**PROGRAMME 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 Higher Education<br>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-govern | |
| **10. Study Scheme (Full Time/Part Time)** | | | Full Time | |
| **11. Study Duration** | | | Minimum : 4 yrs<br>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** | Fulfills University requirements and the following program requirements:<br><br>STPM/ MATRICULATION/SCIENCE FOUNDATION<br><br>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. | | | |

**13. Program Educational Objectives (PEO)**

The objectives of Bachelor of Science in Chemistry are to provide the knowledge, skills, and attributes that should be achieved by the graduate for a successful carrier. The program is designed to:

1. prepare graduates who are able to apply their knowledge and generate new knowledge in chemistry relevant to the nation development.
2. educate graduates to conduct research to solve current and future issues for the development and betterment of the nation and mankind.
3. train graduates who are able to apply their knowledge and skills in the planning, analysis, design and supervision of works related to the fundamental areas of chemistry.
4. develop graduates who are technically competent in solving problems logically, analytically and creatively based on sound facts and ideas.
5. train graduates to possess leadership, ethical and professional qualities contributing towards the development of the nation and mankind.
6. prepare graduates who are able to work collectively in societies of diverse backgrounds to achieve common goals.
7. train graduates who are able communicate effectively across a range of contacts and audiences.

| **14. Program Learning Outcomes (PO)** | | | |
|---|---|---|---|
| **(a) Technical Knowledge and Competencies** | | | |
| **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 chemistry 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 chemistry knowledge and skill** | Ability to apply, practice and analyze fundamental laws, principles of chemistry and chemical techniques using scientific methodologies related to chemical application. (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 presentation, group project, and computer simulation. |
| **PO3 Scientific Study and Research** | Ability to plan, evaluate and demonstrate scientific studies and research related to chemistry. (C6, P6, A3) | Lectures, laboratory works, assigned reading, group discussion and problem solving assignments, Hands on instrumentations, chemistry related softwares 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 & Problem Solving** | Ability to learn independently and demonstrate knowledge and understanding of chemical principles, theories and evaluate current research (P4) | Independent research projects, group research projects, research training | Independent project report, laboratory report, final year project report |
| **PO5 Communication Skills** | Ability to present technical, scientific and chemical information and arguments clearly and correctly, in writing and orally to a range of audience (P4) | Group project, independent research, individual assignment, research training | Oral presentation, written assignment, laboratory report, final year project report |
| **PO6 Team Working** | 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) | Tutorials, laboratory works, group assignments. | Laboratory report and group presentation |

| | | | |
|---|---|---|---|
| **PO7 Lifelong Learning and Information Management** | Ability to seek new knowledge, skills and manage relevant information from various sources (A3) | Tutorials, research projects, laboratory works | Laboratory report, research project report |
| **PO8 Leadership** | Ability to demonstrate leadership, to take action and to get others involved (A3) | Group assignments and presentations. | Group assignment report and presentation |
| **PO9 Ethics and Integrity** | Ability to act with integrity and good ethics in their profession and their obligation to society (A3) | Examination, individual assignment and individual research projects | Report and seminar presentation |
| **PO10 Entrepreneurship** | Awareness of business, entrepreneurship opportunities (P2) | Final year projects, laboratory works, research training. | Written assignment, laboratory report, essay, final year project report. |

**15. Classification of Courses**

| No. | Classification | Credit Hours | Percentage (%) |
|---|---|---|---|
| (i) | Basic Sciences and Mathematics | 13 | 58.5 |
| (ii) | Program core | 62 | |
| (iii) | Program Elective | 33 | 25.8 |
| (iv) | Compulsory university Courses<br>• Humanity<br>• English Language<br>• Co-curriculum<br>• Entrepreneurship | <br>10<br>6<br>2<br>2 | 15.7 |
| | **1.1 Total** | **128** | **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) Lecture | 76 | 59.4 |
| | (b) Laboratory/Workshop/Field | 9 | 7.0 |
| | (c) Research Training | 5 | 3.9 |
| | (d) Final Year Project | 6 | 4.7 |
| | **Total credit hours for Part A** | **96** | 75.0 |
| B. | Related Courses | | |
| | (a) Mathematics | 12 | 9.4 |
| | (b) Humanities/Ethics | 10 | 7.8 |
| | (c) Service learning | 2 | 1.6 |
| | (d) English | 6 | 4.6 |
| | (e) Entrepreneurship | 2 | 1.6 |
| | **Total credit hours for Part B** | **32** | 25.0 |
| | Total credit hours for Parts A and B | 128 | 100 |

