based on the necessary and the sufficient conditions for an extremum, solve some basic applied problems, and know how to use the direct methods for finding the extremum.

SSCM 3803 - Mathematical Modelling II

This course introduces basic tools to derive and construct mathematical models using partial differential equations. Emphasis is given to the use of a conservation law. The methods of characteristics and separation of variables will be applied to solve the model equations.

SSCM 3843 – Optimization Methods

This course comprises of 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).

SSCM 3883 – Multi-Objectives Decision Making

This course is an introduction to the theory and methods behind optimization under competing objectives involving single and also multiple decision makers. In this course, several approaches for finding the solution to the multi criteria decision problems will be explored, as well as the concepts of Pareto optimality and tradeoff curves to better understand the tradeoffs between objectives that occur in multi-objective decision making problems.

SSCM 4113 – Time Series

The course is designed to provide students to learn time series modelling in theory and practice with emphasis on practical aspects of time series analysis. Methods are hierarchically introduced-starting with terminology and exploratory graphics, progressing to descriptive statistics, and ending with basic modelling procedures. The time series modelling will start with reviewing the fundamental concepts in regression, exponential smoothing and general class of Box Jenkins models.

SSCM 4213 – Generalized Linear Model

This course 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.

SSCM 4163 – Stochastic Process

This course begins with the fundamental of stochastic processes that is the probability theory, and proceeds to discussing major stochastic processes, including Markov chains; discrete and continuous Markov chains, Poisson processes, and renewal theory. Applications to inventory problems, equipment replacement and queuing theory are also dealt with through examples.

SSCM 4243 – Sampling Techniques

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.

SSCM 4623 – Non-Euclidean Geometry

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.

SSCM 4633 – Fuzzy Set Theory

The course starts with brief discussion on an overview of crisp sets. It then follows with basic definition and important terminologies which include α - cut, Extension Principle, and operation on Fuzzy sets. Fuzzy Arithmeticon 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

SSCM 4653 – Applied Abstract Algebra

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

SSCM 4683 - Topology

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. Not only the course emphasizes 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 counter-examples to false statements.

SSCM 4733 – Dynamical Systems

This course introduces the concepts of discrete and continuous dynamical systems, with the ultimate goal of introducing chaos and fractals. For continuous autonomous dynamical systems students learn about fixed points, orbits and invariant sets, and the stability of fixed points. In the discrete dynamical systems, they learn about orbits of one dimensional maps, bifurcation, period doubling which can lead to chaos and strange attractors. Applications include population growth, and electrical engineering. Computer software will be used to simulate and study the dynamical systems.

SSCM 4763 – Computational Fluid Dynamics

This is an introductory course on Computational Fluid Dynamics (CFD) where students are exposed to the techniques of obtaining the numerical solution to fluid flow problems using computer. Historical development, philosophy and the significance of CFD are discussed. The governing equations of fluid dynamics are derived from the fundamental physical principles. The derivation of finite difference approximations to derivatives is revised. Discretization is based on both explicit and implicit techniques. The application to classic fluid flow problems such as Couette flow and other unidirectional flows for viscous fluids, supersonic and subsonic flow for inviscid fluids will be discussed.

SSCM 4783 – Quantum Mechanics

This course introduces the basics of quantum mechanics. It covers the topic relating to 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 problem, angular momentum, the hydrogen atom and electron spin and total angular momentum.

SSCM 4813 – Optimal Control

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.

SSCM 4823 – Scheduling

This course discusses various scheduling classes namely single machine, parallel machine, flow shop, job shop and open shop. Approaches for modelling and solving scheduling problems of the mentioned scheduling classes will be discussed. Various performance measures will be considered in obtaining a good schedule.

SSCM 4833 – Discrete-Event Simulation

This course introduces the application and theoretical background of basic discrete-event simulation concepts and models. Topics included the basic queuing systems, random number generation, model development, model

verification and validation and result analysis. Students will be exposed to simulation model development using a simulation package. The course also helps the students to expand their critical thinking skills by experimenting with the simulated model for improvement.

SSCM 4863 – Financial Mathematics

The course begins with an introduction to basic financial mathematics covering the computation of simple interest and discount rates, deriving the compound interest, and applications of different rates of interest in determining the present and future values of different types of annuities for different time periods. The second part of the course concerns with classical quantitative finance i.e. derivatives, specifically option pricing. An introduction to the subject of finance is presented. This consists of a collection of definitions and specifications concerning the financial markets in general. Then, the subject of derivatives and its concepts are introduced. Two main option pricings for pricing derivatives are examined: The Binomial option pricing and the Black-Scholes option pricing.

SSCU 4902 – Undergraduate Project 1

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

SSCU 4904 – Undergraduate Project 2

Students are required to execute a project (research) under an identified supervisor in an agreeable field of mathematics and document their findings. Students will learn to gather information on chosen topics through literature survey/review activities, construct research methodology, anticipate results, analyze findings, draw conclusion, write references, and to suggest further research. Finally, students are required to submit a report comprising of Title, Introduction, Statement of Problem, Research Objectives, Literature Survey/Review, Research Methodology, Analysis of Findings, Conclusion and References.

PROGRAM SPECIFICATION
BACHELOR OF SCIENCE (PHYSICS)

1. Awarding Institution	Universiti Teknologi Malaysia			
2. Teaching Institution	Universiti Teknologi Malaysia			
3. Program Name	Bachelor of Science in Physics			
4. Final Award	Bachelor of Science (Physics)			
5. Program Code	TS15 (SSCZ)			
6. Professional or Statutory Body of Accreditation	Malaysian Ministry of Higher Education			
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-governing			
10. Study Scheme (Full Time/Part Time)	Full Time			
11. Study Duration	Minimum : 4 yrs Maximum : 6 yrs			
Type of Semester	No. of Semesters		No. of weeks per semester	
	Full Time	Part Time	Full Time	Part Time
Normal	8	-	17	-
Short	-	-	-	-
12. Entry Requirement	<p>Fulfills University requirements and the following program requirements:</p> <ol style="list-style-type: none"> 1. Matriculation/Foundation Science: Pass Matriculation/Foundation Science with at least CPA 2.80 AND a minimum Grade B in Physics, a minimum Grade B- in either Mathematics, Chemistry or Biology AND at least Grade C in Mathematics (SPM) AND at least MUET Band 2. <p>OR</p> <ol style="list-style-type: none"> 2. STPM: Pass STPM with a minimum PNGK of 2.80 AND a minimum Grade B in Physics (STPM) AND at least Grade B in either Biology, Chemistry, Further Mathematics or Mathematics AND at least Grade C in Mathematics (SPM) AND at least MUET Band 2. <p>OR</p> <ol style="list-style-type: none"> 3. Diploma in Science or Engineering: Pass Diploma with at least CPA 3.0 from UTM or recognized institutions AND at least a credit in Mathematics (SPM) or at least Grade C in Mathematics (Diploma) AND at least MUET Band 2. 			
13. Program Educational Objectives (PEO)				
<p>The objectives of the BSc (Physics) program are to provide the knowledge, skills and attributes that should be achieved by the graduates for a successful career. The program is designed to:</p> <ol style="list-style-type: none"> 1. To be a competent, innovative, productive, and talented physicist for development and research needs. 2. To be a professional with appropriate soft-skills. 3. To demonstrate positive attitude, integrity, and high responsibility to the community and global citizen. 				

Program Learning Outcomes (PO)	Intended Learning Outcomes	Teaching and Learning Methods	Assessment
PO1 Fundamental Knowledge	Ability to acquire knowledge of fundamental laws and principles of physics related to current application as well as knowledge in social science and personnel development. (C2, P2, A2)	Lectures, tutorials, laboratory works, directed reading, and group discussion.	Examination, test, quiz and report.
PO2 Application of Physics Knowledge and Skill	Ability to apply fundamental laws and principles of physics using experimental method, mathematical and computational techniques to solve physical problems (C4, P4, A3)	Lectures, laboratory works, assigned reading, group discussion and problem solving assignments, hands-on instrumentations, chemistry related software.	Examination, test, quiz, assignment, and laboratory report, oral presentations, group projects, and computer simulation.
PO3 Scientific Study and Research	Ability to plan, analyze and interpret scientific study related to physics field (C6, P6, A3)	Lectures, laboratory works, assigned reading, group discussion and problem solving assignments, Hands on instrumentations, chemistry related software skills, research project, experimental works, project presentation and report, research training.	Examination, test, quiz, assignment, and laboratory report, oral presentation, group project, computer simulation, research proposal, presentation, final year project report and research training supervisory report.

(b) Generic Skills			
PO4 Critical Thinking and Problem Solving	Ability to identify, analyze, formulate and solve problem scientifically (P4)	Lectures, tutorials, laboratory works, directed reading, simulation exercises, computer-based exercises, problem-based learning	Final Year Project reports, examinations, laboratory reports, presentations, assignments
PO5 Communication Skills	Ability to communicate effectively and with confidence in writing and oral (P4)	Supervised project, lectures, laboratory works, individual assignment, research training.	Final Year Project reports, examinations, laboratory reports, presentations, written assignments, research training report.

PO6 Team Working	Ability to function effectively and with responsibility as team member to achieve common goals and adapt to changing situations and priorities (A3)	Group discussion, laboratory work, group assignment, research training.	Laboratory reports, group Assignment, group project reports, research training report.
PO7 Lifelong Learning and Information Management	Ability to seek and acquire contemporary knowledge, work independently and manage learning time effectively (A3)	Final year projects, individual assignments, research training	Final year project reports, written assignments, research training report.
PO8 Leadership	Ability to function effectively and with responsibility as a leader in a team to achieve common goals (A3)	Projects, group assignments, laboratory work	Project report, group assignment, laboratory report
PO9 Ethics and Integrity	Ability to practice ethical values and integrity in scientific and social interactions, think positively and possessing self-esteem (A3)	Lecture, laboratory work, final year project, assignment, research training	Written assignments, laboratory report, final year project reports, research training
PO10 Entrepreneurship	Awareness of business, entrepreneurship and career opportunities (P2)	Lecture, project, research training	Written assignment, project report, research training

15. Classification of Courses

No.	Classification	Credit Hours	Percentage (%)
i.	Basic Sciences and Mathematics	23	58.9
ii.	Program Core	53	
iii.	Program Electives	33	25.6

iv.	Compulsory University Courses a. Humanity b. Language c. Co-curriculum d. Entrepreneurship	10 6 2 2	15.5
Total		129	100

For sciences program, please fill up the following classification. (Others please refer to statutory Body guidelines)

No.	Classification	Credit Hours	Percentage (%)
A	Physics Courses		
	(a) Lectures	77	
	(b) Laboratory/Workshop	6	60.6
	(c) Final Year Project	6	4.7
	(d) Research training	5	4.7
			3.9
	Total credit hours for Part A	94	72.9
B	16 Related Courses		
	(a) Mathematics	15	
	(b) Humanities/Ethics	10	11.6
	(c) Co-Curriculum	2	7.8
	(d) English	6	1.6
	(e) Entrepreneurship	2	4.7
			1.6
	Total credit hours for Part B	33	25.6
	17 Total Credit Hours for Parts A and B	129	100%

16. Total credit hours to graduate	129 credit hours
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17. Program 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 courses 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 not less than **125** credit hours with minimum CPA of 2.0.
- Pass the Research Training
- Complete and pass the undergraduate Final Year Project.

SEMESTER I			SEMESTER 2		
Code	Name of Course	cr	Code	Name of Course	cr
UICI 1012	Islamic and Asian Civilization	2	SSCP 1163	Sound, Wave and Optics	3
SSCP 1102	Introduction to Physics	2	SSCP 1223	Modern Physics	3
SSCP 1143	Mechanics	3	SSCM 1523	Linear Algebra	3
SSCP 1153	Electricity and Magnetism	3	SSCM 1033	Mathematical Methods II	3
SSCM 1023	Mathematical Method I	3	SSCP 1821	Practical Physics II	1
SSCP 1811	Practical Physics I	1	ULAB 1122	Academic English Skills	2
			UHAS 1172	Malaysia Dynamics*	2
			UHAK 1022	Arts, Customs and Beliefs*	2
Total Credit Hours		14	Total Credit Hours		17
*UHAS 1172 : Local Students					
*UHAK 1022 : Foreign Student					
SEMESTER 3			SEMESTER 4		
Code	Name of Course	cr	Code	Name of Course	cr
SSCM 1703	Differential Equations I	3	SSCP 2113	Thermodynamics	3
SSCP 2213	Nuclear Physics	3	SSCP 2413	Solid State Physics	3
SSCP 2313	Basic Electronics	3	SSCP 2613	Mathematical Physics	3
SSCP 2333	Computer Programming	3	SSCP 2821	Practical Physics IV	1
SSCP 2811	Practical Physics III	1	UHAK 1012	Graduate Success Attributes	2
UICL 2302	Scientific and Technological Thinking	2	ULAB 2122	Advanced Academic English Skills	2
UHAK 1032	Introduction to Entrepreneurship	2	UKQA 2092	Community and Science	2
Total Credit Hours		17	Total Credit Hours		16
SEMESTER 5			SEMESTER 6		
Code	Name of Course	cr	Code	Name of Course	cr
SSCP 3113	Electromagnetism	3	UKQE 3001	ExCEL	1
SSCM 3503	Complex Variables	3	ULA* 1112	Foreign Language Elective	2
SSCP 3123	Classical Mechanics	3	SSCP 3643	Quantum Mechanics I	3
SSCP 3133	Thermal and Statistical Physics	3	SSCP 3821	Practical Physics VI	1
SSCP 3811	Practical Physics V	1			
ULAB 3162	English for Professional Purposes	2			
UHAK 2**2	Soft Skills Elective	2			
			Elective (Choose 9 credits)		
			SSCP 3163	Energy and Environmental Physics	3
			SSCP 3333	Computational Physics	3
			SSCP 3523	Modern Physics	3
			SSCP 3143	Relativity	3
			SSCP 3453	Elementary Particles	3
Total Credit Hours		17	Total Credit Hours		16
SHORT SEMESTER					
Code	Name of Course	cr			
SSCU 3915	Research Training (HW)	5			
Total Credit Hours		5			

SEMESTER 7			SEMESTER 8		
Code	Name of Course	cr	Code	Name of Course	cr
SSCU 4902	Undergraduate Project I	2	SSCU 4904	Undergraduate Project II	4
Elective (Choose 12 credits)			Elective (Choose 12 credits)		
SSCP 4163	Astrophysics	3	SSCP 4173	Quantum Mechanics	3
SSCP 4323	Electronic and Instrumentation	3	SSCP 4213	Advanced Nuclear Physics	3
SSCP 4333	Digital Signal Processing	3	SSCP 4433	Magnetism	3
SSCP 4413	Semiconductor Physics	3	SSCP 4453	Low Temperature Physics and Superconductivity	3
SSCP 4423	Condensed Matter Physics	3	SSCP 4513	Laser Physics	3
Total Credit Hours		14	Total Credit Hours		16

18. Mapping of Programmed Learning Outcome to Course

COURSES OFFERED		LEARNING OUTCOMES									
		Fundamental Knowledge	Application of Knowledge	Analyzing and Experimental Skills	Communication Skills	Thinking Skills	Scholarship	Team working Skills	Adaptability	Global Citizen	Enterprising Skills
Code	Courses	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Core Courses											
SSCP1102	Introduction to Physics Program	✓						✓			
SSCM1023	Mathematical Methods I	✓	✓								
SSCM1523	Linear Algebra	✓	✓								
SSCM1033	Mathematical Methods II	✓	✓								
SSCM1703	Differential Equations I	✓	✓								
SSCM3503	Complex Variables	✓	✓					✓			
SSCP 1143	Mechanics	✓	✓								
SSCP 1153	Electricity and Magnetism	✓	✓		✓						
SSCP 1811	Practical Physics I	✓	✓	✓		✓				✓	
SSCP 1163	Sound, Wave and Optics	✓	✓		✓						
SSCP 1223	Modern Physics	✓	✓					✓			
SSCP 1821	Practical Physics II	✓	✓	✓		✓		✓			
SSCP 2313	Basic Electronics	✓	✓	✓		✓					
SSCP 2213	Nuclear Physics	✓	✓					✓			
SSCP 2333	Computer Programming	✓	✓	✓		✓					
SSCP 2811	Practical Physics III	✓	✓	✓	✓						
SSCP 2113	Thermodynamics	✓	✓					✓			
SSCP 2613	Mathematical Physics	✓	✓				✓				
SSCP 2413	Solid State Physics	✓	✓		✓						
SSCP 2821	Practical Physics IV	✓	✓	✓	✓			✓			

SSCP3123	Classical Mechanics	✓	✓				✓				
SSCP 3113	Electromagnetism	✓	✓				✓				
SSCP 3811	Practical Physics V	✓	✓	✓		✓			✓		
SSCU3915	Research Training (HW)	✓	✓	✓	✓	✓		✓		✓	
SSCP3613	Quantum Mechanics 1	✓	✓				✓				
SSCP3133	Thermal and Statistical Physics	✓	✓		✓						
SSCP 3821	Practical Physics VI	✓	✓	✓	✓	✓					
SSCU4902	Undergraduate Project I	✓	✓	✓		✓	✓			✓	
SSCU4904	Undergraduate Project II	✓	✓	✓	✓	✓	✓			✓	
ELECTIVE COURSES											
SSCP3523	Modern Optics	✓	✓		✓						
SSCP3333	Computational Physics	✓	✓	✓		✓					
SSCP3153	Elementary Particles	✓	✓				✓				
SSCP3143	Relativity	✓	✓		✓						
SSCP3163	Energy and Environmental Physics	✓	✓							✓	
SSCP4323	Electronics and Instrumentation	✓	✓	✓	✓						
SSCP4163	Astrophysics	✓	✓	✓					✓		
SSCP4333	Digital Signal Processing	✓	✓	✓					✓		
SSCP4413	Semiconductor Physics	✓	✓					✓			
SSCP4423	Condensed Matter Physics	✓	✓		✓						
SSCP4433	Magnetism	✓	✓					✓			
SSCP4513	Laser Physics	✓	✓					✓			
SSCP4453	Low Temperature Physics and Superconductivity	✓	✓					✓			
SSCP4173	Quantum Mechanics II	✓	✓			✓					
SSCP4213	Advanced Nuclear Physics	✓	✓				✓				
UNIVERSITY COURSES											
UICI1012	Islamic and Asian Civilisation	✓			✓						
UHAS1172	Malaysia Dynamics									✓	
UHAK 1162/1022	Arts, Customs and Beliefs									✓	
ULAB 1122	Academic English Skills						✓				
ULAB 2122	Advanced Academic English Skills	✓			✓						
UHAK 1012	Graduate Success Attributes					✓					
UKQA 2092	Science and Community						✓		✓		
ULAB 3162	English for Professional Purposes							✓			
UICL 2302	Science and Technological Thinking				✓						

UHAK 1032	Introduction to Entrepreneurship											✓
UHAK 2**2	Soft Skills Elective								✓			
ULA* 1112	Foreign Language Elective					✓						
UKQE 3001	ExCEL											