| | |
|---|---|
| **16. Total credit hours to graduate** | **128 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 128 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 Courses** | **cr** | **Code** | **Name of Courses** | **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 | SSCM1033 | Mathematical Methods II | 3 |
| SSCM 1023 | Mathematical Methods 1 | 3 | ULAB1122 | Academic English Skills | 2 |
| | | | UHAS 1172 | Malaysia Dynamics* | 2 |
| | | | UHAS1162/ UHAK1022 | Arts, Customs and Beliefs* | |
| | | | UHAK 1032 | Introduction to Entrepreneurship | 2 |
| **Total credit hours** | | **15** | **Total credit hours** | | **17** |
| *** UHAS 1172 : Local Student** | | | | | |

*** UHAS 1162 : Foreign Student**

| **SEMESTER 3** | | | **SEMESTER 4** | | |
|---|---|---|---|---|---|
| **Code** | **Name of Courses** | **cr** | **Code** | **Name of Courses)** | **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 Management and Safety | 2 | SSCC 2861 | Analytical Chemistry Practical I | 1 |
| UICL 2302 | Scientific and Technological Thinking | 2 | UHAK 1012 | Graduate Success Attributes | 2 |
| **Total credit hours** | | **15** | **Total credit hours** | | **15** |

| SEMESTER 5 | | | SEMESTER 6 | | |
|---|---|---|---|---|---|
| UKQA 2092 | Science and Community | 2 | SSCC 3643 | Application of Spectroscopy | 3 |
| SSCC 3233 | Instrumental Analysis | 3 | SSCC 3463 | Quantum Chemistry | 3 |
| SSCC 3871 | Analytical Chemistry Practical II | 1 | SSCU 3623 | Research Methodology and Information Retrieval | 3 |
| SSCC 3323 | Principles of Polymer Chemistry | 3 | **Elective (Choose 6 credits)** | | |
| ULAB 3162 | English for Professional Purposes | 2 | *SSCC 3533* | *Applications of Computer in Chemistry* | 3 |
| UHAK 2**2 | Soft Skills Elective | 2 | *SSCC 3743* | *Materials Chemistry* | 3 |
| | | | *SSCC 3493* | *Surface and Colloid Chemistry* | 3 |
| | | | *SSCC 3243* | *Separation Methods* | 3 |
| | | | *SSCC 3693* | *Metabolism of Biomolecules* | 3 |
| | | | ULA* 1112 | Foreign Language Elective | 2 |
| **Total credit hours** | | **13** | **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 Courses** | **cr** | **Code** | **Name of Courses** | **cr** |
| SSCU 4902 | Undergraduate Project I | 2 | SSCU 4904 | Undergraduate Project II | 4 |
| **Elective (Choose 15 credits)** | | | **Elective (Choose 12 credits)** | | |

| | | | | | |
|---|---|---|---|---|---|
| *SSCC 4233* | *Analytical Electrochemistry* | 3 | *SSCC 4263* | *Thermal Analysis* | 3 |
| *SSCC 4363* | *Green Chemistry* | 3 | *SSCC 4473* | *Solid State Chemistry* | 3 |
| *SSCC 4443* | *Chemical Reactions Process* | 3 | *SSCC 4653* | *Organic* Synthesis | 3 |
| *SSCC 4723* | *Organo*metallic Chemistry | 3 | *SSCC 4603* | *Medicinal Chemistry* | 3 |
| *SSCC 4733* | *Radiochemistry* | 3 | *SSCC 4763* | *Nanochemistry* | 3 |
| *SSCC 4633* | *Heterocyclic Chemistry* | 3 | *SSCC 4773* | *Inorganic and Organometallic Polymers* | 3 |
| *SSCC 4203* | *Sensors* | 3 | *SSCC 4393* | *Special Topic in Chemistry* | 3 |
| *SSCC 4213* | *Environmental Chemistry* | 3 | *SSCC 4543* | *Modeling and Simulation* | 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 | Critical Thinking and Problem Solving | Communication Skills | Team working | Lifelong Learning | Leadership | Integrity | Entrepreneurship |
| **Code** | **Courses** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| **Core Courses** | | | | | | | | | | | |
| SSCC 1322 | Introduction to Chemistry Program | ✓ | | | | ✓ | | ✓ | | | |
| SSCC 1003 | Principles of Chemistry | ✓ | ✓ | | | ✓ | | | | | |
| SSCC 1901 | Chemistry Practical | ✓ | ✓ | | | | | | | | |
| SSCC 1703 | Inorganic Chemistry | ✓ | ✓ | | | ✓ | | | | | |
| SSCC 1851 | Inorganic Chemistry Practical I | ✓ | ✓ | | ✓ | | ✓ | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SSCM 1023 | Mathematical Methods I | ✓ | ✓ | | | | | | | | |
| SSCM 1103 | Statistics | ✓ | ✓ | | | | | | | | |
| SSCC 1413 | Chemical Thermodynamics | ✓ | ✓ | | ✓ | | | | | | |
| SSCC 1841 | Physical Chemistry Practical I | ✓ | ✓ | | ✓ | | ✓ | | ✓ | | |
| SSCC 1603 | Organic Chemistry – Functional Groups | ✓ | ✓ | | | ✓ | | | | | |
| SSCC 1821 | Organic Chemistry Practical I | ✓ | ✓ | | ✓ | | | | | | |
| SSCM 1023 | Mathematical Methods II | ✓ | ✓ | | | ✓ | | | | | |
| SSCC 2613 | Organic Chemistry – Biomolecule | ✓ | ✓ | | | | | ✓ | | | |
| SSCC 2891 | Organic Chemistry Practical II | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ |
| SSCC 2453 | Chemical Kinetics and Electrochemistry | ✓ | ✓ | | ✓ | | | | | | ✓ |
| SSCC 2841 | Physical Chemistry Practical II | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | | ✓ |
| 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 | ✓ | ✓ | | | | | | √ | | |
| SSCU 3623 | Research Methodology and Information Retrieval | ✓ | ✓ | | | | | ✓ | | ✓ | |
| SSCC 3463 | Quantum Chemistry | ✓ | ✓ | ✓ | ✓ | | | | | | |
| SSCU 3915 | Research Training | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ |
| SSCU 4902 | Undergraduate Project I | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | |
| SSCU 4904 | Undergraduate Project II | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | |
| **Elective Courses** | | | | | | | | | | | |
| SSCC 3243 | Separation Methods | ✓ | ✓ | ✓ | | | | ✓ | | | |
| SSCC 3533 | Application of Computer in Chemistry | ✓ | ✓ | ✓ | | | | | | ✓ | |
| SSCC 3643 | Application of Spectroscopy | ✓ | ✓ | | | | | | | ✓ | |
| SSCC 4723 | Organometallic Chemistry | ✓ | ✓ | ✓ | | | | ✓ | | | |
| SSCC 4233 | Analytical Electrochemistry | ✓ | ✓ | | | | | ✓ | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SSCC 4493 | Surface and Colloid Chemistry | ✓ | ✓ | | | ✓ | | | | | |
| SSCC 4773 | Inorganic and Organometallic Polymers | ✓ | ✓ | | | | ✓ | | | | |
| SSCC 4443 | Chemical Reactions Process | ✓ | ✓ | | | | | | | | ✓ |
| SSCC 4653 | Organic Synthesis | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ |
| SSCC 4473 | Solid State Chemistry | ✓ | ✓ | | ✓ | | | | | | |
| SSCC 4693 | Metabolism of Biomolecules | ✓ | ✓ | ✓ | | | ✓ | | | | |
| SSCC 4763 | Nanochemistry | ✓ | ✓ | ✓ | | | | ✓ | | | |
| SSCC 4263 | Thermal Analysis | ✓ | ✓ | ✓ | | ✓ | | | | | |
| SSCC 4733 | Radiochemistry | ✓ | ✓ | ✓ | | | ✓ | | | | |
| SSCC 4603 | Medicinal chemistry | ✓ | ✓ | | | | | ✓ | | | |
| SSCC 4363 | Green Chemistry | ✓ | ✓ | | | | | | | ✓ | |
| SSCP 4403 | Microscopy and Material Analysis | ✓ | ✓ | | | | | | ✓ | | |
| SSCP 4453 | Low Temperature Physics and Superconductivity | ✓ | ✓ | ✓ | | | ✓ | | | | |
| **University Courses** | | | | | | | | | | | |
| UICI 1012 | Islamic and Asian Civilizations (TITAS) | ✓ | | | ✓ | | | | | ✓ | |
| UHAS 1172 | Malaysia Dynamics | | | | | | | | | | |
| UHAS 1162 | Arts, Custom and Belief of Malaysian | | | | | | | | | | |
| ULAM 1112 | Bahasa Malaysia | | | | | | | | | | |
| UICI 2022 | Science, Technology and Humanity | | | | | | | | | | |
| UHAS 2122 | Critical and Creative thinking | ✓ | | | ✓ | ✓ | | | | | |
| UKQU 2202 | Innovation and creativity | | | | | | | | | | |
| UHAS 2092 | Professional Ethics | ✓ | | | | ✓ | | | | ✓ | |
| UHAS 2032 | Technocrat and Development | | | | | | | | | | |
| UHAS 3012 | Entrepreneurship and Enterprise Development | ✓ | | | | ✓ | | | | | ✓ |
| ULAB 1122 | English for Academic Communications | ✓ | | | | ✓ | | ✓ | | | |
| ULAB 2122 | Advanced English for Academic Skills | ✓ | | | | ✓ | | | | | |
| UKQL 3012 | Service Learning | ✓ | | | | ✓ | ✓ | | | | |