Key:

PO1 – PO3 = Technical Skills:

PO4 – PO10 = Generic Skills

<p>19. Our Uniqueness</p> <p>This program stresses on the research skill and experience in research training in contemporary pure physics for the graduates.</p> <p>Established links with local and international universities/research institutions</p>
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<p>20. Career Prospects and Career Paths</p> <p>Graduates of the program can work as</p> <ul style="list-style-type: none"> ● Academics – Higher learning institutions (following pursuance of their degree qualifications to Masters of PhD levels) ● Research Officer – Research institutes, higher learning institutions and industries ● Science Officer - Research institutes, higher learning institutions and industrie ● Physics Teacher - Schools and colleges ● Quality Control/Assurance and Marketing Officers – Agencies and industries
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<p>21. Cross Campus Program</p> <p>Students are given the opportunity to enroll certain courses in participating universities locally and overseas. The grades and credits up to 1/3 of the total credits of the curriculum are transferable.</p>
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<p>22. Professional Skills Program Certificate (Program UTM Degree ++)</p> <p>Students must enroll in Professional Skills Program conducted by SPACE UTM. Four of such courses are: ISO 9001:2008, OSHE, How to manage your finance, and How to get yourself employed.</p>

<p>23. Facilities available</p> <p>A: Laboratories:</p> <ol style="list-style-type: none"> 1. Material Characterization laboratory 2. Material Preparations laboratory 3. Crystal Growth laboratory 4. Teaching Laboratory : Optics 1 5. Teaching Laboratory : Optics 2 6. Teaching Laboratory : Optics 3
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7. PCB Laboratory
8. Teaching Laboratory : Instrumentation 1
9. Teaching Laboratory : Instrumentation 2
10. Teaching Laboratory : Instrumentation 3
11. Teaching Laboratory : Instrumentation 4
12. Applied Optics Laboratory 1
13. Applied Optics Laboratory 2
14. Applied Optics Laboratory 3
15. Sputtering Laboratory
16. Thin Film Laboratory
17. Atomic Force Scanning Microscope (AFM) Laboratory
18. Teaching Laboratory: Material Physics 1
19. Teaching Laboratory: Material Physics 2
20. Teaching Laboratory: Nuclear Physics
21. Astrophysics Laboratory
22. Electronic Workshop
23. General Workshop
24. Tensile Testing Room
25. Non-destructive Testing Laboratory
26. Material Analysis Laboratory
27. Furnaces Room

B: List of instruments

1. Single crystal growth apparatus
2. UV-VIS Spectrophotometer
3. CNC machine
4. Photoluminescence Spectrometer
5. Ellipsometer
6. High Temperature Furnace
7. Differential Thermal Analyzer(DTA)
8. Vickers Hardness Equipment
9. General mechanical testing machine
10. Hyper pure Germanium Detector
11. Atomic Force Microscope (AFM)
12. Rapid Thermal Process (RTP)
13. Tensile Machine
14. Corrosion Machine

24. Support for Students and Their Learning

- a. Two weeks induction program for orientation and introducing study skills
- b. Student Handbook and Guidance Module
- c. Staff and student ratio of 1: 12
- d. Library facilities and other learning resources
- e. All students are assigned an academic advisor who helps in personal problems and advising the learning program

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

- a. Students performance in terms of:
 - KB/KS/KG –Pass/conditional pass/fail
 - CPA – Cumulative point average
 - Graduating students performance
 - GOT – Graduate on time
 - Completion rate
 - Analysis of course performance
- b. Employability
 - Exit survey
 - Alumni survey
 - Market survey
- c. Lecturer's performance
 - g. Teaching evaluation by students (e-PPP)
 - h. Competency check-list for staff (CS).
 - i. Annual staff appraisal (LPPT)
- d. 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)
- e. Delivery system
 - Academic Quality Assurance Committee
 - Customer Satisfaction Index (CSI)
 - Employer Satisfaction Index (ESI)
 - Vive Chancellor's Quality Award (AKNC) audit
 - Malaysian Quality Assurance (MQA) standard

26 Regulation of Assessment

a. Summary of grades and marks

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

27. Assessment Tools												
Measurement Tools	Learning Outcomes										Duration	Action by
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10		
e-Portfolio	x	x	x	x	x	x	x	x	x	x	continuous	Student
Course outcome survey Employer Survey	x	x	x	x	x	x	x	x	x	x	per semester	Lecturer
Course outcome report	x	x	x	x	x	x	x	x	x	x	per semester	Lecturer
Final Year Project survey	x	x	x	x	x		x		x		per semester	Faculty
PO survey by final year students	x	x	x	x	x	x	x	x	x	x	per semester	Faculty
Research training survey			x	x	x	x	x	x	x		Per session	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	Once/ year	Head of Dept
Employer Survey	x	x	x	x	x	x	x	x	x	x	Once/ year	Head of Dept

BACHELOR OF SCIENCE (INDUSTRIAL PHYSICS)

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 (SSCF)		
6. Professional or Statutory Body of Accreditation		Malaysian Ministry of Higher Education		
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-governing		
10. Study Scheme (Full Time/Part Time)		Full Time		
11. Study Duration		Minimum : 4 yrs Maximum : 6 yrs		
Type of Semester	No. of semester		No. of semester	
	Full Time	Full Time	Full Time	Full Time
Normal	8	-	14	-
Short	-	-	-	-
12. Entry Requirement	<p>Fulfills University requirements and the following program requirements:</p> <p><u>STPM/MATRICULATION/SCIENCE FOUNDATION</u></p> <p>Minimum CGPA of 2.80 and passed with Grade B in Physics and Grade B- in ONE (1) of the following subject : Biology/Mathematics/Chemistry</p> <p><u>DIPLOMA</u></p> <p>Minimum CGPA of 3.00 and passed with credits in Mathematics in the SPM/equivalent examination.</p>			

13. Program Objectives

The objectives of the B.Sc.(Industrial Physics) program are to provide the knowledge, skills and attributes that should be achieved by the graduates for a successful career. The program is designed to:

1. prepare graduates to work as a capable physicist in research and industrial institutions.
2. prepare graduates capable of leading a team and taking higher responsibility in workplace and community.
3. prepare graduates with reputable personality through critical reasoning and analysis, effective written and oral communication skills.
4. prepare graduates with innovative and creative mind to meet new challenges.
5. prepare graduates with professional integrity and capable of managing own learning successfully.
6. prepare graduates that possess entrepreneurship skills and able to foresee towards wealth and job creations.

14. Program Learning Outcomes			
Intended Learning Outcomes	Intended Learning Outcomes	Intended Learning Outcomes	Intended Learning Outcomes
(a) Technical Knowledge and Competencies			
PO1 Fundamental knowledge of Physics	Ability to acquire knowledge of fundamental laws and principles of physics of undergraduate level (C4, P2, A3).	Lectures, tutorials, seminars, laboratory work, directed reading, active learning.	Examinations, test, quiz, laboratory report, presentation, written assignment, problem-based exercise, project report.
PO2 Application of physics knowledge and skills	Ability to apply fundamental laws and principles of physics using experimental method, mathematical and computational techniques related to industrial application(C4, P4, A3).	Lectures, tutorials, computer hands-on sessions, laboratory work, Industrial training.	Examinations, laboratory report, presentation, written assignment, problem-based exercise, project report, simulation exercise, industrial training report.
PO3 Analyzing and experimental skills	Ability to plan, analyze and interpret scientific study of physics related to industrial application (C6, P6, A3)	Supervised projects, lectures, laboratory works, directed reading, simulation exercises, computer-based exercises, problem-based learning, Industrial training	Final Year Project report, examination, laboratory report, presentation, written assignment, industrial training report.
(b) Generic Skills			
PO4 Critical Thinking and Problem Solving	Ability to identify, analyze, formulate and solve fundamental physics related problems (P4)	Lectures, tutorials, laboratory works, directed reading, simulation exercises, computer-based exercises, problem-based learning, Industrial training.	Final Year Project reports, examinations, laboratory reports, presentations, written assignments, Industrial Training report

<p align="center">PO5 Communication Skills</p>	<p>Ability to communicate effectively and with confidence in writing and oral (P4)</p>	<p>Supervised project, lectures, laboratory works, individual assignment, Industrial training.</p>	<p>Final Year Project report, examination, laboratory report, presentation, written assignment, industrial training report.</p>
<p align="center">PO6 Team Working</p>	<p>Ability to function effectively as a member in a team to achieve common goals and adapt to changing situations and priorities (A3)</p>	<p>Final year project, laboratory work, group assignment, Industrial training</p>	<p>Laboratory report, final year project report, industrial training report.</p>
<p align="center">PO7 Lifelong learning and Information Management</p>	<p>Ability to seek and acquire contemporary knowledge, work independently and manage learning time effectively (A3)</p>	<p>Final year projects, individual assignments, industrial training</p>	<p>Final year project report, written assignment, industrial training report.</p>
<p align="center">PO8 Leadership skills</p>	<p>Ability to function effectively and with responsibility as a leader in a team to achieve common goals (A3)</p>	<p>Projects, tutorials, group assignments, laboratory work,</p>	<p>Oral presentation, group report.</p>
<p align="center">PO9 Ethics and Integrity</p>	<p>Ability to practice ethical values and integrity in scientific and social interactions, think positively and possessing self-esteem (A3)</p>	<p>Lecture, final year project, industrial training</p>	<p>Written assignments, final year project report, industrial training report.</p>
<p align="center">PO10 Entrepreneurship</p>	<p>Awareness of business, entrepreneurship and career opportunities (P2)</p>	<p>Lectures, project, industrial training.</p>	<p>Written assignment, project report, industrial training report.</p>

15. Classification of Courses			
No.	Classification	Credit Hours	Percentage (%)
1	Basic Sciences and Mathematics	20	58.9
2	Program core	56	
3	Program Elective	33	25.6
4	Compulsory university courses <ul style="list-style-type: none"> • Humanity • English Language • Co-curriculum • Entrepreneurship 	10 6 2 2	15.5
	Total	129	100
For Science program please fill up the following classification. (Others please refer to the Statutory Body guidelines)			
	Classification	Credit Hours	Percentage (%)
A	18 Physics Courses:		
	19 (a) Lectures	71	55.0
	20 (b) Laboratory/Workshop/	6	4.7
	21 (c) Final Year Project	6	4.7
	(d) Industrial training	5	3.8
	Total credit hours for Part A	88	68.2
B	22		
	23 Related Courses:		
	24 (a) Mathematics	12	9.3
	25 (b) Management and marketing	9	7.0
	26 (c) Humanities/Ethics	10	7.8
	27 (d) Co-Curriculum	2	1.6
	28 (e) English	6	4.7
(f) Entrepreneurship	2	1.6	
	Total credit hours for Part B	41	31.8
	29 Total credit hours for Parts A and B	129	100%

16. Total credit hours to graduate	129 credit hours
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17. Program structures and features, curriculum and award requirements
<p>The course is offered on full-time mode and is based on a 2- Semester Academic Session with several courses being delivered and assessed in each Semester. Assessment is based on final examination and coursework conducted throughout the semester.</p> <p>Award requirements: To graduate, students should:</p> <ul style="list-style-type: none"> • Attain a total of 129 credit hours with minimum CPA of 2.00. • Pass industrial training. • Complete and pass the undergraduate Final Year Project.

SEMESTER I			SEMESTER 2		
Code	Name of Course	cr	Code	Name of Course	cr
UICI 1012	Islamic and Asian Civilization	2	SSCP 1163	Sound, Wave and Optics	3
SSCM 1023	Mathematical Methods I	3	SSCP 1223	Modern Physics	3
SSCP 1102	Introduction to Physics Program	2	SSCM 1523	Linear Algebra	3
SSCP 1143	Mechanics	3	SSCM 1033	Mathematical Methods II	3
SSCP 1153	Electricity and Magnetism	3	SSCP 1821	Practical Physics II	1
SSCP 1811	Practical Physics I	1	ULAB 1122	Academic English Skills	2
			UHAS 1172	Malaysia Dynamics*	2
			UHAS 1162/ UHAK 1022	Arts, Customs and Beliefs*	2
			UHAK 1032	Introduction to Entrepreneurship	
Total Credit Hours		14	Total Credit Hours		17
*UHAS 1172 : Local Students					
*UHAS 1162 : Foreign Student					
SEMESTER 3			SEMESTER 4		
Code	Name of Course	cr	Code	Name of Course	cr
SSCM 1703	Differential Equations I	3	SSCP 2113	Thermodynamics	3
SSCP 2213	Nuclear Physics	3	SSCP 2413	Solid State Physics	3
SSCP 2313	Basic Electronics	3	SSCP 2613	Mathematical Physics	3
SSCP 2333	Computer Programming	3	SSCP 2821	Practical Physics IV	1
SSCP 2811	Practical Physics III	1	UHAK 1012	Graduate Success Attributes	2
UICL 2302	Scientific and Technological Thinking	2	ULAB 2122	Advanced Academic English Skills	2
UHAK 1032	Introduction to Entrepreneurship	2	UKQA 2092	Community and Science	2
Total Credit Hours		17	Total Credit Hours		16
SEMESTER 5			SEMESTER 6		
Code	Name of Course	cr	Code	Name of Course	cr
SSCP 3113	Electromagnetism	3	UKQE 3001	ExCEL	1
SSCP 3133	Thermal and Statistical Physics	3	ULA* 1112	Foreign Language Elective	2
SSCP 3323	Advanced Electronics	3	SSCP 3343	Instrumentation and Data Acquisition	3
SSCP 3811	Practical Physics V	1	SSCP 3613	Quantum Mechanics I	3
ULAB 3162	English for Professional Purposes	2	SSCP 3821	Practical Physics VI	1
UHAK 2**2	Soft Skills Elective	2			
Elective (Choose 3 credits)			Elective (Choose 6 credits)		
SHAC 1163	Principles of Accounting	3	SHAF 1013	Principles of Marketing	3
SHAD 1043	Principles of Management	3	SHAD 1043	Organizational Behaviors	3
			SSCP 3433	Quality Control	3
Total Credit Hours		17	Total Credit Hours		16
SHORT SEMESTER					
Code	Name of Course	cr			
SSCU 3915	Industrial Training (HW)	5			
Total Credit Hours		5			
SEMESTER 7			SEMESTER 8		
Code	Name of Course	cr	Code	Name of Course	cr

SSCU 4902	Undergraduate Project I	2	SSCU 4904	Undergraduate Project II	4
Elective (Choose 12 credits from a group)			Elective (Choose 12 credits from a group)		
Group A			Group A		
SSCP 4123	Nondestructive Testing and Evaluation	3	SSCP 4013	Data Processing	3
SSCP 4133	Industrial Electronics	3	SSCP 4303	Process Control	3
SSCP 4143	Electronics Circuit Simulation	3	SSCP 4353	Ultrasonic Techniques	3
SSCP 4333	Digital Signal Processing	3	SSCP 4363	Electronics Testing and Maintenance	3
SSCP 4393	Computer Interfacing	3	SSCP 4373	Communication Electronics	3
Group B			Group B		
SSCP 4223	Radiation Detection	3	SSCP 4253	Medical Physics	3
SSCP 4233	Radiation Protection	3	SSCP 4263	Occupational Health and Safety	3
SSCP 4243	Applied Radiation Physics	3	SSCP 4273	Nuclear Energy	3
SSCP 4293	Radiation Dosimetry	3	SSCP 4283	Environmental Radiation Protection	3
SSCP 4913	Radiobiology	3	SSCP 4203	Medical Radiation Protection	3
Group C			Group C		
SSCP 4623	Material Science	3	SSCP 4463	Corrosion Sciences	3
SSCP 4633	Ceramic and Amorphous Material	3	SSCP 4473	Spectroscopy and Material Analysis	3
SSCP 4643	Polymer Science	3	SSCP 4483	Semiconductor Physics	3
SSCP 4603	Vacuum and Thin Film Technology	3	SSCP 4443	Magnetic Material	3
SSCP 4493	Metallurgy	3	SSCP 4403	Microscopy and Material Analysis	3
Group D			Group D		
SSCP 4713	Introduction to Nonlinear Optics	3	SSCP 4553	Applied Optics	3
SSCP 4523	Laser Technology	3	SSCP 4563	Photonics	3
SSCP 4533	Fibre Optics Technology	3	SSCP 4573	Laser in Medicine	3
SSCP 4543	Optoelectronics	3	SSCP 4583	Photonics	3
SSCP 3523	Modern Optics	3	SSCP 4593	Solid State Laser Engineering	3
Total Credit Hours		14	Total Credit Hours		16

18. Mapping of Program Learning Outcomes to Courses											
COURSES OFFERED		LEARNING OUTCOMES									
		Fundamental Knowledge	Application of Knowledge	Analyzing and Experimental Skills	Communication Skills	Thinking Skills	Scholarship	Team working Skills	Adaptability	Global Citizen	Enterprising Skills
Code	Courses	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
Core Courses											
SSCP 1102	Introduction to Physics Program	✓						✓			
SSCP 1143	Mechanics	✓	✓								
SSCP 1153	Electricity and Magnetism	✓	✓								
SSCM1023	Mathematical Methods I	✓	✓								
SSCM1523	Linear Algebra	✓	✓								
SSCM1033	Mathematical Methods II	✓	✓								
SSCM1703	Differential Equations I	✓	✓								
SSCP 1811	Practical Physics I	✓	✓	✓				✓			
SSCP 1163	Sound, Wave and Optics	✓	✓								
SSCP 1223	Modern Physics	✓	✓								
SSCP 1821	Practical Physics II	✓	✓	✓				✓			
SSCP 2313	Basic Electronics	✓	✓	✓		✓					
SSCP 2213	Nuclear Physics	✓	✓					✓			
SSCP 2333	Computer Programming	✓	✓	✓		✓					
SSCP 2811	Practical Physics III	✓	✓	✓				✓			
SSCP 3323	Advanced Electronics	✓	✓					✓			
SSCP 2613	Mathematical Physics	✓	✓				✓				
SSCP 2413	Solid State Physics	✓	✓		✓						
SSCP 2821	Practical Physics IV	✓	✓	✓	✓			✓			
SSCP 3113	Electromagnetism	✓	✓				✓				
SSCP 2113	Thermodynamics	✓	✓					✓			
SSCP 3343	Instrumentation and Data Acquisition	✓	✓	✓		✓					
SSCP 3811	Practical Physics V	✓	✓	✓				✓			
SSCP 3821	Practical Physics VI	✓	✓	✓				✓			
SSCP 3613	Quantum Mechanics I	✓	✓				✓				
SSCP 3133	Thermal and Statistical Physics	✓	✓		✓						
SSCU 4902	Undergraduate Project I	✓	✓	✓		✓					