**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.

**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. High Resolution Nuclear Magnetic Resonance Spectrometer
2. Solid State Nuclear Magnetic Resonance Spectrometer
3. Gas Chromatography-Mass Spectrometer System
4. Fourier Transform Infrared Spectrometers
5. Gel Permeation Chromatograph
6. UV-Visible Spectrometers
7. Diffuse-Reflectance UV-Visible Spectrophotometer
8. High Performance Liquid Chromatograph
9. Gas Chromatograph
10. Atomic Absorption Spectrometer
11. Scanning Electron Microscope
12. Field Emission Scanning Electron Microscope
13. Transmission Electron Microscope

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14. Ion Chromatograph
15. Capillary Electrophoresis Unit
16. Single point BET Surface Area Analyzer
17. Multipoint Surface Analyzer
18. Differential Scanning Calorimeter
19. Thermogravimetry Analyzer
20. Voltammetric System
21. Fluorescence Spectrometer
22. Surface Adsorption/Desorption System
23. Total Organic Carbon Analyzer
24. Flame Photometer
25. Electron Spin Resonance Spectrometer
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

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

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

3 Lecturer's performance
a. Teaching evaluation by students (e-PPP)
b. Competency check-list for staff (CS).
c. Annual staff appraisal (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
   - 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 |
| 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 | Head of Dept |
| Employer Survey | x | x | x | x | x | x | x | x | x | x | Once/ year | Head of Dept |

**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 Higher Education<br>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<br>Maximum : 6 yrs | |
| Type of Semester | No. of semester | | No. of weeks per semester | |
| | Full Time | Part Time | Full Time | Part Time |
| Normal | 8 | 8 | 14 | 14 |
| Short | - | 4 | - | 6 |
| | | | | |
| **12. Entry Requirement** | Fulfills University requirements and the following program requirements:<br><br><u>STPM/MATRICULATION/SCIENCE FOUNDATION</u><br><br>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<br><br><u>DIPLOMA</u><br><br>Minimum CGPA of 3.00 and passed with credits in Mathematics in the SPM/equivalent examination. | | | |

**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 program is designed to:

8. educate graduates who continually use and seek out new knowledge and skills in the planning, analysis, design and supervision of works related to the chemistry discipline.
9. train graduates who are able to find out immediate solutions related to current industrial chemistry issues for the development and betterment of the nation and the world.
10. educate graduates who are able to analyze and identify business opportunities and embark on entrepreneurship.
11. prepare graduates who are able to contribute in a team or a group involved in chemical industrial projects.
12. train graduates to be a leader in an organization with good leadership, ethics and professional qualities for the development of the nation and mankind.
13. prepare graduates who are able to work collectively in societies of diverse backgrounds to achieve common goals.
14. prepare graduates who are able to communicate effectively across a range of contacts and audiences.

| **14. Program Learning Outcomes** | | | |
|---|---|---|---|
| **Code** | **Intended Learning Outcomes** | **Teaching and Learning Methods** | **Assessment** |
| **(a) Technical Knowledge and Competencies** | | | |
| **PO1 Fundamental knowledge** | 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, P2, A2) | Lectures, tutorials, laboratory works, directed reading, group discussion | Examination, test, quiz, and laboratory report. |
| **PO2 Application of Chemistry knowledge and skills** | Ability to apply, practice and analyze fundamental laws and principles of chemistry using scientific methodologies related to industrial application (C4, P4, A3) | Lectures, laboratory works, assigned reading, group discussion and problem solving assignments, hands-on instrumentations, and chemistry related softwares. | Examination, test, quiz, assignment, laboratory report, oral presentation and group project, |
| **PO3 Analyzing and experimentation skills** | Ability to plan, evaluate and demonstrate scientific study related to industrial chemistry (C6, P6, A3) | Lectures, laboratory work, 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** | | | |
| **PO4 Critical Thinking and Problem Solving** | Ability to practice knowledge and skills of chemical principles and theories to solve scientific problems. (P4) | Independent research projects, group research projects, industrial training | Independent project report, individual assignment report and industrial training report |
| **PO5 Communication Skills** | 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 |
| **PO6 Team Working** | 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 |

| | | | |
|---|---|---|---|
| **PO7 Lifelong learning and Information Management** | Ability to 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 |
| **PO8 Leadership skills** | Ability to demonstrate leadership, to take actions and to influence others in order to achieve common goals. (A3) | Group assignment, laboratory work | Group assignment report and laboratory report |
| **PO9 Ethics and Integrity** | Ability to adapt ethical values with integrity in their profession and their obligation to society. (A3) | Lecture, Individual assignment, Laboratory work, Final Year Project and industrial training | Laboratory Report, individual assignment report, seminar presentation and final year project report |
| **PO10. Entrepreneurship** | Awareness of business, entrepreneurship and career opportunities. (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 | 13 | 58.5 |
| 2 | Program core | 62 | |
| 3 | Program Elective | 33 | 25.8 |
| 4 | Compulsory university courses<br>• Humanity<br>• English Language<br>• Co-curriculum<br>• Entrepreneurship | <br>10<br>6<br>2<br>2 | 15.6 |
| | **1.2 Total** | **128** | **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) Lecture | 70 | 54.7 |
| | (b) Laboratory/Workshop/Field | 9 | 7.0 |
| | (c) Industrial Training | 5 | 3.9 |
| | (d) Final Year Project | 6 | 4.7 |
| | **Total credit hours for Part A** | **93** | **70.3** |
| B. | Related Courses | | |
| | (a) Mathematics | 9 | 7.0 |
| | (b) Humanities/Ethics | 10 | 7.8 |
| | (c) Co-Curriculum | 2 | 1.6 |
| | (d) English | 6 | 4.7 |
| | (e) Entrepreneurship | 2 | 1.6 |
| | (f) Management | 9 | 7.0 |
| | **Total credit hours for Part B** | **38** | **29.7** |
| | **Total credit hours for Parts A and B** | **128** | **100%** |

| | |
|---|---|
| **16. Total credit hours to graduate** | **128 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 **128** 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** |
| 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 |
| | | | UHAS 1162/ UHAK 1022 | Arts, Custom and Belief* | 2 |
| | | | UHAK 1032 | Introduction to Entrepreneurship | 2 |
| **Total credit hours** | | **15** | **Total credit hours** | | **17** |
| *** UHAS 1172 : Local Student**<br>*** UHAS 1162 : Foreign Student** | | | | | |
| **SEMESTER 3** | | | **SEMESTER 4** | | |
| **Code** | **Name of Courses** | **cr** | **Code** | **Name of Courses** | **cr** |
| SSCC 2613 | Organic Chemistry - | 3 | ULAB 2122 | Advanced Academic English | 2 |

| | | | | | |
|---|---|---|---|---|---|
| | Biomolecules | | | Skills | |
| 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 System and Management | 2 | SSCC 2243 | Principles of Analytical Chemistry | 3 |
| SSCM 1103 | Statistics | 3 | SSCC 2861 | Analytical Chemistry Practical I | 1 |
| UICL 2302 | Scientific and Technological Thinking | 2 | UHAK 1012 | Graduate Success Attributes | 2 |
| **Total credit hours** | | **15** | **Total credit hours** | | **15** |

| **SEMESTER 5** | | | **SEMESTER 6** | | |
|---|---|---|---|---|---|
| **Code** | **Name of Courses** | **cr** | **Code** | **Name of Courses** | **cr** |
| SSCC 3233 | Instrumental Analysis | 3 | SSCC 3423 | Industrial Chemical Process | 3 |
| SSCC 3871 | Analytical Chemistry Practical II | 1 | SSCU 3623 | Research Methodology and Information Retrieval | 3 |
| SSCC 3213 | Environmental Chemistry | 3 | UKQA 2092 | Science and Community | 2 |
| SHAS 1043 | Organizational Behaviors | 3 | ULA* 1112 | Foreign Language Elective | 2 |
| ULAB 3162 | English for Professional Purposes | 2 | **Elective (Choose 6 credits)** | | |
| UHAK 2**2 | Soft Skills Elective | 2 | SSCC 3643 | Application of Spectroscopy | 3 |
| | | | SSCC 3353 | Consumer Chemistry | 3 |
| | | | SSCC 3493 | Surface and Colloid Chemistry | 3 |
| | | | SSCC 3243 | Separation Methods | 3 |
| | | | SSCC 3533 | Applications of Computer in Chemistry | 3 |