SSCU 4904	Undergraduate Project II	✓	✓	✓	✓						
SSCU 3905	Industrial Training (HW)	✓	✓	✓					✓		
ELECTIVE COURSES											
SSCP 3433	Quality Control	✓	✓					✓			
SHAD 1043	Organizational Behaviors	✓								✓	
SHAC 1163	Principles of Accounting	✓			✓			✓			
SHAF 1013	Principles of Marketing	✓			✓						
SHAD 1033	Principles of Management	✓								✓	
GROUP A											
SSCP 4123	Nondestructive Testing and Evaluations.	✓	✓		✓						
SSCP 4133	Industrial electronics	✓	✓	✓				✓			
SSCP 4143	Electronic Circuit Simulations	✓	✓	✓				✓			
SSCP4333	Digital Signal Processing	✓	✓	✓		✓					
SSCP 4393	Computer Interfacing	✓	✓	✓				✓			
SSCP 4353	Ultrasonic Techniques	✓	✓							✓	
SSCP 4363	Electronics Testing and Maintenance	✓	✓	✓		✓					
SSCP 4373	Communication Electronics	✓	✓					✓			
SSCP 4303	Process Control	✓	✓						✓		
SSCP 4013	Data Processing	✓	✓	✓						✓	
GROUP B											
SSCP 4913	Radiobiology	✓	✓		✓						
SSCP 4223	Radiation Detection	✓	✓					✓			
SSCP 4233	Radiation Protection	✓	✓							✓	
SSCP 4243	Applied Radiation Physics	✓	✓			✓					
SSCP 4293	Radiation Dosimetry	✓	✓					✓			
SSCP 4253	Medical Physics	✓	✓							✓	
SSCP 4263	Occupational Health and Safety	✓	✓		✓						
SSCP 4273	Nuclear Energy	✓	✓			✓					
SSCP 4283	Environmental Radiation Protection	✓	✓					✓			
SSCP 4203	Medical Radiation Protection	✓	✓	✓	✓						
GROUP C											
SSCP 4623	Material Sciences	✓	✓					✓			
SSCP 4633	Ceramic and Amorphous Materials	✓	✓						✓		
SSCP 4643	Polymer Science	✓	✓					✓			
SSCP 4603	Vacuum and Thin Film Technology	✓	✓						✓		
SSCP 4493	Metallurgy	✓	✓							✓	

SSCP 4463	Corrosion Sciences	✓	✓		✓						
SSCP 4473	Spectroscopy and Material Analysis	✓	✓			✓					
SSCP 4483	Semiconductor Devices	✓	✓				✓				
SSCP 4443	Magnetic Materials	✓	✓			✓					
SSCP 4403	Microscopy and Material Analysis	✓	✓			✓					
GROUP D											
SSCP 4523	Laser Technology	✓	✓					✓			
SSCP 4533	Fibre Optics Technology	✓	✓				✓				
SSCP 4543	Optoelectronics	✓	✓				✓				
SSCP 3523	Modern Optics	✓	✓		✓						
SSCP 4713	Introduction to Nonlinear Optics	✓	✓						✓		
SSCP 4553	Applied Optics	✓	✓				✓				
SSCP 4563	Photonics	✓	✓		✓						
SSCP 4573	Laser in Medicine	✓	✓					✓			
SSCP 4583	Photometrics	✓	✓			✓					
SSCP 4593	Solid State Laser Engineering	✓	✓							✓	
UNIVERSITY COURSES											
UICI 1012	Islamic and Asian Civilisation				✓						
UHAS 1172	Malaysia Dynamics									✓	
UHAK 1022/ UHAK 1162	Arts, Custom and Beliefs									✓	
UICL 2302	Scientific and Technological Thinking				✓						
UHAK 2**2	Soft Skills Elective								✓		
UHAK 1012	Graduate Success Attributes					✓					
ULA* 1112	Foreign Languages Elective					✓					
ULAB 1122	Academic English Skills						✓				
ULAB 2122	Advanced Academic English Skills					✓					
ULAB 3162	English for Professional Purpose							✓			
UKQA 2092	Science and Community						✓		✓		
UHAK 1032	Introduction to Entrepreneurship										✓
UKQE 3001	ExCEL										

PO1-PO3 = Technical Skills
PO4-PO10 = Generic Skills

19. Our Uniqueness

- The program is specially tailored to suit the current industrial needs.
- This program allows student to do their industrial placement at local or foreign companies.
- Established links with local and international industries.
- The program allows student to do transfer credit of certain equivalence courses offered by other university locally and overseas.
- Our laboratories are equipped with state of the art facilities and instruments.

20. Career Prospects and Career Path

s program prepares graduate to pursue carriers in various industries such as industrial supervisor, human resource manager, instrumentation services manager, quality control and production engineer and Occupational Health Officers. In public sectors, the graduate may pursue carrier as Science Officer, Research Scientist, Meteorologist and etc.

21. Cross Campus Program

Students are given the opportunity to enroll certain courses in participating universities locally and overseas. The grades and credits up to 1/3 of the total credits of the curriculum are transferable.

22. Professional Skills Program Certificate(Program UTM Degree ++)

Students are given a chance to enroll in certificate programs offered by SPACE UTM during their semester breaks. Four of such courses are: ISO 9001:2008, OSHE, How to manage your finance, and How to get yourself employed.

23. Facilities available

A: Laboratories:

28. Material Characterization laboratory
29. Material Preparations laboratory
30. Crystal Growth laboratory
31. Teaching Laboratory : Optics 1
32. Teaching Laboratory : Optics 2
33. Teaching Laboratory : Optics 3
34. PCB Laboratory
35. Teaching Laboratory : Instrumentation 1
36. Teaching Laboratory : Instrumentation 2
37. Teaching Laboratory : Instrumentation 3
38. Teaching Laboratory : Instrumentation 4
39. Applied Optics Laboratory 1
40. Applied Optics Laboratory 2
41. Applied Optics Laboratory 3
42. Sputtering Laboratory
43. Thin Film Laboratory
44. Atomic Force Scanning Microscope (AFM) Laboratory
45. Teaching Laboratory: Material Physics 1
46. Teaching Laboratory: Material Physics 2

47. Teaching Laboratory: Nuclear Physics
48. Astrophysics Laboratory
49. Electronic Workshop
50. General Workshop
51. Tensile Testing Room
52. Non-destructive Testing Laboratory
53. Material Analysis Laboratory
54. Furnaces Room

B: List of instruments

15. Single crystal growth apparatus
16. UV-VIS Spectrophotometer
17. CNC machine
18. Photoluminescence Spectrometer
19. Ellipsometer
20. High Temperature Furnace
21. Differential Thermal Analyzer(DTA)
22. Vickers Hardness Equipment
23. General mechanical testing machine
24. Hyper pure Germanium Detector
25. Atomic Force Microscope (AFM)
26. Rapid Thermal Process (RTP)
27. Tensile Machine
28. Corrosion Machine

24. Support for Students and Their Learning

- f. Two weeks induction program for orientation and introducing study skills
- g. Student Handbook and Guidance Module
- h. Staff and student ratio of 1: 12
- i. Library facilities and other learning resources
- j. All students are assigned an academic advisor who helps in personal problems and advising the learning program

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

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

- b. Employability
 - Exit survey
 - Alumni survey
 - Market survey
- c. Lecturer's performance
 - Teaching evaluation by students (e-PPP)
 - Competency check-list for staff (CS).
 - Annual staff appraisal (LPPT)
- d. 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)
- e. Delivery system
 - Academic Quality Assurance Committee
 - Customer Satisfaction Index (CSI)
 - Employer Satisfaction Index (ESI)
 - Vive Chancellor's Quality Award(AKNC) audit
 - Malaysian Quality Assurance (MQA) standard

26.Regulation of Assessment

- a. Summary of grades and marks

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

27. Assessment Tools

	Learning Outcomes	Duration	

Measurement Tools	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		Action by
e-Portfolio	x	x	x	x	x	x	x	x	x	x	continuous	Student
Course outcome survey Employer Survey	x	x	x	x	x	x	x	x	x	x	per semester	Lecturer
Course outcome report	x	x	x	x	x	x	x	x	x	x	per semester	Lecturer
Final Year Project survey	x	x	x	x	x		x		x		per semester	Faculty
PO survey by final year students	x	x	x	x	x	x	x	x	x	x	per semester	Faculty
Industrial training survey			x	x	x	x	x	x	x		Per session	Faculty
Alumni Survey	x	x	x	x	x	x	x	x	x	x	Once/ year	Head of Dept.
Employer Survey	x	x	x	x	x	x	x	x	x	x	Once/year	Head of Dept.

SYNOPSIS OF PHYSICS COURSES

SSCM1023 – Mathematical Methods I

The course revises and extends Matriculation and STPM topics such as differentiation and integration and includes topics such as complex numbers and differential equations, which may be new to many students. Topics covered include parametric equations, functions, polar coordinates, vectors, and complex numbers. 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. Additional topics include limits and continuity, differentiation techniques and its applications, integration techniques including improper integrals. Upon completion, the students would have acquired some quite powerful tools of analysis. This is also an introductory course on differential equations. Topic includes first order ordinary differential equations (ODEs). Students will learn how to classify and solve first order ODEs.

SSCM1033 – Mathematical Methods II

This course continues and extends the techniques introduced in Mathematical Methods I, with further differential equations and calculus of multivariable functions. Topics include linear second order ODEs with constant coefficients, functions of several variables, partial differentiation and multiple integrations. Students will learn how to classify and solve second order linear ODEs with constant coefficients using the method of undetermined coefficients and variation of parameters. They will also 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.

SSCP1102 — Introduction to Physics Program

Physics is one of the most fundamental scientific disciplines with the main goal of understanding how the universe behaves. It covers a wide range of phenomena from the smallest sub-atomic particles to the largest galaxies, it is the scientific study of matter and energy and how they interact with each other. Physicist is a scientist who studies or practices physics. Examples of careers in physics are scientists and researchers in various fields of science and technology. The philosophy of physics is essentially a part of the philosophy of science.

SSCP1143 – Mechanics

This course mainly discusses motion of a body or a system. Beginning with the basic and derived physical quantities and vector as mathematical tool, various types of motion such as linear, free-fall, projectile, circular, rotational and simple harmonic motions are described. Other topics such as equilibrium, elasticity, gravitation and fluids mechanics illustrate the application of a body in motion under the influence of a force.

SSCP1153 – Electricity and Magnetism

The course examines the force of electromagnetism, which encompasses both electricity and magnetism. It includes the exploration of some electromagnetic phenomena. It begins by examining the nature of electric charge and then a discussion of interaction of electric charges at rest. It then study about charges in motion particularly electric circuit. It continues into the study of magnetic interaction how moving charges and currents responds to magnetic field. The principle of electromagnetic induction and how resistors, inductors and capacitors behave in ac circuits is discussed. The understanding the electrical energy-conversion devices such as motors, generators and transformers are also discussed. Finally the study of the four fundamental equations that completely described both electricity and magnetism.

SSCP1163 – Sound, Wave and Optics

The course starts with introduction to the concept of sound, how it is produced, its characteristics, intensity and quality as well as the interference of sound which will be applied to modern sound devices. Finally, emphasize on optics on its dual properties. These will be inseminated in the phenomenon of interference and diffraction of light and its modern-day applications. In general, the course provides the basic concepts of sound and optics.

SSCP1223 – Modern Physics

The course begins with a brief discussion on the nature of science in the quest of better understandings of the natural phenomena, highlighting the dilemmas and failures of classical physics in the face of some landmark experiments and discoveries, which gave the impetus to new ideas and paradigm shift into the modern physics. Finally, formalities of quantum mechanics is introduced by discussing the 1-D time independent Schrodinger equation (TISE), applied to an idealised infinite square potential well.

SSCM1523 – Linear Algebra

The course begins with the study of matrices and determinant. Starting with simple matrix operations, elementary row operation and inverses, and determinant 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, subspace, linear independence, spanning sets, bases, coordinate vector and change of basis, orthogonal bases, and the Gram-Schmidt process. There follows a discussion of linear transformation and matrices, as well as the kernel and range. Finally, find the eigenvalues and eigenvectors and use them in diagonalization problem.

SSCM1703 – Differential Equations

An introductory first course in 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 elementary partial differential equations (PDEs). Students will learn how to classify and solve first order ODEs, solve second order linear ODEs with constant coefficients using the method of undetermined coefficients and variation of parameters, use the technique of Laplace transforms to solve ODEs with specified initial or boundary conditions, and use the technique of separation of variables to solve initial-boundary value problems involving heat and wave equations and boundary value problems involving Laplace equation.

SSCP1811 – Practical Physics I

Students perform experiments related to mechanics, electricity and magnetism and wave optics. These experiments are performed in pairs. At the end of the experiments, students submit technical reports which describe the experiment, the analysis and the findings. Upon completion, students should have the ability to handle the instrumentations and relate the experiments to the theories learned in *Mechanics* and *Electricity and Magnetism*, perform experimental analysis and write technical reports.

SSCP1821 – Practical Physics II

Students perform experiments related to thermodynamics, optics, modern physics and electronics. These experiments are performed in pairs. At the end of each experiment the student submit a technical report which describes the experiment, the analysis and the findings. Upon completion, the students should have the ability to handle the instrumentations and relate the experiments to the theories learned in *Sound, Wave and Optics* and *Modern Physics*, perform experimental analysis on the laboratory works and write technical reports.

SSCP2113 – Thermodynamics

The course starts with discussions on basic concepts of thermodynamics, thermodynamic properties of materials and thermodynamic processes. Energy transfer and energy analysis of systems and processes using the first and second laws of thermodynamics will be covered. The principles of gas power and refrigeration cycles are also briefly highlighted. In general, the course provides on the basic concepts of thermodynamics and its applications in conservation and utilisation of energy.

SSCP2213 – Nuclear Physics

The course introduces major concepts and theories of nuclear physics. The course begins with understanding the basic knowledge of the constituents of nucleus and the properties of nuclear forces. Radiation sources and the types of ionizing radiations are introduced. 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 covered. Basic concepts on radioactivity including radioactive decay law, radioactive decay series and radioactive equilibria are covered. Some nuclear models such as liquid drop model, shell model and optical model of the nucleus will be introduced at the end of the course.

SSCP2313 – Basic Electronics

The course starts with introduction to electronic components, circuit building and basic measurement of signal. Various circuit theory analysis such as superposition principle, mesh current analysis, Thevenin and Norton theorem are taught. DC and AC circuit analysis and the use of semiconductor devices such as diodes and transistors are discussed. Simple transistor amplifier are analysed using r-parameter model. JFET principle and bias circuit are also covered. The course provides good balance between theoretical and practical works on electronic circuits and its everyday applications.

SSCP2333 – Computer Programming

This course begins with a comprehensive introduction to computer, role of computer in physics, and operating system. Computer programming involving choices of computer languages and programming concept is also discussed. In the laboratory, the student experience working with a Linux desktop, client-server working environment, and all the necessary tools for terminal-server programming works. Throughout the course students are guided to build computer programs from simple to complex, all about solving various physics problem, based on the Java programming language. Students are exposed to methods for writing command-line based programs and tools utilising widgets for building application with graphical user interface.

SSCP2413 – Solid State Physics

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.

SSCP2613 – Mathematical Physics

The main aim of the course are to intergrate physics and mathematics and to provide students with mathematical techniques for solving problems in physics. The course content consists of vector analysis, vector calculus, complex variable, matrices, ordinary and partial differential equations and Fourier series.

SSCP2821 – Practical Physics IV

Students perform experiments related to materials science, advanced electronics, lasers, optics and nuclear physics. These experiments will be conducted in groups of two or three students. At the end of each experiment the group prepares a technical report which contains the experimental procedure, detailed data analysis, discussion on the findings, and the conclusions. Upon completion, the student should have the ability to relate the experiments to the physical principles learned in relevant courses in materials science, advanced electronics, lasers, optics and nuclear physics, perform experimental analysis on the laboratory works and write technical reports.

SSCP3113 – Electromagnetism

The course introduces the vector and calculus approach in understanding various laws and principles of electromagnetism and time independent Maxwell's equations. The course describes the time varying electromagnetic fields and its physical principles in various applications.

SSCP3123 – Classical Mechanics

The course starts with brief discussion on Lagrangian and Hamiltonian dynamics. Euler and Lagrange equations, Hamiltonian principle, Euler theorem and kinetic energy, space time homogeneity, isotropy of specific velocity and momentum space, canonical equation, cyclic coordinates are discussed. Central field motion, orbit in a central field, planetary motion, Kepler's law, motion in an inverse square field, Rutherford scattering are highlighted. Dynamics of rigid body, kinetic energy, inertia tensor, angular momentum, base axis for inertia are studied. Oscillation, one dimensional motion, simple harmonic motion in one and two dimensions, damped and forced oscillations, electric circuit oscillation, coupled oscillation, two coupled oscillators and weak coupled oscillation are also discussed. The course ends with discussion on orthogonality of eigenvector, normal coordinate and molecular vibration.

SSCP3133 – Thermal and Statistical Physics

The course introduces the concepts of statistical mechanics and quantum statistics. The partition function, properties of large numbers of particles, the Fermi Dirac, Bose-Einstein and Maxwell-Boltzmann distribution laws are discussed. Upon completion, the student will have the ability to 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 thermodynamic systems.

SSCP3143 – Relativity

The course presents main concepts of general relativity theory. The emphasis is on the physical understanding of the theory and the mathematical development is kept simple. The principle of equivalence, energy momentum stress tensor, Einstein field equation and Schwarzschild solutions are discussed. Tests of general relativity are described. Black holes and gravitational collapse are explained. The course ends with description of gravitational waves and their detection.

SSCP3153 – Elementary Particle

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

SSCP3163 – Energy and Environmental Physics

The course starts with a brief introduction on the processes and issues in environmental physics which include the global warming. The main topics are the physics of the built environment, energy for living, environmental health, revealing the planet, the biosphere, the global climate and climate change. The alternative sources of energy such as nuclear, wind and water are included. This course provides essential physics principles that govern environmental issues and the contribution to the interdisciplinary field of environmental science.

SSCP3323 – Advanced Electronics

The course begins with the hybrid h and ϕ small signal models for transistor. The small signal amplifiers and power amplifiers are analysed. The operational amplifier and its applications such as summing, differential amplifier, differentiator or integrator, and active filter are discussed. Sensors and amplification of signals are introduced. Basic concepts and principles of digital circuits, number codes and number system, Boolean algebra, logic gates, Karnaugh maps, IC specification and interfacing, encoding and decoding, flip-flops, counters, shift registers and digital arithmetic circuits are also discussed. Analog to digital and digital to analog conversion are covered. The course will be conducted by lectures and hands-on to provide students with basic concepts and practical experience in advanced analog and digital electronics.

SSCP3333 – Computational Physics

This course begins with a comparative discussion about analytical and numerical methods of studying physical phenomena. The design of program codes and equivalent pseudo codes are discussed. Numerical methods for investigation of elementary mechanics problems such as projectile, oscillatory, planetary motions, and the chaos of non-linear pendulum are introduced. Calculation of potential surface, electric and magnetic fields, and visualization of the respective calculated data are also covered. Wave phenomena are investigated numerically. Methods for investigation of random system and Monte Carlo simulation are also studied. The course ends with an introduction to molecular dynamic simulation method and how to animate visualization of simulated system.