| | | | | | |
|---|---|---|---|---|---|
| | | | SSCC 3463 | Quantum Chemistry | 3 |
| **Total credit hours** | | **14** | **Total credit hours** | | **16** |

| **SHORT SEMESTER** | | |
|---|---|---|
| **Code** | **Name of Course** | **cr** |
| SSCU 3905 | Industrial Training (HW) | 5 |
| **Total credit hours** | | **5** |

| **SEMESTER 7** | | | **SEMESTER 8** | | |
|---|---|---|---|---|---|
| **Code** | **Name of Courses** | **cr** | **Code** | **Name of Courses** | **cr** |
| SSCU 4902 | Undergraduate Project 1 | 2 | SSCU 4904 | Undergraduate Project II | 4 |
| **Elective (Choose 15 credits)** | | | **Elective (Choose 12 credits)** | | |
| SSCC 4273 | Forensic Science | 3 | SSCC 4753 | Catalytic Chemistry | |
| SSCC 4323 | Principles of Polymer Chemistry | 3 | SSCC 4253 | Food Analysis | 3 |
| SSCC 4663 | Natural Product Chemistry | 3 | SSCC 4673 | Industrial Organic Chemistry | 3 |
| SSCC 4483 | Corrosion Chemistry | 3 | SSCC 4303 | Oleochemistry | 3 |
| SSCC 4683 | Biotechnology | 3 | SSCC 4423 | Liquid Crystal | 3 |
| SSCC 4793 | Inorganic Energy Material | 3 | SSCC 4383 | Special Topic in Industrial Chemistry | 3 |
| SSCC 4333 | Petrochemistry | 3 | SSCP 3433 | Quality Control | 3 |
| SSCC 4293 | Radioanalytical Chemistry | 3 | | | |
| SHAC 1023 | Cost Accounting | 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 | Critical Thinking and Problem Solving | Communication Skills | Team working | Lifelong Learning | Leadership | Integrity | Entrepreneurship |
| **Code** | **Courses** | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| **Core Courses** | | | | | | | | | | | |
| SSCC 1322 | Introduction to Chemistry Program | ✓ | | | | ✓ | | ✓ | | | |
| SSCC 1003 | Principles of Chemistry | ✓ | ✓ | | | ✓ | | | | | |
| SSCC 1901 | Chemistry Practical | ✓ | ✓ | | | | | | | | |
| SSCC 1703 | Inorganic Chemistry | ✓ | ✓ | | | ✓ | | | | | |
| SSCC 1851 | Inorganic Chemistry Practical I | ✓ | ✓ | | ✓ | | ✓ | | | | |
| SSCM 1023 | Mathematical Methods I | ✓ | ✓ | | | ✓ | | | | | |
| SSCM 1113 | Statistics | ✓ | ✓ | | | | ✓ | | | | |
| 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 | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | | ✓ |
| 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 2831 | Analytical Chemistry Practical I | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | | |
| SSCC 3233 | Instrumental Analysis | ✓ | ✓ | ✓ | | | | | | ✓ | |
| SSCC 3871 | Analytical Chemistry Practical II | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | |
| SSCC 3323 | Principles of Polymer Chemistry | ✓ | ✓ | | | | | | ✓ | | |
| SSCU 3623 | *Research Methodology and Information Retrieval* | ✓ | ✓ | | | | | ✓ | | ✓ | |
| SSCC 3463 | Quantum Chemistry | ✓ | ✓ | ✓ | ✓ | | | | | | |
| SSCU 3915 | Research Training | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ |
| SSCU 4902 | Undergraduate Project I | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | |
| SSCU 4904 | Undergraduate Project II | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | |
| **Elective Courses** | | | | | | | | | | | |
| SSCC 3283 | *Separation Methods* | ✓ | ✓ | ✓ | | | | ✓ | | | |
| SSCC 3533 | Application of Computer in Chemistry | ✓ | ✓ | ✓ | | | | | | ✓ | |
| SSCC 3643 | Application of Spectroscopy | ✓ | ✓ | | | | | | | ✓ | |
| SSCC 4723 | Organometallic Chemistry | ✓ | ✓ | ✓ | | | | ✓ | | | |
| SSCC 4233 | *Analytical Electrochemistry* | ✓ | ✓ | | | | | ✓ | | | |
| SSCC 4493 | *Surface and Colloid Chemistry* | ✓ | ✓ | | | ✓ | | | | | |
| SSCC 4773 | *Inorganic and Organometallic Polymers* | ✓ | ✓ | | | | ✓ | | | | |
| SSCC 4443 | *Chemical Reactions Process* | ✓ | ✓ | | | | | | | | ✓ |
| SSCC 4653 | *Organic Synthesis* | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ |
| SSCC 4473 | *Solid State Chemistry* | ✓ | ✓ | | ✓ | | | | | | |
| SSCC 4693 | *Metabolism of Biomolecules* | ✓ | ✓ | ✓ | | | ✓ | | | | |
| SSCC 4763 | *Nanochemistry* | ✓ | ✓ | ✓ | | | | ✓ | | | |
| SSCC 4263 | *Thermal Analysis* | ✓ | ✓ | ✓ | | ✓ | | | | | |
| SSCC 2733 | *Radiochemistry* | ✓ | ✓ | ✓ | | | ✓ | | | | |
| SSCC 4603 | *Medicinal Chemistry* | ✓ | ✓ | | | | | ✓ | | | |
| SSCC 4363 | *Green Chemistry* | ✓ | ✓ | | | | | | | ✓ | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SSCP 4403 | *Microscopy and Material Analysis* | ✓ | ✓ | | | | | | ✓ | | |
| SSCP 4453 | *Low Temperature Physics and Superconductivity* | ✓ | ✓ | ✓ | | | ✓ | | | | |
| **University Courses** | | | | | | | | | | | |
| UICI 1012 | Islamic and Asian Civilizations (TITAS) | | | | | | | | | | |
| UICI 2022 | Science, Technology and Humanity | | | | | | | | | | |
| UKQU 2202 | Innovation and Creativity | ✓ | | | | ✓ | | | | ✓ | |
| UHAS 1172 | Malaysia Dynamics | | | | | | | | | | |
| UHAS 1162 | Arts, Custom and Belief of Malaysian | | | | | | | | | | |
| ULAM 1112 | Bahasa Malaysia | | | | | | | | | | |
| UHAS 2032 | Technocrate and Development | | | | | | | | | | |
| UHAS 2092 | Professional Ethics | | | | | | | | | | |
| UHAS 2122 | Critical and Creative thinking | | | | | | | | | | |
| UHAS 3012 | Entrepreneurship and Enterprise Development | ✓ | | | | ✓ | | | | | |
| ULAB 1122 | Academic English Skills | ✓ | | | ✓ | ✓ | | | | | |
| ULAB 2122 | Advanced English Academic Skills | | | | | | | | | | |
| ULAB 3162 | English for Professional Purposes | | | | | | | | | | |
| UQL3012 | Service Learning | ✓ | | | | ✓ | ✓ | | | | |