SSCP3343 – Instrumentation and Data Acquisition

The course consists of two parts. The first part begins with a review of basic elements in measurement systems, sensing element, signal conditioning, signal processing and signal presentation. The classification of instruments, errors in measurement, static and dynamic characteristics of instrument and calibration are introduced. The measurements of physical quantities which include displacement, velocity and acceleration for translational and rotational motion, force and torque, low, medium and high pressure, temperature, flow, level, humidity and electrical quantities are discussed. For the second part, basic concepts and techniques for interfacing a microcontroller to external devices for data collection and process control and developing the related software required are discussed. Transferring and converting analogue variables into the digital form needed for processing are covered. The course provides the general concepts of measurement technique and system technology.

SSCP3433 – Quality Control

The course starts with a brief discussion on the general concept and definition, the importance, as well as the costs of quality in managing a business organization. Topics that are focused include the quality management principles, total quality management and ISO 9001 quality management requirements in manufacturing and servicing industries. The statistical techniques in quality control such as the process modelling, the acceptance sampling and the statistical process control (SPC) are discussed. Common SPC tools for troubleshooting and monitoring a process including the process capability analysis are emphasized. Basic concepts and definition of reliability is also highlighted. The course provides the general concepts of quality, quality management systems and the applications of various techniques in statistical quality control (SQC) both in production and service industries.

SSCM3503 – Complex Variables

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.

SSCP3523 – Modern Optics

The course introduces the fundamentals of modern optics. Elementary optics, ray optics, optical instruments, source and detector, interference and diffraction, image processing, laser, polarization and electromagnetic effects, fibre optics and integrated optics are discussed. Upon completion, students should be able to apply the concepts to solve problems related to optical phenomena. Students should have the ability to apply and use standard optical components including laser and fibre optics. Students should be able to explain the functions of various components in optical systems for various applications.

SSCP3613 – Quantum Mechanics I

This course introduces phenomena that lead to the development of quantum mechanics. Black body radiation, photoelectric effect, particle-wave duality, wave packets, Schrödinger equations, observable expectation values, quantum operator and postulates of quantum mechanics are discussed. One dimensional time independent Schrödinger equations for infinite and finite square potential well, potential barrier, harmonic oscillator, hydrogen atom are discussed. Basic concepts in quantum mechanics are described and the application of quantum mechanical approach in solving contemporary quantum mechanical problems are explained. The differences of quantum mechanics and classical mechanics are emphasized.

SSCP3811 – Practical Physics V

Students taking Practical Physics V will conduct two mini projects. They work in pairs, perform open-ended experiments and produce formal technical report of their work. The students will be supervised on one-to-one basis and are expected to develop ability to work independently. At the end of semester the student will present a short seminar which describes the project, its analysis and findings.

SSCP3821 – Practical Physics VI

Students taking Practical Physics VI will conduct two mini projects on physics based ICT. The students are required to develop ICT projects to solve problems related to physics. The students will be supervised by a supervisor, but they are encouraged to work independently. At the end of semester the student will present a short seminar which describes the project, its analysis and findings.

SSCU3915 – Industrial Training or Research Training

Industrial training or research training is viewed as an important training to expose students to real work life situation and to equip them with the necessary skills so that they would be job ready upon graduation. The students undertake a 12-week training at an organization or industry. During this training, the students will apply the knowledge learned in the university and boost their skills needed by a profession. The students will involve in hands-on use of instruments or quality control or statistical analysis and optimization techniques and other relevant skills. At the end of the training, the students should acquire basic skills in a professional manner and the experience gained during the training should enrich their generic skills.

SSCP4013 – Data Processing

This course introduces the ways of expressing data from experiment and how to analyze and draw meaningful conclusions. Emphasis is on the usage of open source software packages. Measurement uncertainty, accuracy, precision, systematic and random errors, sources of errors, standard deviation and level of confidence, error propagation, and rejection of measurement using Chauvenet's criterion are discussed. Binomial, Gaussian, Lorentzian, and Poisson distributions are described. Student will be introduced to linear and non linear curve fitting techniques which include linear regression, multiple regressions, peak resolution and fitting, correlation coefficient and Chi-squared measure of fitting quality. Various methods of data visualisation will be highlighted. These include 2D plot, surface plot, vector plot, and plot animation. Student will learn to do drawing of scientific diagram, digital image manipulation, import and export of image files. Scientific data analysis software packages that are used include Gnuplot, Octave, Scilab, and Maxima.

SSCP4123 – Non Destructive Testing and Evaluation

The course introduces major non-destructive testing (NDT) methods such as penetrant testing, magnetic particle testing, industrial radiography and Eddy current testing. Discussion of their physical principles and the techniques used follows. Specific application techniques based on the methods are discussed in detail, focussing on parameters affecting the outcome of each NDT method. The applications of eddy current techniques in material inspection such as thin plates and tubes are described. In radiography, the parameters affecting the exposure and the radiograph quality are discussed. The codes and standards and their application to specific NDT methods are described. Acceptance criteria applicable to specific requirements are also discussed. Safety aspects in NDT which include radiation and work safety are emphasized.

SSCP4133 – Industrial Electronics

The subject of industrial electronics is introduced. Discrete control, input and output devices, solid state devices in industrial electronics are described. Operational amplifiers and linear ICs. SCRs, triacs and other thyristors are discussed. Discrete automation sensors and devices, analog process control devices and sensors are highlighted. Other topics covered are safety, DC motors and control circuits, AC motors and variable speed drives, special purpose motor and control devices programmable logic controllers embedded microcontrollers, open and closed loop process control. The course provides the basic knowledge of electronic devices, motors and machines related to industrial applications and the working principle of common instruments in industrial applications.

SSCP4143 – Electronic Circuit Simulation

This course introduces students to the principle and the various techniques in electronic circuit simulation such as DC, AC, transients, and worst-case scenario analysis. The circuit simulation utilizes SPICE and QUCs circuit simulator packages. Noise and performance analysis, harmonic distortion and sensitivity analysis are also discussed. The course focuses on discrete passive and active electronic components. The course provides alternative way to experience circuit building and analysis without having to build real circuit.

SSCP4163 – Astrophysics

Students will be introduced to the concepts and methods of astronomy and astrophysics. Topics covered by the course include astronomical objects and their classification, measurements and units, astrophysical nature of radiation, orbital dynamics, stellar structure, and many body dynamics.

SSCP4173 – Quantum Mechanics II

The course starts with discussion on quantum phenomena such as black body radiations, photoelectric effects, particle-wave duality and wave packets. Schrödinger equations, observable expectation values, quantum operator and postulates of quantum mechanics are discussed. One dimensional time independent Schrödinger equations for infinite and finite square potential well, potential barrier are examined and solved. Harmonic oscillator and hydrogen atom are described using operators. The students are expected to understand spin and Zeeman effect, perturbation theory and Stark effect. At the end of the course, the student should be able to solve some quantum mechanical problems. The students should also be able to work in a team and adhere to professional ethics.

SSCP4203 – Medical Radiation Protection

This course will give an overview on the various techniques and radiation doses involved in diagnostic radiology, radiotherapy and nuclear medicine. The current trends in use of diagnostic radiology, radiotherapy and nuclear medicine are surveyed. The relevant laws, regulations and procedures that need to be observed and be implemented

for radiological protection in medical practice will be elaborated. At the end of the course, students should have an overall grasp on the operation of the medical radiological protection.

SSCP4213 – Advanced Nuclear Physics

This is a continuation of the introductory *Nuclear Physics* course. Some topics are repetition of the introductory course but would be dealt in more detail. The course begins with the discussion of the nuclear properties, followed by the quantum mechanics theory applied specifically to the different potential wells of the nucleus. Different aspects of nuclear forces are dealt with great length. The classical shell models of the nucleus are discussed in detail together with some other realistic nuclear models. The alpha emission, beta decay and gamma radiation will also be dealt. In addition the types of nuclear reactions, types and processes are included. The course ends with the introduction of nuclear energy production and nuclear astrophysics.

SSCP4223 – Radiation Detection

The important detection techniques of 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 principles of operation and basic characteristics of various detection systems are outlined. Various nuclear detectors such as gas filled detector, scintillation detector and semiconductor detector are described. The course also emphasizes on the principle and operation of thermal and fast neutron detector. The principle of radiation dosimetry such as thermoluminescent dosimetry, chemical dosimetry, film dosimetry and calorimeter are also discussed at the end of the course.

SSCP4233 – Radiation Protection

The course is designed to ground students in the principles of radiation protection, that is, on justification, optimization and dose limits. It emphasizes on the theories, the techniques and the procedures for external dose control that is the use of distance, shielding and time. Internal dose control, including introduction to the physics of aerosol, use of unsealed sources, primary and secondary containments, radioactive laboratories and leak tests are discussed. The course also discusses organization and radiation protection programmes, 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.

SSCP4243 – Applied Radiation Physics

This course is a follow-up of *Nuclear Physics* and is designed to expose student to different types of radiation that exist in nature and environment, in particular the nuclear based radiation. Primary and secondary, directly and indirectly ionizing radiation are differentiated. Interactions of alphas, betas, photons and neutrons with matter are detailed. Radiation effects on materials are discussed. Applications of radiation in radio tracing, gauging, dating, and industrial imaging are studied. Accelerator as sources of radiation and their usefulness is also covered. Upon completion student are expected to have good grounding in applied radiation physics and ability to explain and discuss the application of radiations in various fields.

SSCP4253 – Medical Physics

This course introduces medical physics to physics majors as an elective in their program. Three main areas of medical physics namely medical imaging, nuclear medicine and radiotherapy are surveyed. The emphasis is in the physics that govern the field. At the end of the course students are expected to have an idea of the subject matter, its usefulness and applications in modern medicine.

SSCP4263 – Occupational Health and Safety

This course is designed in such a way that the student understands the issues of health that are prevailed among workers. The concept of the relationship between work and health will be discussed in detail. Some of the relevant topics covered during the course will be the subject of toxicology, thermal stress and mental health. Students are required to know about the principles of epidemiology, ergonomics and health services related to work. This course 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.

SSCP4273 – Nuclear Energy

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

SSCP4283 – Environmental Radiation Protection

This course introduces students to the theoretical basis of environmental radiological protection and the basic principles and procedures of radiological protection in medical practice. Sources of environmental radiation and its dosage implications will be elaborated. Environmental models for radionuclide dispersal will be introduced. Handling of TENORM will be discussed. At the end of the course, students should have an overall grasp on the operation of the environmental radiological protection. Transport regulation and radioactive waste management.

SSCP4293 – Radiation Dosimetry

This course introduces radiation dosimetry as an area of radiation physics. Principle of dosimetry, radiation dose, radiation units, fluence, kerma and absorbed dose will be discussed. Dosimetry techniques and measurements, Bragg-Gray cavity theory and stopping power are discussed. The working principles of standard air chamber, thimble chamber and its calibration for dose measurement are discussed. High energy photon and electron dosimetry are briefly outlined. Internal dosimetry of beta and gamma, and external neutron dosimetry are also studied. At the end of the course students are expected to have a working knowledge of radiation dosimetry.

SSCP4303 – Process Control

This course begins with discussion of process control of a system related to a production process, the criterion of control system for performance evaluation, the piping and instrumentation drawing (P&ID) to process control system, the process control system responses, sensor time response – first order and second order response and the various aspects of digital control system. The process control characteristics and some aspects of digital process control are discussed. The course will be conducted by lectures and simple simulated hands-on to provide students with practical experience in process control.

SSCP4323 – Electronics and Instrumentations

The course begins with discussion of operational amplifier and its applications such as summing and differential amplifier, differentiator or integrator, and active filters. Basic elements in measurement systems, sensing element, signal amplification, signal conditioning, signal processing and signal presentation are introduced. Basic concepts and principles of digital circuits, number codes and number system, Boolean algebra, logic gates, Karnaugh maps, IC specification and interfacing are discussed. Finally analog to digital and digital to analogue conversion are covered. In general, the course will be conducted by lectures and hands-on to provide students with basic concepts and practical experience in advanced analog and digital electronics.

SSCP4333 – Digital Signal Processing

The course starts with the discussion on the breadth and depth of digital signal processing. Then students will learn about the mathematics essential to signal processing such as statistics, probability, complex number, matrices and polynomial. Analog to digital converter and digital to analog converter.

SSCP4353 – Ultrasonic Techniques

The course describes the physical principles of ultrasonic waves and its interactions with media leading to the application in defect detections of engineering components and systems. The discussion will highlight the transduction mechanisms, ultrasonic systems, and various ultrasonic application techniques ranging from low to high intensity applications.

SSCP4363 – Electronic Testing and Maintenance

The course provides the basic knowledge of how to test suspected electronic components and how to properly maintain and handle them during usage. The course starts with hazard and safety procedure in dealing with electricity. Basic electronic testing instruments such as digital multi meter, oscilloscope, and spectrum analyser are described. Common electronic problems such as short and open circuit, loading effect, ground loop, electrostatic discharge, electromagnetic interference, impedance mismatch are discussed. Testing basic discrete electronic components such

as resistors, capacitors, inductors, diodes, transistors are covered. Common sensors such as thermocouple, Hall effect sensors, accelerometer and piezoelectric crystal are discussed. Upon completion, students will have basic skill to procure cost effective testing instruments, to use the equipments, to identify common electronic problems and to perform basic troubleshooting on basic components. The focus on safety will enable students to avoid electrical hazard.

SSCP4373 – Electronic Communications

This course introduces several process controls in industries. The process control characteristics and some aspects of digital process control are discussed. After completing this course, the student are expected to be able to describe the various industrial process controls. The student must also be able to explain the techniques in digital process control.

SSCP4383 – Signal Processing

The course covers the continuous (analog) and discrete (digital) signal processing. Students are introduced to continuous and discrete systems. The focus will be on linear time invariant system. Laplace and Z transforms are discussed, followed by Fourier and discrete Fourier transforms. Finally students are taught to design the analogue and digital filters. Upon completion, students will have adequate background to explore the world of signal processing.

SSCP4393 – Computer Interfacing

This course introduces basic concepts and techniques for interfacing a microcontroller to external devices for data collection and process control and developing the related software required. This includes transferring and converting analog variables into the digital form needed for processing. It is aimed at students interested in data acquisition and real-time control systems.

SSCP4403 – Microscopy and Material Analysis

This is an introductory course on microscopic techniques that deals with the basic working principles and construction of various microscopes, namely, light microscope, electron microscope, x-ray microscope, acoustic microscope, field ion microscope, and scanning probe microscope. For each type of microscope, particular reference is given to the resolving power, sample preparation, and analysis of the micrograph. In general, this course provides the students with necessary knowledge on the choice of microscope for the study of materials.

SSCP4413 – Semiconductor Physics

The aim of this course is to provide basic knowledge and theory of semiconductor physics and introduction to semiconductor devices. It will start with the growth and doping of semi conducting materials. The energy band and carrier concentration in thermal equilibrium and carrier transport phenomena in semiconductor are studied. Discussion on the p-n junction and some selected diodes are made toward the end of the course.

SSCP4423 – Condensed Matter Physics

The course starts with the discussion on single electron model and Schrodinger equation, followed by the theory of a nearly free and tightly bound electron. The electron-electron interaction and the band structure are discussed. The dynamic theory of the electron transport is studied in detail. The knowledge is important for example in industry that deals with low temperature physics.

SSCP4433 – Magnetism

The course describes the fundamentals of magnetism, its discovery and its impact on civilisation and technology. The phenomenological and theoretical approach will be employed, beginning with a brief review on elementary magnetostatics and origins of magnetism, magnetic dipole, its response to an applied magnetic field and various interactions giving rise to different types of magnetic ordering in solids. It covers material's classifications: Diamagnetism, para-, ferro-, antiferro- and ferrimagnetism, as well as relevant rules, laws, theoretical approaches: Hund's Rule, Curie's and Curie-Wiess law, Langavim and Stoner theories. Crystalline–electric field effects are treated at a level that is sufficient to provide the basic knowledge in understanding the properties of materials. Other topics include the techniques for magnetic field generation and measurements, magnetic materials and their various applications, such as in electrical and media devices. In general, the students should be able to understand phenomenon related to magnetism, distinguish between the class of magnetic materials and types of magnetism, their wide applications and technological advancements, and be able to perform basic calculations.

SSCP4443 – Magnetic Materials

The course covers fundamentals of magnetism, basic theories and applications of magnetic materials. It begins with a brief review on elementary magnetostatics and origins of magnetism. The basic theories describing ferro-, ferri-, para-, dia- and antiferromagnets will be outlined briefly. Properties such as anisotropy and magneto-optical effect are discussed in order to understand their applications. Finally, the students will be introduced to some novel magnetic phenomena and exotic magnetic materials with some modern device applications. The students will also undertake a written assignment to cover other related topics, such as in the field of space science, medicine, biology and agriculture.

SSCP4453 – Low Temperature Physics and Superconductivity

This course introduces basic knowledge of low temperature physics and many important properties of materials at low temperature regimes. Important aspects of the cryogenic world – the cryogens and cryophysics are introduced. Liquid helium and its important properties which are important in the cryophysics will be discussed in detail, followed by the techniques and methods of achieving low temperatures and measurement at low temperatures. Low temperature phenomena such as superconductivity and related theory are discussed. Basic properties of superconductivity will be discussed. Theories of superconductivity such as Gorter and Casimir theory, London theory, Ginzburg-Landau theory and BCS theory are introduced. The course ends with the discussion on high temperature superconductors.

SSCP4463 – Corrosion Science

This is an introductory course on corrosion science with emphasis on the electrochemistry and kinetics of corrosion. The areas covered are measurements and testing of corrosion, standard practices in corrosion prevention and inhibition, choices of materials and their environments, atmospheric corrosion, and metals oxidation. This course will provide students with general knowledge on corrosion mechanism and methods and ways of combating corrosion.

SSCP4473 – Spectroscopy and Material Analysis

The course starts with a basic concept of spectroscopy followed by the properties of electromagnetic waves. The interaction of electromagnetic radiation with matter is discussed. Basic instrumentation that is used in the spectroscopy is described. The spectrum and its intensity are discussed. Molecular vibration, microwave spectroscopy, infrared spectroscopy, Raman spectroscopy, NMR spectroscopy are highlighted. The course provides some knowledge on the spectroscopy techniques for material analysis that are used mainly in material related industry.

SSCP4483 – Semiconductor Devices

This course is designed to focus on the semiconductor devices and material requirement for devising particular devices. It started with discussion on the growth, doping process, contact materials and properties of semiconductor. The study and discussion on the p-n junction and Schottky contact/diode will be a main objective of the subject. The basic principle, operation and material requirement of devices and introduction to micro and nano-materials and electronics will be given toward the end of the lectures.