**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. UTM Degree ++ Program**

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
2. Solid State Nuclear Magnetic Resonance Spectrometer
3. Gas Chromatography-Mass Spectrometer System
4. Fourier Transform Infrared Spectrometers
5. Gel Permeation Chromatograph
6. UV-Visible Spectrometers
7. Diffuse-Reflectance UV-Visible Spectrophotometer
8. High Performance Liquid Chromatograph
9. Gas Chromatograph
10. Atomic Absorption Spectrometer
11. Scanning Electron Microscope
12. Field Emission Scanning Electron Microscope
13. Transmission Electron Microscope
14. Ion Chromatograph
15. Capillary Electrophoresis Unit
16. Single Point BET Surface Area Analyzer
17. Multipoint Surface Analyzer
18. Differential Scanning Calorimeter

19. Thermogravimetry Analyzer
20. Voltammetric System
21. Fluorescence Spectrometer
22. Surface Adsorption/Desorption System
23. Total Organic Carbon Analyzer
24. Flame Photometer
25. Electron Spin Resonance Spectrometer
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

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

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

3. Lecturer's performance
   d. Teaching evaluation by students (e-PPP)
   e. Competency check-list for staff (CS).

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) standards

| | |
|---|---|
| f. Annual staff appraisal (LPPT) | |

**26. Regulation of Assessment**

(a) Summary of grades and marks

(b)

| ***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 |
| 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. |

## SYNOPSES OF CHEMISTRY COURSES

**SSCC 1003 – Principles of Chemistry**
This course aims to strengthenand enhance the knowledge on principles of chemistry before students proceed to more specialized and higher level chemistry courses. The first part of this course exposes students to fundamentals of atoms and molecules and chemical bonding, 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 chemical reactions. The last part of this course emphasizes on the fundamental knowledge of organic chemistry and introduces students to the concept of green chemistry.