SSCP4493 – Metallurgy

Solidification and crystallization, phase equilibrium diagrams, composition determination, steel hardening process, heat treatment of steel, welding process and types of welding, defects in welding, casting process and types of casting, forging process and defects in forging, types of oxidation formation, corrosion, corrosion protection, metallography testing, mechanical testing

SSCP4513 – Laser Physics

This course relates the principle of laser generation and its fundamental characteristics. It starts by discussing the rejuvenation of optics due to the invention of laser. This is followed by introducing the nature of light interaction with atom, Einstein relation, absorption and gain coefficient, laser mode, and laser beam modulation. Last but not least the laser light properties are highlighted and comparison is made with respect to conventional light.

SSCP4523 – Laser Technology

This course introduces the laser source and its application in industry. It covers basic laser, light interaction with atom, laser structure and generation, laser type. The laser sources have been applied in many areas including in industry and holography. In engineering the laser is used for material processing. Holography is used for quality control. Laser is used to drive fusion interaction. In military the lasers are used as a guidance and weapon.

SSCP4533 – Fibre Optic Technology

The course 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. The application of fiber optics in communication and sensing will be described and discussed. Upon completion, the students are expected to be able to describe the structure, material content and 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 for use in communication and sensing, and be able to describe the preparation and measurement techniques required.

SSCP4543 – Optoelectronics

This course is designed to expose the students to the present trends in optoelectronics and will be introduced to the basic concepts and working principles in optoelectronic components and devices. The fundamental and functional of components in optoelectronic system are discussed, including the analysis of parameters essential in the design and applications of optoelectronic system. Students are expected to have the ability to explain the main concepts of optoelectronics as it emerges in wide range of physics especially light and optics. Students are expected to comprehend the working of various optoelectronic concept, components and devices, describe and discuss the functions of the components and analyze the parameters involved in the design and application of optoelectronic system.

SSCP4553 – Applied optics

This course introduces the variety of applications 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.

SSCP4563 – Photonics

The course introduces the various fields of study in photonics such as fourier optics, crystal optics, integrated optics, nanophotonics and biophotonics. The principles and parameters involved in the various fields of study will be described. The applications that have emerged from these studies such as in communication, sensing and imaging will be described and discussed. Upon completion, the student must have the ability to describe the models used in the various fields of study in photonics. The student should also be able to analyze the functional role of the various components and devices in different photonic systems, such as their roles in communication, sensing and imaging systems.

SSCP4573 – Laser In Medicine

This course introduces laser devices applied in medicine. It covers laser biophysics, nonlinear effect and photodisruption, mechanism of damage induced by Nd:YAG laser, laser tissue interactions, laser in eye surgery, laser in dentistry, laser acupuncture, low level laser therapy, digital holography. Lasers have been utilized in wide area of medical field.

SSCP4583 – Photometry

The course introduces basic concepts in photometry and various the photometric parameters involved. Photometric measurement procedures and instrumentation will be described. Fundamentals of colorimetry will also be discussed, including the CIE system used. Upon completion, the students are expected to be able to describe the various photometric parameters, measurement procedures and instrumentation related to photometry and colorimetry. The student should also be able to use photometry parameters in analyzing simple optical systems.

SSCP4593 – Solid State Laser Engineering

This course describes the design and construction of solid state laser. This includes the design of optical resonator, which cover the transverse modes, longitudinal mode, intensity and frequency control, hardware design, unstable resonator and wavelength selection. To pump the laser, various pump sources are discussed. The pump radiation transfer methods are also described. To stabilize the laser, the effect of thermo-optic is considered. Finally the laser beam is modulated by Q-switch and mode locked.

SSCP4603 – Vacuum and Thin Film

Conductance and throughput. Vacuum gauges and pumps. Nucleation, physical vapour deposition, chemical vapour deposition, characterization measurements, properties – structural, optical, electrical and magnetic, novel properties – quantum effect, giant magnetoresistance, thin film solar cells, layered magnetic nanostructures - GMR sensors, single-electron devices.

SSCP4623 – Material Science

This course introduces basic and important properties of materials. This includes material structures and defects that determine the vital properties such as its mechanical, electrical or optical properties. Students are also taught the important parameters of materials characteristics and methods of testing these parameters. In general this course provides the relationship between the required properties and materials processing to suit certain product application

SSCP4633 – Ceramic and Amorphous Materials

The course starts with a brief introduction on the amorphous and ceramic materials, the formation theory and thermodynamic approach. Their preparation techniques will be given consequently. The microscopic and the macroscopic structure of amorphous and ceramic materials which include the bond and the imperfections are discussed. The physical, mechanical, optical and the electrical properties will be emphasized. The chemical durability of amorphous will be attentively highlighted. In general, the course provides some knowledge on the amorphous and ceramic materials and their characterization that are useful in the glass and ceramic industry.

SSCP4643 – Polymeric Materials

The course starts with basic concept of polymer and degree of polymerization. The classification of polymer will then followed. Preparation techniques and crosslinkages are studied. The crystallinity, amorphousity and the morphology of the polymer are highlighted. The mechanical, physical and thermal properties will also be presented. In general, the course provides some knowledge on the polymeric material and their characterization that are useful in polymer industry.

SSCP4713 – Introduction to Nonlinear Optics

This course describes the interaction of laser with nonlinear materials. It starts with interaction of photon and atom, followed by discussion of laser operation, laser oscillation, electro-optic, and introduction to non linear optic. The nonlinear process includes second harmonic generation, parametric and phase conjugation. Finally, the solitary wave in dispersive media for generating ultra-short pulse is discussed.

SSCP4913 – Radiobiology

This course introduces students to the theoretical basis and the model of the biological effects of radiation. Physical, chemical and cellular perspectives will be elaborated. It will examine the macroscopic effects of radiation, be it 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.

SSCU4902 – Undergraduate Project I

A student is required to plan a project (research) under a supervisor in an agreeable field of physics and document the findings. Students will learn to gather information of the related topic through literature survey/review activities, construct research methodology, anticipate the expected results (if no data were obtained), and write conclusion and references. Finally, students are required to submit a research proposal comprising of the title, introduction, literature survey/review, research methodology, expected results and discussion, Gantt chart and references.

SSCU4904 – Undergraduate Project II

A student is required to execute a project (research) under a supervisor in an agreeable field of physics and document the findings. Students will learn to gather information of the related topic through literature survey/review activities, construct research methodology, perform the related experiments, collect the data, discuss the results, and make conclusions. Finally, it is compulsory for the students to submit a thesis, proceeding and present their work in an undergraduate symposium.

PROGRAMME SPECIFICATION
BACHELOR OF SCIENCE (BIOLOGY)

1. Awarding Institution		Universiti Teknologi Malaysia		
2. Teaching Institution		Universiti Teknologi Malaysia		
3. Program Name		Bachelor of Science in Biology		
4. Final Award		Bachelor of Science (Biology)		
5. Program Code		TS02 (SSCG)		
6. Professional or Statutory Body of Accreditation		Malaysian Ministry of Higher Education		
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 : 4 yrs Maximum : 6 yrs		
Type of Semester	No. of semester		No. of semester	
	Full Time	Full Time	Full Time	Full Time
Normal	8	-	14	-
Short	-	-	-	-
12. Entry Requirement	<p>Fulfills University requirements and the following program requirements:</p> <p>Matriculation or STPM:</p> <ol style="list-style-type: none"> 1. Pass with minimum grade of B-(CGPA 2.67) in Biology 2. Pass at least with grade C+ (CGPA 2.33) in any two subjects : physics, chemistry, mathematics (additional maths, advance additional maths) 3. Pass at least with distinction in mathematics at the level of SPM/STPM <p>Diploma:</p> <ol style="list-style-type: none"> 1. Diploma holder from UTM or any other institution certified by Malaysian government and related 2. Pass with minimum CGPA of 2.5 3. Other equivalent qualification with minimum CGPA 2.5. Candidates with CGPA <2.5 with at least 2 years of working experience in related field 			

13. Program Objectives

The Programme Educational Objectives (PEOs) have been developed to meet the needs of the stakeholders of the faculty and the University. Besides that, the PEOs are formulated to be consistent with the vision and mission of both faculty and university. The PEOs are expected to be accomplished within several years after the graduation. The educational objectives of the biomedical engineering programme are to:

1. Graduates with competency to work in biomedical industry.
2. Graduates with leadership positions in the biomedical engineering sector.
3. Graduates embrace professional development through biomedical engineering practice and life-long learning.
4. Graduates who conduct their professional work ethically and contribute towards societal responsibilities.

14. Program Learning Outcomes			
Program Learning Outcomes	Intended Learning Outcomes	Teaching and Learning Methods	Assessment
Technical Knowledge and Competencies			
PO1 Acquire Knowledge	Ability to acquire fundamental and practical knowledge of biological sciences.	Lectures, tutorials, seminars, laboratory works, directed reading, and independent research.	Examinations, laboratory reports, quizzes, written assignments, and oral presentations
PO2 Apply Knowledge and Practical Skills	Ability to apply knowledge and relevant technical skills in biological sciences.	Lectures, tutorials, computer based exercises, laboratory works, supervised projects, and industrial training.	Examinations, laboratory reports, quizzes, written assignments, oral presentations, final year project reports, and industrial training reports.
PO3 Ability to Analyse, Synthesise or Evaluate Data	Ability to analyse, synthesise or evaluate theoretical or experimental data using fundamental knowledge in biological sciences.	Supervised projects, lectures, tutorials, seminars, laboratory works, directed reading, computer-based exercises, independent research, and industrial training.	Examinations, laboratory reports, written and oral presentations, final year project reports, and industrial training reports.
Generic Skills			
PO4 Communication	Ability to communicate, with clarity and coherence, concepts and arguments in biological Sciences.	Group assignments, industrial training, final year project supervision, laboratory works, tutorials, and presentation.	Rubrics for written assignments, laboratory reports, oral presentations, final year project report, final year project log book, poster presentations, industrial training reports, and industrial training log book.

<p>PO5 Creative Thinking and Problem Solving</p>	<p>Ability to solve problems using scientific approach in the context of their chosen specialisation.</p>	<p>Final year project supervision, group assignments, industrial training, laboratory work and tutorial.</p>	<p>Tutorial, PBL, case study, oral presentations, written assignments, final year project report, final year project log book, laboratory reports, industrial training reports, industrial training log book, examinations, and tests.</p>
<p>PO6 Leadership and Teamworking</p>	<p>Ability to work collaboratively as an individual and as a leader in a team.</p>	<p>Group assignments, laboratory works, industrial training, PBL, and case study.</p>	<p>Oral presentations, laboratory reports, industrial training reports, industrial training log book and peer assessment.</p>
<p>PO7 Entrepreneurship</p>	<p>Ability to create awareness of business opportunity and entrepreneurship.</p>	<p>Lectures, and assignments.</p>	<p>Examinations, oral presentations, written assignments, entrepreneur activities, business plan, and case study.</p>
<p>PO8 Ethics and Integrity</p>	<p>Ability to practice ethical values in professional practice and social interactions for sustainable development.</p>	<p>Lectures (TITAS), assignments, laboratory works, final year projects, and industrial training.</p>	<p>Laboratory reports, written assignments, final year project reports, final year project log book, industrial training reports, industrial training logbook and examinations.</p>
<p>PO9 Lifelong Learning</p>	<p>Ability to demonstrate the acquisition of the skills and attributes necessary for lifelong learning, including intellectual independence, effective time management and utilization of a variety of resource materials.</p>	<p>Final year projects, group assignments, field trips, and industrial training.</p>	<p>Laboratory reports, written assignments, final year project reports, final year project log book, industrial training reports, industrial training log book, and examinations.</p>
<p>PO10 Adaptability</p>	<p>Ability to adapt and understand knowledge in contemporary issues locally and internationally.</p>	<p>Lectures, and assignments.</p>	<p>Oral presentation, examinations, and written assignments.</p>

15. Classification of Courses			
No.	Classification	Credit Hours	Percentage(%)
i.	Basic Sciences and Mathematics	24	57.6
ii.	Programme Core	52	
iii.	Programme Electives	33	25.0
iv.	Compulsory University Courses		17.4
	• General	13	
	• Languages	8	
	• Co-curriculum	2	
	Total	132	100
For Science programme please fill up the following classification. (Others please refer to the Statutory Body guidelines)			
No.	Classification	Credit Hours	Percentage(%)
A	Biology Courses		
	(a) Lectures	70	53.0
	(b) Lecture + Laboratory	18	13.6
	(c) Industrial Training	5	3.8
	(d) Final Year Project	6	4.5
	Total Credit Hours for Part A	99	74.9
B	Related Courses		
	(a) Chemistry	4	3.0
	(b) Mathematics	6	4.5
	(c) Humanities / Entrepreneurships/ Management	13	9.8
	(d) Co-Curriculum	2	1.5
	(e) Languages	8	6.1
	Total Credit Hours for Part B	33	24.9
	Total Credit Hours for Part A and B	132	100
16. Total credit hours to graduate		132 credit hours	

17. Program structures and features, curriculum and award requirements

The course is offered on full-time mode and is based on 2-Semesters Academic Session with several Courses 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 not less than **132** credit hours with minimum CPA of 2.00.
- Pass Industrial training (equivalent to 5 credit hours).
- Complete and pass the undergraduate project Final Year Project.

SEMESTER 1			SEMESTER 2		
Code	Courses	Cr	Code	Courses	cr
SSCB 1613/ SMBT1303	Microbiology (+Lab)	3	SSCB 1703/ SMBB 1143	Cellular and Molecular Biology	3
SSCB 1112/ SMBB 1182	Introduction To Biomolecules	2	SSCB 1123/ SMBB 1173	Cellular Biochemistry and Metabolism (+Lab)	3
SSCM 1023	Mathematical Method I	3	SSCB 1402/ SMBB 1222	Introduction to Biosciences	2
SSCM 1103	Statistics	3	SSCK 1203	Analytical Chemistry for Engineering	3
ULAB 1122	Academic English Skills	2	SSCK 1891	Analytical Chemistry Practical	1
UHAK 1012	Graduate Success Attributes	2	SSCB 1103/ SMBB 1603	Bioorganic Chemistry	3
UHAS 1172	Malaysian Dynamics (Local)	2	UICI 1012	Islamic and Asian Civilization (TITAS) (Local)	2
UHAK 1012	Malay Language Communication 2 (International)	2	UHAK 1022	Malaysian Studies (International students)	2
Total Credit Hours		17	Total Credit Hours		17
SEMESTER 3			SEMESTER 4		
Code	Courses	Cr	Code	Courses	Cr
SSCB 2633/ SMBB 2323	Mycology	3	SSCB 2803/ SMBB 2603	Enzymology (+ Lab)	3
SSCB 2753/ SMBB 2753	Basic Genetics	3	SSCB 2323/ SMBB 2263	Plant Physiology (+ Lab)	3
SSCB 2713/ SMBB 2153	Genetic Engineering (+ Lab)	3	SSCB 2303/ SMBB 2503	Immunology	3
UKQX 2XX2	Co-curriculum Service Learning	2	SSCB 2423/ SMBB 2193	Bioethics in Research and Development	3
ULAB 2122	Advanced Academic English Skills	2	UICL 2302	Science And Technology Thinking	2
ULAX 1122	Foreign Language	2	UICL 2XX2 OR UHAK 2XX2	Elective of Knowledge Enhancement Cluster OR Elective of Generic Skills Cluster	2

Total Credit Hours			15	Total Credit Hours			16
SEMESTER 5				SEMESTER 6			
Code	Courses	Cr	Code	Courses	cr		
SSCB 3333/ SMBB 3273	Animal Physiology (+ Lab)	3	SSCB 3603/ SMBB 3433	Virology	3		
SSCB 3613/ SMBB 3113	Phycology	3	SSCB 3403/ SMBB 3613	Research Methodology	3		
UHAK 1032	Introduction to Entrepreneurship	2	ULAB 3162	English for Professional Purposes	2		
			UKQE 3001	Extracurricular Experiential Learning	1		
Electives Courses (choose 9 credits)				Electives Courses (choose 9 credits)			
SSCB 3113/ SMBB 3183	Bioenergetics	3	SSCB 3803/ SMBB 3683	Structure and Function of Proteins	3		
SSCB 3673/ SMBB 3323	Physiology and Screening of Industrial Microorganisms	3	SSCB 3823/ SMBB 3723	Biocomputation and Bioinformatics	3		
SSCB 3133/ SMBB 3203	Nutritional Biochemistry	3	SSCB 3623/ SMBB 3413	Extremophiles	3		
SSCB 3633/ SMBB 3333	Food Microbiology	3	SSCB 3703/ SMBB 3213	Molecular Biotechnology	3		
SSCB 3213/ SMBB 3573	Biological Control and Environmental Conservation	3	SSCB 3723/ SMBB 3173	Gene Expression	3		
	Total Credit Hours	17		Total Credit Hours	18		

SHORT SEMESTER		
Code	Courses	Cr
SSCB 3455	Industrial Training (HW)	5
Total Credit Hours		5

SEMESTER 7			SEMESTER 8		
Code	Courses	Cr	Code	Courses	cr
SSCB 4412/ SMBU 4922	Undergraduate Project I	2	SSCB 4404/ SMBU 4924	Undergraduate Project II	4
SSCB 4433/ SMBB 4583	Ecology	3	SSCB 4703/ SMBB 4193	Cell Signalling	3
Electives Courses (choose 9 credits)			Electives Courses (choose 6 credits)		
SSCB 4713/ SMBB 4713	Genomics and Proteomics	3	SSCB 4803/ SMBB 4733	Structural Biology	3
SSCB 4813/ SMBT 4663	Protein Separation Techniques in Biotechnology	3	SSCB 4743/ SMBB 4153	Synthetic Biology	3
SSCB 4113/ SMBT 4183	Applied Microbial Biochemistry and Biotransformation	3	SSCB 4723/ SMBB 4143	Gene Therapy	3

SSCB 4333/ SMBB 4493	Toxicology	3	SSCB 4243/ SMBT 4693	Biosensor Technology (+Lab)	3
SSCB 4733/ SMBB 4723	Systems Biology	3			
Total Credit Hours		14	Total Credit Hours		13

Appendix

(List of UKQX, ULAX, UICL and UHAK courses)

Students are allowed to choose from the following list.

UKQX		ULAX		UICL		UHAK	
UKQA 2XX2	*	ULAA 1112	Arabic Language	UICL 2012	Al-Quran and Human Civilization	UHAK 2012	Leadership
UKQR 2XX2	*	ULAC 1112	Mandari Language	UICL 2032	Life Institutions and Sustainable Development	UHAK 2022	Critical and Creative Thinking
UKQS 2XX2	*	ULAF 1112	France Language	UICL 2042	Future Studies	UHAK 2032	The Human Side of Knowledge Management
UKQU 2XX2	*	ULAJ 1112	Japanese Language	UICL 2052	Family Law	UHAK 2042	Development and Global Issues
		ULAN 1112	Persian Language	UICL 2062	World Science	UHAK 2052	Guidance and Counselling
				UICL 2072	Sustainable Economy	UHAK 2062	Psychology of Adjustment
				UICL 2082	Practices and Concept of Halal Management	UHAK 2072	Fundamentals of Intellectual Property
				UICL 2092	Phylosophy of Islamic Art	UHAK 2082	Law of Entrepreneurs
				UICL 2102	Islam and Health	UHAK 2092	Entrepreneurship and Enterprise Development
				UICL 2132	Islamic Entrepreneurship	UHAK 2102	Social Entrepreneurship
						UHAK 2112	Engineering Communication
						UHAK 2122	Human Communication
						UHAK 2132	Professional Ethics

* for code and name of courses, please refer Co-curriculum and Service Learning Centre.

18. Mapping of Program Learning Outcomes to Courses

Courses Offered		Acquire Knowledge	Apply Knowledge and Practical Skills	30 Ability to Analyse, Synthesis and Evaluate Data	31 Communication	Creative Thinking and Problem Solving	Leadership and Teamworking	32 Entrepreneurship	Ethics and Integrity	33 Lifelong Learning	34 Adaptability
Code	Course Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
Core Courses											
SSCB 1613	Microbiology	/	/	/		/					/
SSCB 1112	Introduction to Biomolecules	/	/			/					
SSCB 1703	Cellular and Molecular Biology	/		/	/		/				
SSCB 1123	Cellular Biochemistry & Metabolism	/	/	/	/	/					
SSCB 1103	Bioorganic Chemistry	/	/	/	/	/					
SSCK 1203	Analytical Chemistry for Engineering										
SSCK 1891	Analytical Chemistry Practical										
SSCM 1023	Mathematical Methods										
SSCM 1103	Statistics										
SSCB 1402	Introduction to Biosciences	/	/		/				/		
SSCB 2753	Basic Genetics	/	/			/					
SSCB 2713	Genetic Engineering	/		/	/		/				
SSCB 2633	Mycology	/	/	/		/					
SSCB 2803	Enzymology	/	/	/	/	/					
SSCB 2323	Plant Physiology				/						
SSCB 2303	Immunology	/	/	/		/			/		/

SSCB 2423	Bioethics in Research and Development	/	/			/			/		/
SSCB 3403	Research Methodology	/	/	/	/	/					
SSCB 3333	Animal Physiology	/	/	/		/			/		
SSCB 3613	Phycology	/	/	/	/			/			
SSCB 3603	Virology	/	/	/					/	/	
SSCB 3455	Industrial Training	/	/	/	/	/	/		/	/	/
SSCB 4433	Ecology	/	/	/	/	/					
SSCB 4703	Cell Signalling	/	/	/		/				/	
SSCB 4412	Undergraduate Project I	/	/	/	/				/	/	
SSCB 4404	Undergraduate Project II	/	/	/	/	/			/	/	
Elective Courses											
SSCB 3113	Bioenergetics	/		/		/					
SSCB 3673	Physiology and Screening of Industrial Microorganisms	/	/		/	/			/		
SSCB 3133	Nutritional Biochemistry	/		/	/						
SSCB 3633	Food Microbiology	/	/	/		/					
SSCB 3213	Biological Control and Environmental Conservation	/	/		/	/			/		
SSCB 3803	Structure and Function of Proteins	/	/		/					/	
SSCB 3823	Biocomputation and Bioinformatics	/	/	/	/	/					
SSCB 3623	Extremophiles	/	/	/		/					
SSCB 3703	Molecular Biotechnology	/	/	/		/		/	/		
SSCB 3723	Gene Expression	/								/	
SSCB 4713	Genomics and Proteomics	/	/	/	/	/				/	
SSCB 4813	Protein Separation Techniques in Biotechnology	/	/		/		/				
SSCB 4113	Applied Microbial Biochemistry and Biotransformation	/	/	/		/					

SSCB 4333	Toxicology	/	/		/	/					
SSCB 4733	Systems Biology	/	/	/	/	/					
SSCB 4723	Gene Therapy	/		/					/	/	
SSCB 4803	Structural Biology	/	/		/		/				
SSCB 4743	Synthetic Biology	/	/	/	/	/			/		
SSCB 4243	Biosensor Technology	/	/		/	/					
University Courses											
UICI 1012	Islamic and Asia Civilization (TITAS)										
UHAS 1172	Malaysian Dynamics (Local student)										
UHAK 1022	Malaysian Studies (International student)										
UHAK 1012	Graduate Success Attributes										
UICL 2302	The Thought of Science and Technology										
ULAB 1122	Academic English Skills										
ULAB 2122	Advanced Academic English Skills										
ULAB 3162	English for Professional Purposes										
UKQX 2XX2	Co-curriculum and Service Learning										
ULAX 1122	Foreign Language										
UHAK 1032	Introducion to Enterpreneuship										
UKQE 3001	Extracurricular Experiential Learning										

PO1-PO3 = Technical Skills

PO4-PO10 = Generic Skills

19. Our Uniqueness

The Bachelor of Science (Biology) is a highly structured programme designed to cover both traditional and modern Biology which emphasizes coursework and training in many aspects of molecular biology, genetics, plant and animal physiology, phycology, mycology, ecology, enzymology, immunology, virology, cell signalling, proteomics and genomics, DNA analysis techniques, protein isolation techniques, and recombinant DNA techniques. The programme is designed not only to train students in the necessary technical skills but also to provide them with the theoretical basis for continued study. Graduates are prepared to pursue further graduate study in bioscience, molecular biology, biochemistry, and other related areas or to obtain employment in academic, industrial, or government research laboratories.

20. Career Prospects and Career Path

From our alumni survey, graduates from this programme have found employment in various private and government sectors or research institutes as Academicians, Microbiologist, Research Officers, Clinical

Coordinator, Project Manager, Environmental officer, and Postdoctoral position to name but a few. Most of our graduates have opted to pursue their MSc or PhD degrees locally or abroad in more advanced fields of biosciences such as cell signalling, cancer and stem cell research, protein chemistry, and structural biology.

21. Cross Campus Program

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

22. Professional Skills Program Certificate

All 5 courses under Professional Skills Certificate are compulsory for students for graduation. The courses are listed below:

TECS - Test of English Communication Skills (Oral & Writing)
GLL1001 - How to Get Yourself Employed
GLL1029 – ISO 9001:2008 Quality Management System Requirement
GLL1041 – How to Manage Your Personal Finance
GLL1040 – Occupational Safety, Health & Environment (OSHE)

23. Facilities available

List of laboratories:

1. Biosensors and Biomolecular Technology Laboratory
2. Bioinformatics Teaching Laboratory 1 and 2
3. Chemistry Teaching Laboratory 1 and 2
4. Fermentation / Enzyme Teaching Laboratory 1 and 2
5. Genetic Engineering Teaching Laboratory 1 and 2
6. Microbiology Teaching Laboratory 1 and 2
7. Central Analytical Laboratory
8. Analytical Service Laboratory
9. Animal Tissue Culture Laboratory
10. Biofilm Research Laboratory
11. Bioinformatics Research Laboratory
12. Bio-nanotechnology Laboratory
13. Bio-refinery Technology Research Laboratory
14. Cancer Research Laboratory
15. Environmental Bioengineering Laboratory
16. Enzyme Research Laboratory
17. Extremophiles Laboratory
18. Genomics Laboratory
19. Microbiology Research Laboratory
20. Nanomaterial Laboratory
21. Nutritional Biochemistry Laboratory
22. Plant Biotechnology Laboratory
23. Proteomics Laboratory
24. Structural Biology Laboratory
25. Tissue Engineering Laboratory
26. Virus Research Laboratory
27. Water & Wastewater Research Laboratory

List of other special facilities/equipments

Instrument room which houses centralized analytical equipment such as:

High Performance Liquid Chromatography, Luminometer, top range UV-visible spectrophotometer, Gas Chromatography, Total Organic Carbon analyzer, Gradient and Real Time PCR machines and ACTAprime system for protein purification, and others.

Wireless coverage is assessable from all laboratories and classrooms.

24. Support for Students and Their Learning

(a) Support Personnel

- Academic Advisor
- Counselor
- Student Association (PESAT)

(b) Infrastructure support

- Internet access (Wireless)
- e-learning
- Digital library
- Cafeterias
- Health care center
- Sports and recreational areas
- Smart classroom
- Students activity room
- Reading Stations

(c) Financial support

- Perbadanan Tabung Pendidikan Tinggi Negara (PTPTN)
- MARA
- JPA and others.

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

2. Employability

- Exit survey
- Alumni survey
- Market survey

3. Lecturer's performance

- Teaching evaluation by students (e-PPP)

- Competency check-list for staff (CV)
 - Annual staff appraisal (e-LPPT)
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
 - Customer Satisfaction Index (CSI)
 - Employer Satisfaction Index (ESI)
 - Anugerah Kualiti Naib Canselor (AKNC) audit
 - Malaysia Quality Assurance (MQA) standard

26.Regulation of Assessment

a. Summary of grades and marks

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

27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by
	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10		

e- Portfolio	x	x	x	x	x	x	x	X	x	x	Conti-nuous	Student
Course outcome report	x	x	x	x	x	x	x	X	x	x	Per semester	Lecturer
Final Year Project survey		x	x	x				X		x	Per semester	Faculty
PO survey by final year students					x			X			Per semester	Faculty
Research training survey					x	x			x		Per session	Faculty
Alumni Survey	x	x			x		x				Once/ year	Head of Dept
Employer Survey		x			x	x	x	x			Once/ year	Head of Dept
Examination	x	x	x								Conti-nuous	Head of Dept
Assignment		x	x	x					x	x	Per semester	Head of Dept
Practical competency exam		x							x		Per semester	Head of Dept

PROGRAMME SPECIFICATION

BACHELOR OF SCIENCE (INDUSTRIAL BIOLOGY)

1. Awarding Institution		Universiti Teknologi Malaysia		
2. Teaching Institution		Universiti Teknologi Malaysia		
3. Program Name		Bachelor of Science in Industrial Biology		
4. Final Award		Bachelor of Science (Industrial Biology)		
5. Program Code		TS31 (SSCB)		
6. Professional or Statutory Body of Accreditation		Malaysian Ministry of Higher Education Kementerian Pengajian Tinggi Malaysia		
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-governing		
10. Study Scheme (Full Time/Part Time)		Full Time		
11. Study Duration		Minimum : 4 yrs Maximum : 6 yrs		
Type of Semester	No. of semester		No. of semester	
	Full Time	Full Time	Full Time	Full Time
Normal	8	8	14	14
Short	-	4	-	6
12. Entry Requirement	<p>Fulfills University requirements and the following program requirements:</p> <p><u>STPM/MATRICULATION/SCIENCE FOUNDATION</u></p> <ul style="list-style-type: none"> ● Pass with minimum grade of B-(CGPA 2.67) in Biology ● Pass at least with grade C+ (CGPA 2.33) in any two subjects : physics, chemistry, mathematics (additional maths, advance additional maths) ● Pass at least with distinction in mathematics at the level of SPM/STPM <p><u>DIPLOMA</u></p> <ul style="list-style-type: none"> ● Diploma holder from UTM or any other institution certified by Malaysian government and related ● Pass with minimum CGPA of 2.5 ● Other equivalent qualification with minimum CGPA 2.5 ● Candidates with CGPA <2.5 with at least 2 years of working experience in related field 			

13. Program Educational Objectives

The objectives of the B.Sc. (Industrial Biology) program are to provide the knowledge, skills and attributes that should be achieved by the graduates for a successful career. The program is designed to:

- are technically competent, creative and resourceful in the field of biotechnology
- are motivated and prepared for further study or for employment in biotechnology-based industries as scientists or technologists in production and research development or explore independent employment and business opportunities
- are able to propose new thoughts or idea from data or information with a critical logical mind-set and highethical standard
- are able to adapt to the changing social and research environment in order to stay competitive in further education a well as the job market

14. Program Learning Outcomes

Program Learning Outcomes	Intended Learning Outcomes	Teaching and Learning Methods	Assessment
Technical Knowledge and Competencies			
PO1 Acquire knowledge	Ability to acquire knowledgas well as understand the fundamental and applied concepts in applied biology	Lectures, tutorials, seminars, laboratory works, directed reading and independent study.	Examinations, laboratory reports, quizzes, written assignments and oral presentations.
PO2 Apply knowledge and practical skills	Ability to apply knowledge and practical skills in applied biology to effectively, creatively and innovatively solve problem	Lectures, tutorials, computer based exercises, laboratory works, supervised projects and industrial training.	Examinations, laboratory reports, quizzes, written assignments, oral presentations, final year project reports and industrial training reports.
PO3 Ability to analyse, synthesise or evaluate data	Ability to pratise knowledge and skills in applied biology to solve problem, challenge and task.	Ability to pratise knowledge and skills in applied biology to solve problem, challenge and task.	Examinations, laboratory reports, written and oral presentations, final year project reports and industrial training reports.

Generic Skills			
PO4 Communication skills	Ability to communicate and interact with clarity and coherence orally and literally in using various media	Group assignments, industrial training, final year project supervision, laboratory works, tutorials and presentation.	Rubrics for written assignments, laboratory reports, oral presentations, final year project report, final year project log book, poster presentations, industrial training reports and industrial training log book.
PO5 Creative thinking and problem solving	Ability to think critically, systematically and beyond paradigm in solving problems using alternative approaches in the context of their chosen specialization.	Final year project supervision, group assignments, industrial training, laboratory work and tutorial.	Tutorial, PBL, case study, oral presentations, written assignments, final year project report, final year project log book, laboratory reports, industrial training reports, industrial training log book, examinations and tests.
PO6 Leadership and team working	Ability to work collaboratively as an individual as well as a leader in a team and respects others opinion in making decision	Group assignments, laboratory works, industrial training, PBL and case study.	Oral presentations, laboratory reports, industrial training reports, industrial training log book and peer assessment.
PO7 Entrepreneurship	Ability to create awareness of business opportunity, dare to take risks and not easily give up when encounter problems in business	Lectures and assignments.	Examinations, oral presentations, written assignments, entrepreneur activities, business plan and case study.
PO8 Ethics and integrity	Ability to practice ethical values in professional practice and social interactions for sustainable development	Lectures (TITAS), assignments, laboratory works, final year projects and industrial training.	Laboratory reports, written assignments, final year project reports, final year project log book, industrial training reports, industrial training logbook and examinations.

PO9 Lifelong learning	Ability to demonstrate the acquisition of the skills and attributes necessary for lifelong learning through searching and management of relevant information and systematic research activities	Final year projects, group assignments, field trips and industrial training.	Laboratory reports, written assignments, final year project reports, final year project log book, industrial training reports, industrial training log book and examinations.
PO10 Adaptability	Ability to adapt with pragmatic changes in socio-culture, economy, politic and environment	Lectures and assignments.	Oral presentation, examinations, written and assignments.

15. Classification of Courses

No.	Classification	Credit Hours	Percentage (%)
1	Basic Sciences and Mathematics	24	57.6
2	Program core	52	
3	Program Elective	33	25
4	Compulsory University Courses		17.4
	• General	13	
	• English Language	8	
	• Co-curriculum	2	
	Total	132	100

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

No.	Classification	Credit Hours	Percentage (%)
A	Biology Courses		
	(a) Lecture	58	43.9
	(b) Lecture + Laboratory	21	15.9
	(c) Industrial Training	5	3.8
	(d) Final Year Project	6	4.5
	Total credit hours for Part A	90	68
B	Related Courses		

(a) Chemistry	4	3.0
(b) Mathematics	6	4.5
(b) Humanities/Entrepreneurship /Management	22	16.7
(c) Co-Curriculum	2	1.5
(d) Languages	8	6.1
Total credit hours for Part B	42	31
Total credit hours for Parts A and B	132	100

16. Total credit hours to graduate	132 credit hours
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17. Program structures and features, curriculum and award requirements
The course is offered on full-time mode and is based on 2-Semesters Academic Session with several courses 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:
<ul style="list-style-type: none"> • Attain a total of not less than 132 credit hours with minimum CPA of 2.00. • Pass Industrial Training (equivalent to 5 credit hours). • Complete and pass the undergraduate project Final Year Project.

SEMESTER 1			SEMESTER 2		
Code	Name of Courses	cr	Code	Name of Courses	cr
SSCB 1613/ SMBT 1303	Microbiology (+Lab)	3	SSCB 1703/ SMBB 1143	Cellular and Molecular Biology	3
SSCB 1112/ SMBB 1182	Introduction To Biomolecules	2	SSCB 1123/ SMBB 1173	Cellular Biochemistry and Metabolism (+Lab)	3
SSCM 1023	Mathematical Method I	3	SSCB 1422/ SMBT 1212	Introduction to Biotechnology	2
SSCM 1103	<i>Statistics</i>	3	SSCK 1203	<i>Analytical Chemistry</i>	3
ULAB 1122	<i>Academic English Skills</i>	2	SSCK 1891	Analytical Chemistry Practical	1
UHAS 1172	Malaysian Dynamics - <i>Local students</i>	2	SSCB 1103/ SMBB 1603	Bioorganic Chemistry	3

ULAM 1012	Malay Language Communication 2 - <i>International students</i>	2	UICI 1012	Islamic and Asian Civilization (TITAS) - <i>Local students</i>	2
UHAK 1012	Graduate Success Attributes	2	UHAK 1022	Malaysian Studies - <i>International students</i>	2
Total credit hours		17	Total credit hours		17
SEMESTER 3			SEMESTER 4		
Code	Name of Courses	cr	Code	Name of Courses	cr
SSCB 2513/ SMBT 2513	Introduction to Bioprocess Engineering	3	SSCB 2503/ SMBT 2233	Fermentation Technology	3
SSCB 2713/ SMBB 2153	<i>Genetic Engineering (+ Lab)</i>	3	SSCB 2823/ SMBT 2693	Enzyme Technology and Biocatalysis (+Lab)	3
SHAD 1033	Principles of Management	3	SSCB 2423	<i>Bioethics in Research and Development</i>	3
UKQX 2XX2	Co-curriculum Service Learning	2	SHAF 1013	<i>Principles of Marketing</i>	3
ULAB 2122	<i>Advanced Academic English Skills</i>	2	UICL 2302	The Thought of Sciences and Technology	2
ULAX 1122	Elective Foreign Language	2	Please choose any 2 credits		
			UICL 2XX2	The Thought of Sciences and Technology	2
			UHAK 2XX2	Elektif of Knowledge Enhancement OR Elective of Generic Skills	2
Total credit hours		15	Total credit hours		16
* Please refer Appendix for list of UKQX, ULAX, UICL and UHAK courses					
SEMESTER 5			SEMESTER 6		
Code	Name of Courses	cr	Code	Name of Courses	cr
SSCB 3513/ SMBT 3253	Bioprocess Engineering	3	SSCB 3823/ SMBB 3723	Biocomputation and Bioinformatics	3
SSCB 3313/ SMBT 3243	<i>Tissue Culture Technology (+ Lab)</i>	3	SSCB 3403/ SMBT 3613	<i>Research Methodology</i>	3
UHAK 1032	<i>Introduction to Entrepreneurship</i>	2	SHAD 1043	<i>Organizational Behaviour</i>	3

Elective Courses (Please choose 9 credits)			ULAB 3162	English for Professional Purposes	2
			UKQE 3001	Extracurricular Experiential Learning	1
SSCB 3713/ SMBT 3163	Techniques in Molecular Biology	3	Elective Courses (Please choose 6 credits)		
SSCB 3653/ SMBT 3353	Industrial Microbiology	3	SSCB 3603/ SMBB 3433	Virology	3
SSCB 3633/ SMBT 3333	Food Microbiology	3	SSCB 3303/ SMBB 3503	Immunology	3
SSCB 3213/ SMBB 3573	Biological Control and Environmental Conservation	3	SSCB 3703/ SMBT 3213	Molecular Biotechnology	3
SSCB 3673/ SMBB 3323	Physiology and Screening of Industrial Microorganisms	3	SSCB 3723/ SMBB 3173	Gene Expression	3
Total credit hours		17	Total credit hours		18
SHORT SEMESTER					
Code	Name of Course	cr			
SSCB 3455/ SMBU 3915	Industrial Training (HW)	5			
Total credit hours		5			
SEMESTER 7			SEMESTER 8		
Code	Name of Courses	cr	Code	Name of Courses	cr
SSCB 4412/ SMBU 4922	Undergraduate Project 1	2	SSCB 4404/ SMBU 4924	Undergraduate Project II	4
SSCB 4313/ SMBT 4253	Applications of Tissue Culture	3			
Elective Courses (Please choose 9 credits)			Elective Courses (Please choose 9 credits)		
SSCB 4813/ SMBT 4663	Protein Separation Techniques in Biotechnology	3	SSCB 4203/ SMBT 4293	<i>Environmental Biotechnology</i>	3
SSCB 4513/ SMBT 4273	<i>Biorefinery Technology</i>	3	SSCB 4243/ SMBT 4693	<i>Biosensor Technology (+Lab)</i>	3
SSCB 4113/ SMBT 4183	<i>Applied Microbial Biochemistry and Biotransformation</i>	3	SSCB 4223/ SMBT 4323	<i>Bioremediation and Biodegradation</i>	3
SSCB 4213/ SMBT 4283	<i>Industrial Waste Management</i>	3	SSCB 4723/ SMBB 4143	<i>Gene Therapy</i>	3
SSCB 4533/ SMBT 4263	<i>Pharmaceutical Biotechnology</i>	3			
Total credit hours		14	Total credit hours		13

Appendix
(List of UKQX, ULAX, UICL and UHAK courses)

Students are allowed to choose from the following list.

UKQX		ULAX		UICL		UHAK	
UKQA 2XX2	*	ULAA 1112	Arabic Language	UICL 2012	Al-Quran and Human Civilization	UHAK 2012	Leadership
UKQR 2XX2	*	ULAC 1112	Mandari Language	UICL 2032	<i>Life Institutions and Sustainable Development</i>	UHAK 2022	Critical and Creative Thinking
UKQS 2XX2	*	ULAF 1112	France Language	UICL 2042	<i>Future Studies</i>	UHAK 2032	The Human Side of <i>Knowledge Management</i>
UKQU 2XX2	*	ULAJ 1112	Japanese Language	UICL 2052	<i>Family Law</i>	UHAK 2042	Development and Global Issues
		ULAN 1112	Persian Language	UICL 2062	World Science	UHAK 2052	Guidance and Counselling
				UICL 2072	Sustainable Economy	UHAK 2062	<i>Psychology of Adjustment</i>
				UICL 2082	Practices and Concept of <i>Halal Management</i>	UHAK 2072	<i>Fundamentals of Intellectual Property</i>
				UICL 2092	Phylosophy of <i>Islamic Art</i>	UHAK 2082	<i>Law of Entrepreneurs</i>
				UICL 2102	Islam and Health	UHAK 2092	Entrepreneurship and Enterprise Development
				UICL 2132	Islamic Enterpreneurship	UHAK 2102	Social Entrepreneurship
						UHAK 2112	Engineering Communication
						UHAK 2122	Human Communication
						UHAK 2132	<i>Professional Ethics</i>

* for code and name of courses, please refer Co-curriculum and Service Learning Centre.

18. Mapping of Program Learning Outcomes to Courses											
Courses Offered		Acquire knowledge	Apply knowledge and practical skills	Ability to analyse, synthesize or evaluate data	Communication skills	Creative thinking and problem solving	Leadership and team working	Entrepreneurship	Ethics and integrity	Lifelong learning	Adaptability
Code	Course Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
Core Courses											
SSCB 1613	Microbiology (+Lab)	√	√	√							√
SSCB 1112	Introduction To Biomolecules	√	√			√					
SSCM 1023	Mathematical Method I										
SSCM 1103	Statistics										
SSCB 1703	Cellular and Molecular Biology	√		√	√		√				
SSCB 1123	Cellular Biochemistry and Metabolism (+Lab)	√	√	√	√	√					
SSCB 1422	Introduction to Biotechnology	√	√			√	√		√		
SSCK 1203	Analytical Chemistry										
SSCK 1891	Analytical Chemistry Practical										
SSCB 1103	Bioorganic Chemistry	√	√	√	√	√					
SSCB 2513	Introduction to Bioprocess Engineering	√	√	√		√	√				

SSCB 2713	Genetic Engineering (+ Lab)	√		√	√		√				
SHAD 1033	Principles of Management										
SSCB 2503	Fermentation Technology	√	√	√		√					
SSCB 2823	Enzyme Technology and Biocatalysis (+Lab)	√	√	√	√	√					
SSCB 2423	Bioethics in Research and Development	√	√			√			√		√
SHAF 1013	Principles of Marketing										
SSCB 3513	Bioprocess Engineering		√	√	√	√					
SSCB 3313	Tissue Culture Technology (+ Lab)	√	√	√			√		√		
SSCB 3823	Biocomputation and Bioinformatics	√	√	√	√	√					
SSCB 3403	Research Methodology	√	√	√	√	√					
SHAD 1043	Organizational Behaviour										
SSCB 3455	Industrial Training (HW)	√	√	√	√	√	√		√	√	√
SSCB 4412	Undergraduate Project 1	√	√	√	√				√	√	
SSCB 4313	Applications of Tissue Culture	√	√	√			√	√			
SSCB 4404	Undergraduate Project II	√	√	√	√	√			√	√	
Elective Courses											
SSCB 3713	Techniques in Molecular Biology	√	√	√		√			√		

SSCB 3653	Industrial Microbiology	√	√	√		√					
SSCB 3633	Food Microbiology	√	√	√		√					
SSCB 3213	Biological Control and Environmental Conservation	√	√		√	√			√		
SSCB 3673	Physiology and Screening of Industrial Microorganisms	√	√		√	√	√				
SSCB 3603	Virology	√	√	√					√	√	
SSCB 3303	Immunology	√	√	√		√			√		
SSCB 3703	Molecular Biotechnology	√	√	√		√		√	√		
SSCB 3723	Gene Expression	√								√	
SSCB 4813	Protein Separation Techniques in Biotechnology	√	√		√		√				
SSCB 4513	Biorefinery Technology	√	√			√					
SSCB 4113	Applied Microbial Biochemistry and Biotransformati on	√	√	√		√					
SSCB 4213	Industrial Waste Management	√	√	√		√	√				
SSCB 4533	Pharmaceutical Biotechnology	√	√	√		√					
SSCB 4203	Environmental Biotechnology	√	√	√		√			√		
SSCB 4243	Biosensor Technology (+Lab)	√	√		√	√					

SSCB 4223	Bioremediation and Biodegradation	√	√	√					√		
SSCB 4723	Gene Therapy	√		√					√	√	
University Courses											
ULAB 1122	Academic English Skills										
UHAS 1172	Malaysian Dynamics - <i>Local students</i>										
ULAM 1012	Malay Language Communication 2 - <i>International students</i>										
UHAK 1012	Graduate Success Atributes										
UICI 1012	Islamic and Asian Civilization (TITAS) - <i>Local students</i>										
UHAK 1022	Malaysian Studies - <i>International students</i>										
UKQX 2XX2	Co-curriculum Service Learning										
ULAB 2122	Advanced Academic English Skills										
ULAX 1122	Elective Foreign Languange										
UICL 2302	The Thought of Sciences and Technology										
UICL 2XX2	The Thought of Sciences and Technology										
UHAK 2XX2	Elektif of Knowledge Enhancement OR Elective of Generic Skills										

UHAK 1032	Introduction to Entrepreneurship										
ULAB 3162	English for Professional Purposes										
UKQE 3001	Extracurricular Experiential Learning										

PO1-PO3 = Technical Skills

PO4-PO10 = Generic Skills

19. Our Uniqueness

- A biotechnology-based program designed to grant a strong academic foundation in biological sciences and chemistry, training in the various biotechnologies and a solid understanding of their application in industry and biomedicine.
- The curriculum is designed to contribute to the modern biotechnology education that provides multidisciplinary knowledge.
- The curriculum also reflects the broad spectrum of bioengineering concept as well as skills to accomplish the needs of biotechnological based industries and also research institutes.
- The program offers courses that integrate knowledge with the elements of blue biotechnology (environmental biotech), white biotechnology (industrial biotech), green biotechnology (agri-biotech) and red biotechnology (biopharma).

20. Career Prospects and Career Path

Graduates of the program can work as

- Research Scientist/Science Officer/Assistant Science Officer
- Academician (Lecturer/teacher/tutor)
- Biotechnologist/Biotechnology Engineer
- Quality Control Officer/Quality Control Engineer
- Product Specialist/ Sales Executive for Biotech Product
- Clinical Coordinator
- Environmental Safety Officer
- Laboratory Manager

From our alumni survey, graduates from this programme have found employment in various private and government sectors or research institutes as Academicians, Microbiologist, Research Officers, Clinical Coordinator, Project Manager, Environmental officer, and Postdoctoral position to name but a few. Some of our graduates have opted to pursue their MSc or PhD degrees locally or abroad in more advanced fields of biotechnology such as cancer and stem cell research, proteomics and metabolic engineering. A number of them became an academia in universities or private institutes or became a science and mathematics teacher in secondary schools.

Academics or researchers in higher learning institutions, following pursuance of their degree qualifications to Masters or PhD levels.

Quality control or quality assurance and marketing officers in agencies or industries in which sound knowledge of chemistry skills are required.

21. Cross Campus Program

Students are given the opportunity to enroll certain courses in participating universities locally and overseas. The grades and credits up to 1/3 of the total credits of the curriculum are transferable.

22. Professional Skills Program Certificate

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.

All 5 courses under Professional Skills Certificate are compulsory for students for graduation. The courses are listed below:

- TECS - Test of English Communication Skills (Oral & Writing)
- GLL1001 - How to Get Yourself Employed
- GLL1029 – ISO 9001:2008 Quality Management System Requirement
- GLL1041 – How to Manage Your Personal Finance
- GLL1040 – Occupational Safety, Health & Environment (OSHE)

23. Facilities available

List of Laboratories :

1. Biosensors and Biomolecular Technology Laboratory
2. Bioinformatics Teaching Laboratory 1 and 2
3. Chemistry Teaching Laboratory 1 and 2
4. Fermentation / Enzyme Teaching Laboratory 1 and 2
5. Genetic Engineering Teaching Laboratory 1 and 2
6. Microbiology Teaching Laboratory 1 and 2
7. Central Analytical Laboratory
8. Analytical Service Laboratory
9. Animal Tissue Culture Laboratory
10. Biofilm Research Laboratory
11. Bioinformatics Research Laboratory
12. Bio-nanotechnology Laboratory
13. Bio-refinery Technology Research Laboratory
14. Cancer Research Laboratory
15. Environmental Bioengineering Laboratory
16. Enzyme Research Laboratory
17. Extremophiles Laboratory
18. Genomics Laboratory
19. Microbiology Research Laboratory
20. Nanomaterial Laboratory
21. Nutritional Biochemistry Laboratory

22. Plant Biotechnology Laboratory
23. Proteomics Laboratory
24. Structural Biology Laboratory
25. Tissue Engineering Laboratory
26. Virus Research Laboratory
27. Water & Wastewater Research Laboratory

List of special facilities/equipments

1. High Performance Liquid Chromatography
2. Luminometer
3. Top range UV-visible Spectrophotometer
4. Gas Chromatography
5. Total Organic Carbon Analyzer
6. Gradient and Real Time PCR machines
7. ACTAprime system for protein purification and others.

24. Support for Students and Their Learning

(a) Support Personnel

Academic Advisor

Counselor

Student Association (PESAT)

(b) Infrastructure support

Internet access (Wireless)

e-learning

Digital library

Cafeterias

Health care center

Sports and recreational areas

Smart classroom

Students activity room

Reading Stations

(c) Financial support

Perbadanan Tabung Pendidikan Tinggi Negara (PTPTN)

MARA

JPA and others.

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/KG – Pass/conditional pass/fail
- CPA – Cumulative point average
- Graduating students performance

- GOT – Graduate on time
 - Completion rate
 - Analysis of course performance
2. Employability
 - Exit survey
 - Alumni survey
 - Market survey
 3. Lecturer’s performance
 - Teaching evaluation by students (e-PPP)
 - Competency check-list for staff (CS)
 - Annual staff appraisal (e-LPPT)
 4. Curriculum review
 - Faculty academic committee
 - Laboratory attachment training survey
 - External examiner reports
 - CO achievement survey by students
 - Generic skills evaluation
 5. Delivery system
 - Academic Quality Assurance Committee
 - Customer Satisfaction Index (CSI)
 - Employer Satisfaction Index (ESI)
 - Anugerah Kualiti Naib Canselor (AKNC) audit
 - Malaysia Quality Assurance (MQA) standard

26.Regulation of Assessment

1. 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

2. Role of External Examiners (Visiting Examiners)

- Visiting Examiners are appointed by the Faculty Academic Committee to
- review and evaluate programme curriculum,
- review and evaluate methods of students assessment,
- make necessary recommendations to the Academic committee

27. Assessment Tools

Measurement Tools	Learning Outcomes										Duration	Action by	
	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10			
e- Portfolio	x	x	x	x	x	x	x	x	x	x	x	Continuous	Student
Course outcome report	x	x	x	x	x	x	x	x	x	x	x	per semester	Lecturer
Final Year Project survey		x	x	x				x			x	per semester	Final year project coordinator
PO survey by final year students					x						x	Once/year	Faculty
Industrial training survey					x	x		x				End of Session	Industrial training coordinator
Alumni Survey	x	x			x		x					Once/year	Head of Dept.
Employer Survey		x			x	x	x	x				Once/year	Head of Dept.
Peer assessment						x		x				per semester	Course owner
Examination	x	x	x									Continuous	Course owner
Assignment		x	x	x								Continuous	Course owner
Practical competency exam		x								x		per semester	Course owner

SYNOPSIS OF BIOLOGY COURSES

Compulsory Courses

SSCM 1023 MATHEMATICAL METHODS 1

The course revises and extends Matriculation and STPM topics such as differentiation and integration and includes topics such as complex numbers and differential equations, which may be new to many students. Topics covered include parametric equations, functions, polar coordinates, vectors, and complex numbers. 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. Additional topics include limits and continuity, differentiation techniques and its applications, integration techniques including improper integrals. Upon completion, the students would have acquired some quite powerful tools of analysis. This is also an introductory course on differential equations. Topic includes first order ordinary differential equations (ODEs). Students will learn how to classify and solve first order ODEs.

SSCM 1103 STATISTICS

The course is an introduction to statistics, reviewing some descriptive statistics which includes probability and random variables. Then, the topic of sampling distributions and inferential statistics which include estimation procedures and hypothesis testing is covered. The latter using the method of analysis of variance when more than two means are involved. Also, simple linear regression and contingency table are introduced. Students will be trained in the use of computer software such as Microsoft Excel and SPSS.

SSCK 1203 ANALYTICAL CHEMISTRY

This course provides a basic introduction to quantitative chemical analysis, with emphasis on wet chemical methods. Topics include introduction to analytical chemistry, sampling, sample preparation, data analysis & method validation, gravimetric analysis and volumetric analysis.

SSCK 1891 ANALYTICAL CHEMISTRY PRACTICAL

The subject introduces students to Good Laboratory Practices in classical (wet chemistry) methods. Experiments are designed to complement the topics covered in Fundamentals of Analytical Chemistry (SSCH 2243), which include gravimetric and volumetric techniques. Part of the course consists of a short laboratory project.

SSCB 1703 CELLULAR AND MOLECULAR BIOLOGY

This subject will facilitate students to understand and visualize processes in cell biology and those responsible for DNA transmission and expression hence mechanisms by which bacteria inherit genetic information as the blue print of life. The lectures will explain relationship between structure and function in molecular biology and how this relationship operates to control biochemical processes. Topics include macromolecules like DNA, RNA and proteins and how processes like replication, transcription and translation operate, eukaryotic genetics. Students will cover related aspects such as mutation and mutagenesis, effects of mutation and how cells overcome mutation. Students will also learn about basic techniques in molecular biology as the basis for genetic engineering. PowerPoint presentation by each group will be done at the end of the semester on designated topics.

SSCB 1112 INTRODUCTION TO BIOMOLECULES

This course focuses on the description to the structure and function of biomolecules that are important in understanding the biochemistry of living organisms. These include the discussion on the structural and functional properties of proteins, nucleic acids, carbohydrates and lipids. Proteins are at the center of the action in biological processes thus

it will be given a major attention during this course. The properties of amino acids, reaction kinetics and catalytic mechanisms of enzymes will be explained in detail.

SSCB 1123 CELLULAR BIOCHEMISTRY AND METABOLISM (+LAB)

This course focuses on theory and practical in basic biochemistry. Practical are arranged in separate sessions to give students enough time to develop their skills in biochemical analysis. Discussion on properties of water as medium for most of the biochemical reactions is also conducted. This also includes the introduction to metabolism, glucose catabolism, glycogen catabolism and synthesis and gluconeogenesis, citric acid cycle, oxidative phosphorylation and electron transport chain. Important aspects of lipid breakdown and synthesis, protein metabolism, amino acid and nucleotide synthesis are also covered in detail.

SSCB 1613 MICROBIOLOGY (+LAB)

This course focuses on theory and practical in basic microbiology. Practical are arranged in separate sessions to give students enough time to develop their skills related to microbiological techniques, particularly in aseptic techniques and microscopy. Discussions are mainly on different classes of microorganism especially bacteria: bacterial physiology and anatomy, nutrient requirement and physical factors influencing growth, metabolism and microbial genetics. Metabolic diversity in microorganisms, classes of fungi, algae, protozoa and their benefit and applications are also looked into. Discussion on physical and chemical control of microbial growth is part of the role of microorganisms in controlling diseases caused by microorganisms. Application of microbes in industries such as food, beverages and in environment will also be included.

SSCB 1103 BIOORGANIC CHEMISTRY

This course focuses on basic and fundamental theory in bio-organic chemistry. Bio-organic chemistry is the knowledge of organic chemistry for the biological materials. The fundamental of organic chemistry is essential prior to understanding the biochemistry and biomolecules since each of biological compounds comprises of organic molecules. An introduction of this subject includes the fundamental of organic compounds frameworks and their functional groups. The topic on the basic structure of biological compounds such as proteins, carbohydrates, nucleic acid etc. is enclosed. The analysis and characterization of organic compounds by various instrumental techniques namely UV-Visible spectroscopy, Infrared (IR) spectroscopy, nuclear magnetic resonance (NMR) and mass spectrometry (MS) are also covered in detail.

SSCB 2713 GENETIC ENGINEERING (+LAB)

Pre-requisite: SSCB 1703 Cellular and Molecular Biology

This course encompasses the basic principles and techniques involved in molecular biology which will enable students to apply these techniques in the genetic engineering laboratory. The introductory lecture will expose students to genetic engineering and its application in various sectors of the industry such as agriculture, medical, pharmaceutical, environmental, etc. The following lectures will revolve around techniques in genetic engineering, cloning of heterologous genes in the *Escherichia coli* host which will include common procedures in molecular biology, enzymes important in molecular biology, plasmids and bacteriophage as cloning vectors, gene libraries preparation and screening for gene of interest. Before semester ends, students are to produce a group poster relevant to genetic engineering as a form of team-working experience. Peer group evaluation is mandatory. Some of the concepts taught will be applied in this laboratory practical. Students will have the opportunity to hands on the isolation of genomic DNA, agarose gel electrophoresis, PCR amplification, DNA ligation, preparation of competent cells, transformation, and lastly verify the clones of interest by plasmid DNA extraction and DNA restriction digestion.

SSCB 2423 BIOETHICS IN RESEARCH AND DEVELOPMENT

This course provides an introduction to bioethical principles used to make decisions when confronted with ethical issues involving the application and use of biotechnology. The goal is to develop a framework for the appreciation

and understanding of ethical dilemmas within the biotechnological, pharmaceutical and medical fields. This course begins with a brief overview of ethics, and then moves to develop and consider the moral values and principles relevant to biotechnology and bioethics. The course hopes to develop moral wisdom (knowledge about ethics and the ability to think ethically) and moral virtue (a stronger commitment to act morally). Students will also be introduced to fundamental bioethical review systems, including the theory of peer review and moral and ethical responsibilities of scientists.

SSCB 3403 RESEARCH METHODOLOGY

This course will introduce students to research methodology so as to develop understanding of the research process as applied to biological sciences. Qualitative and quantitative research methods and approaches to solve problems are examined. An appropriate research methodology and analysis of a particular research problem is proposed and justified. The written proposal is evaluated based on the logical consistency of the written material and evaluate the outcome of a research project in terms of useable knowledge; and to design, defend and evaluate research proposals.

SSCB 3455 INDUSTRIAL TRAINING

Students are required to undergo Industrial Training (LI) 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 credits hours, and
- (ii) Is of Good Standing (KB) in Semester 1 of Year 2, or was on Probationary Standing (KS) only once prior to Industrial Training.

Students 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.

SSCB 4412 UNDERGRADUATE PROJECT I

This course is the first part of the Final Year Project. Each student will be assigned a topic and a supervisor at the beginning of Semester 1 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 SQBU 4924 in the following semester. The evaluation of this course will be based on the progress report, evaluation by supervisor, and a possible oral presentation as required. Only students of Good Standing (KB) in the previous semester are allowed to register for SQBU 4924.

SSCB 4404 UNDERGRADUATE PROJECT II

Pre-requisite: SSCB 4412 Undergraduate Project I

This course is the second part of the Final Year Project and is a continuation of SQBU 4922. It is an extension of the laboratory work/written research assignments from SQBU 4922. At the end of the semester, each student is required

to present their findings and submit a report to the faculty on a certified date. Evaluation of the course is based on oral presentation and submitted report.

SSCB 1402 INTRODUCTION TO BIOSCIENCES

This course explores how biology is used in both academic and commercial settings within the fields of biotechnology, pharmaceutical and clinical sciences. Topics will include: applications of biotechnology in microbes, plants, and animals, the human genome project and its relation to medical biotechnology, DNA forensics, and pharmaceutical drug discovery, delivery, and FDA approval. The debate surrounding subjects such as cloning, stem cells, and genetically modified foods will also be discussed.

SSCB 2633 MYCOLOGY

Pre-requisite: SSCB 1613 Microbiology (+Lab)

Introduces the structure of fungi, development of reproduction system, mechanisms of spore release and classification of fungi based on life cycle. Interaction of species in community of fungi will be discussed. The influence of fungi towards stability of plant community, nutrient cycle and environment will be taught. The benefits and disadvantages of fungi in economic, agriculture, medical and industrial will be explained in details. Biosafety regulation when working with fungi will be explained.

SSCB 2303 IMMUNOLOGY

Introduces the basic concept of immunology and mechanism of immune response for better understanding on the development of immune system. Mechanism of natural and acquired immunity, structure and function of antibody will also be discussed further. Upon completion, students should be able to define and describe the role of immune system against infection and disease and their example.

SSCB 2803 ENZYMOLOGY (+LAB)

Pre-requisite: SSCB 1703 Cellular Biochemistry and Metabolism (+Lab)

The course of enzymology deals with the general theoretical basis, with some industrial applications. The mechanisms of enzyme action are studied, with rates of enzymatic reactions: kinetics (Michaelian and non Michaelian kinetics, inhibition, effects of pH) and enzymes catalysis: acid-base catalysis and covalent catalysis. Special interest is devoted to structure-function relationship of enzymes with examples of enzymes with known structures. This course will move on to cover allosteric interactions of enzymes, enzyme regulation and finally the applications of enzymes in biotechnology and industry in particular the use of immobilized enzymes for industrial processes.

SSCB 2753 BASIC GENETICS

Genetics is the science of heredity. Various concepts and branches will be introduced. Topics to be discussed included Mendel's Laws, the cytological basis of heredity and cytogenetics, biochemical Genetics molecular and microbial Genetics, genetic variation at the protein and DNA levels, genetic basis of evolution and recombinant DNA technology/genetic engineering.

SSCB 2323 PLANT PHYSIOLOGY (+LAB)

Plant Physiology is an integrative discipline that answers questions about plant form and function. In this course, several aspects of plant physiology which include plant water relations, transpiration, phloem transport, photosynthesis, respiration, growth and development will be focused. This course will also emphasize on the roles of hormones in plant development and secondary metabolite in plant defenses.

SSCB 3613 PHYCOLOGY

Pre-requisite: SSCB 1613 Microbiology (+Lab)

This course provides an introduction to algae and its application in industry. Topics include definition of algae, techniques in applied phycology, and characteristics of seaweed properties, morphology and life history. Physiology, genetics and ecology are provided to understand a healthy utilization of coastal environments and seaweed resources.

SSCB 3333 ANIMAL PHYSIOLOGY (+LAB)

Physiology is the study of functions in living body at cellular level (cellular physiology) and systemic level (animal physiology). An overview will be given on events occurring at molecular and cellular level. Lectures will focus on tissue and systemic levels addressing how structure and functions are interrelated between different levels of organisation. Foundation from this course is applicable to other courses including mammalian cell and tissue culture, microbiology, immunology, biochemistry and bioenergetic. From this course, students could go on into the fields of biomedical investigation at cellular level (such as cancer biology, host-pathogen interaction, cell and molecular physiology) to systemic level (such as organ and system physiology, pathology, or zoology).

SSCB 3603 VIROLOGY

Viruses are diverse and ubiquitous; every animal, plant and protist species on this planet is infected with viruses. To each species is specific range of viruses. Despite such diversity, all viruses share common molecular denominator that underlies the process of virus replication. This course will introduce students to virus diversity, the molecular aspects of virus entry, genome replication and assembly. It covers the mechanism that viruses use to manipulate host to multiply and cause diseases. The course will make use of contemporary issue in virology to explain virus-host interactions and current diseases.

SSCB 4703 CELL SIGNALLING

Pre-requisite: SSCB 1123 Cellular Biochemistry and Metabolism

This course provides an overview of current understanding of the biological roles of extracellular molecular chaperones. First the structure and function of molecular chaperones, their role in the cellular response to stress and their disposition within the cell will be discussed. It also questions the basic paradigm of molecular chaperone biology - that these proteins are first-and-foremost protein-folding molecules. The current paradigms of protein secretion are reviewed and the evolving concept of proteins (such as molecular chaperones) as multi-functional molecules for which the term 'moonlighting proteins' has been introduced is discussed. The role of exogenous molecular chaperones as cell regulators is examined and the physiological and pathophysiological role that molecular chaperones play is described. In the final section, the potential therapeutic use of molecular chaperones is described and the final chapter asks the question - what does the future hold for the extracellular biology of molecular chaperones?

SSCB 4433 ECOLOGY

This course will introduce students to the major concepts, principles and elements of ecology i.e. higher levels of the organisation of life on earth and the interactions between organisms and their environment in a hierarchy of levels of organization: individuals, populations, communities, and ecosystems. Students will then examine ways in which ecology can be applied to solving crucial environmental problems like global climate change, sustainability, agroforestry, biodiversity and conservation, invasive species, ecotoxicology, biomonitoring and bioremediation, and restoration ecology. Case studies are examined in detail. While some sociological and economic issues are discussed, the emphasis is on the biological aspects of these crucial problems.

Elective courses

SSCB 3113 BIOENERGETICS

Pre-requisite: SSCB 1123 Cellular Biochemistry and Metabolism (+Lab)

Transformations of energy in biological systems will be discussed in this course. Essential features of cell metabolism and thermodynamic principles underlying biological processes will be described to relate processes by which energy is made available. Since most of the energy generated by heterotrophs is derived from the oxidation of substrates and plants from photosynthesis, processes related to oxidative phosphorylation and photophosphorylation will be emphasized. Generation and consumption of energy in central metabolic pathways of carbohydrates and lipid metabolism will be illustrated and compared.

SSCB 3673 PHYSIOLOGY AND SCREENING OF INDUSTRIAL MICROORGANISM

Pre-requisite SSCB 1613 Microbiology (+Lab)

This course introduces students to the role of microbes and how some of them may be isolated from the environment. The course aims to address the topics such as identification of potential industrial microbes, microbial growth requirements, enumeration techniques and preparation of stock culture, isolation of strict anaerobes, hyperthermophiles, fungi, alkalophiles, acidophiles and actinomycetes from the environment. Important biotechnological application and benefits of each microbe will also be discussed.

SSCB 3803 STRUCTURE AND FUNCTION OF PROTEINS

Pre-requisite: SSCB 1112 Introduction to Biomolecules

This course is a comprehensive introduction to the study of proteins and their importance to modern biochemistry. This course will start with a brief historical overview of the subject then move on to discuss the building blocks of proteins and their respective chemical and physical properties. This course will also explore experimental and computational methods of comparing proteins, methods of purification and protein folding and stability.

SSCB 3823 BIOCOMPUTATION AND BIOINFORMATICS

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

SSCB 4243 BIOSENSOR TECHNOLOGY (+LAB)

This course will present an overview of the fundamental principles and applications of biosensors. More specifically it will cover the following subjects: What is a sensor? How does a sensor become biological in nature? The history of biosensors. What are the components of a biosensor? What are the types of transducers used in biosensors? What are bioreceptor molecules? How are bioreceptor molecules attached to the transducers, i.e. immobilised? What are the most important factors that govern the performance of a biosensor? In what areas have biosensors been applied?

SSCB 4713 GENOMICS AND PROTEOMICS

Students will learn the fundamental concepts of genomics and proteomics. Lectures will cover the structure, function and evolution of the human genome, strategies for large-scale sequencing projects, Human disease genes and expression. Bioinformatics for the analysis of sequence data; approaches for determining gene expression patterns and

functions Will be explained in addition to protein/peptide separation techniques, protein mass spectrometry, bioinformatics tools, and biological applications which include quantitative proteomics, protein modification proteomics, interaction proteomics, structural genomics and structural proteomics.

SSCB 3723 GENE EXPRESSION

This course is designed to allow students to understand the molecular mechanisms in gene expression and regulation in both prokaryotes and eukaryotes. A brief introduction and an overview on molecular genetics will be included. Regulation and control of gene expression will be discussed using selected operons as model.

SSCB 3133 NUTRITIONAL BIOCHEMISTRY

This course is designed to expose students to the knowledge and understanding of food and nutrition. Food are substances that can be metabolized and used by organism while nutrition is the usage of food and other nourishing material by body or living organism. The metabolism of macronutrient, micronutrient and functional food as well as the influence of nutrition in cell growth and gene function will be explain.

SSCB 3623 EXTREMOPHILES

This course will give a broad overview of how life can not only survive, but thrive and flourish under conditions considered to be 'extreme' in the human sense. More specifically this course will describe the environments where these organisms reside and shed light, at the molecular level, on the mechanisms that enable these unique organisms to survive. Covering all known types of extremophiles (including thermophiles, psychrophiles, halophiles, acidophiles, piezophiles, and alkaliphiles).

SSCB 3213 BIOLOGICAL CONTROL AND ENVIRONMENTAL CONSERVATION

This course discussed about principle and philosophy of biological control agents and methods in implementing this technique, in order to develop alternatives for conventional pesticides that may be more acute in some commodities than in others. Various specific aspects in this course are; i) the conceptual of agents (types and mechanisms) and targets on quantitative techniques, ecology and behavior of selected natural enemies, ii) measures focus on beneficial arthropods, entomopathogenic nematodes, viruses and microorganisms, iii) as well as on the interaction between crop, pest and beneficial organisms, iv) the future and factors that limit the biological control. The study case and current issues also will be discussed to guarantee the student alert with the effectiveness and benefit of this application. It is useful in encouraging student ability in debating biological control function of cultural and natural ecosystem management.

SSCB 3703 MOLECULAR BIOTECHNOLOGY

This course covers the principle and application of biotechnology in industry as well as current issues involved in molecular biotechnology. The course will introduce genetic engineering basically from the perspective of advantages, strategies and the products. Some of the biotechnology products can be commercialized will be discussed as well. Production of transgenic plants and transgenic animals will be discussed in greater details especially on molecular techniques involved. Subsequently the course deals with an introduction to eugenics, human genetic engineering and human cloning, techniques in gene therapy with its application. This course will also include an introduction to intellectual property, permission for usage, protection as well as benefits and relationship between biotechnology and intellectual property and current issues involved in biotechnology from various field.

SSCB 3633 FOOD MICROBIOLOGY

This course will emphasize on the study of both beneficial and detrimental effects of micro-organisms in food. Initially this course will introduce the types of micro-organisms found in food, factors that affect their survival and growth in foods, and effects of microbial growth in foods. Discussion focuses on micro-organisms related to food spoilage and food preservation. Disease-causing micro-organisms are studied in the context of food safety. General principles of food preservation, contamination and food deterioration will be discussed in greater details. Pathogenic microorganisms and useful microbes in food will be differentiated for the industrial application. The purpose and importance of Hazard Analysis Critical Control Point (HACCP) in promoting food safety is addressed. Relationship of Good Manufacturing Practices (GMP) to HACCP is discussed. Halal issues are also addressed in relation to food safety.

SSCB 4723 GENE THERAPY

The course will introduce the students to the background and basic principles of gene therapy. Current gene therapy approaches and strategies which include the use of a variety of vectors useful for gene delivery and non-viral vectors. Among the diseases of interest used as models are cystic fibrosis, cancer, ADA, AIDS and SCID. The advantages, limitation, ethical issues, clinical trial and future of gene therapy will also be discussed.

SSCB 4743 SYNTHETIC BIOLOGY

Pre-requisite: SSCB 2713 Genetic Engineering

This course offers an introduction to synthetic biology. It is designed for final year students who have an interest in bioengineering at the cellular network level. Students will be introduced to the field of synthetic biology and its application in systems biology and applied engineering. Students will be taught in quantitative terms the basic principles of operation of regulation at the cellular level, including metabolic, signaling and gene networks; discover how cellular networks can be reengineered, applications in metabolic engineering; building computer models of cellular networks systems and how these can be modeled and studied experimentally. By the end of the course, students will be able to make explain the network's possible dynamic behavior using simple visual inspection of a network structure.

SSCB 4333 TOXICOLOGY

An introductory toxicology course emphasizing on principles and applications of toxicology. Techniques of measuring toxicity, differentiating ecotoxicity tests and bioassays. Characterization of natural and chemical toxins. Natural toxins are those produced by microorganisms and plants; toxins produced by a variety of microorganisms such as bacterial toxins, marine toxins, aflatoxin and phytotoxins will also be discussed. While, chemical toxins/pollutants will include polar and non-polar organic compounds such as insecticides, pesticides and oxidants. Toxicity due to heavy metals and radionuclides will also be included apart from physical, chemical and biological factors that can influence the dose-response relationships. Chemical and biological transformation of toxins; and the ecological, toxicological, and molecular biological responses associated with exposure. Case studies focusing on toxicity effects of natural and chemical toxins on human health, animals and other biological systems will be discussed.

SSCB 4733 SYSTEMS BIOLOGY

This course offers an introduction to systems biology. This course is designed for students who have an interest in bioengineering at the cellular network level. Students will be introduced to the field of systems biology and its application in applied engineering. Students will understand in quantitative terms the basic principles of operation of regulation at the cellular level, including metabolic, signaling and gene networks; discover how cellular networks can

be reengineered and its applications such as metabolic engineering; learn how to build computer models of cellular networks and how these can be modeled and studied experimentally. By the end of the course students will be able to make statements on the network's possible dynamic behavior.

SSCB 4803 STRUCTURAL BIOLOGY

This course will provide an understanding of basic and applied aspects of macromolecular structure including structure-function relationships and structure determination techniques. This course will provide knowledge that would enable students to interpret typical structural data in terms of biological function, and to use structural data bases. Finally, this course will provide the students with knowledge of the applications of structural biology in the areas of biotechnology and in particular in the field of drug design and discovery.

SSCB 4113 APPLIED MICROBIAL BIOCHEMISTRY AND BIOTRANSFORMATION

Pre-requisite: SSCB 1123 Cellular Biochemistry and Metabolism

Discussion on the physiology of microorganisms, primary metabolic pathways, microbial metabolic diversity and secondary metabolism in microorganisms. The secondary metabolites with important application to health, industries and the environment will be described. In addition, microbial transformation of synthetic and naturally occurring recalcitrant molecules will be explained and outlined. Heavy metals biotransformation will also be included.

SSCB 4813 PROTEIN SEPARATION TECHNIQUES IN BIOTECHNOLOGY

In this course, fundamental knowledge of protein structure: primary, secondary, tertiary and quaternary structures as well as chemical characteristics of proteins will be discussed. Different techniques of extraction and purification will be described. The efficiency of the protein purification technique is then evaluated in order to maximize protein recovery and purity.

**ACADEMIC STAFF
FACULTY OF SCIENCE**

DEPARTMENT OF CHEMISTRY

DEPARTMENT OF MATHEMATICAL SCIENCES

DEPARTMENT OF PHYSICS

DEPARTMENT OF BIOSCIENCE