**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 (SSCE/ SSCM)**
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.

**SSCM 1303 – Computer Literacy**
This course introduces basic computer data processing with no computer background required or assumed. It provides a general knowledge about computing including the what, the do's, the don'ts and its operation. The emphasis is on developing skills in handling Microsoft Office such as MS Word, MS PowerPoint, MS Excel and MS Office. Mathematical Software such as Maple and SPSS will also be introduced.

**SSCC 1322 – Introduction to Chemistry Program**
The course provides students with the understanding of the role of chemists and the relationship between chemistry and society so that they can make reasoned judgements on issues that are affected by the processes and products of chemistry. The students will be introduced to the role of the chemist in researching, analyzing and developing chemistry knowledge and products for the purpose of benefiting mankind and for sustaining the world. The course also discusses research and development of chemistry and career prospects for chemistry graduates. Part of the course also provide students with the view of the foundation of chemistry through their applications to every day lives specifically in the topics of chemistry and the environment, green chemistry, food chemistry, chemistry of household products, cosmetics and personal care, medicines, drugs and crime. Development of the students' study and generic skills essential for a successful graduate and qualified professional chemist is also addressed.

**SSCC 1332 – Introduction to Industrial Chemistry Program**
This course introduces students to the definition and the different fields of the Chemistry, and the relationship between chemistry and society. It also provides students with the understanding of the role of the chemists in providing and using scientific knowledge to make reasoned judgements on issues that are affected by the processes and products of chemistry. The students will be introduced to the aspects of chemistry required for analyzing, developing and managing chemical knowledge and products that are beneficial to mankind and sustainable environment. The management of chemistry research and development and career prospects for industrial chemistry graduates will also be discussed. The course also provides the basic foundation of chemistry for applications to every day lives specifically in the topics of chemistry and the environment, green chemistry, food chemistry, chemistry of household products,

cosmetics and personal care, medicines, drugs and crime. In addition, the development of the students' study and generic skills essential for a successful graduate and qualified professional chemist is introduced

**SSCC 1413 – Chemical Thermodynamics**
The course provides the concepts and principle of physical chemistry, starting with a brief discussion on gases, which include the properties and equation of state of ideal and real gas and continues with the principle of corresponding states. The next topics emhasizes on 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 the Chemical Equilibria will focus on chemical potentials and phase equilibria, which include 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 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 1703 – Inorganic Chemistry**
This course introduces the basic concepts of inorganic chemistry, focusing largely on 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 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 1841 - Physical Chemistry Practical I**
This course is design 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 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 1901 - Chemistry Practical**
This course is designed to improve students' skills in observing chemical reactions, practicing good safety habits, using laboratory apparatus, handling chemicals and performing chemistry experiments. It comprises of chemical laboratory techniques such as glassware calibration, preparation and dilution of solutions, titration, separation, extraction, including data analysis and reporting. Upon completion of the course, students should be able to apply appropriate general chemistry laboratory techniques, draw conclusions and present scientific data in a clear and logical manner.

**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, complexation and redox titrations.

**SSCC 2312 - Laboratory Safety and Management**
The emphasis of this subject is to expose the students to the fundamental concept and theory related to Laboratory Organization and Laboratory Design, Material and Chemical managements, Dangerous Instrumentations, Safety in Laboratory and Chemical Store, Safety Procedures and Documentations. The basic knowledge on Quality Laboratory System, Legal and Environmental Act 1974, Chemistry Act 1975, Machine and Factory Act 1967 and Occupational Safety and Health Act 1994 will also be introduced.

**SSCC 2453 - Chemical Kinetics and Electrochemistry**
This course presents the fundamental concept and the application of chemical kinetics and electrochemistry. The chemical kinetics study includes rate and mechanism of reactions, orders 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. While electrochemistry includes the electrolyte conductivity, theory on conductivity, activity, transport numbers, electrochemical cells and electrode processes and kinetics.

**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 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-dimensioal structures and fundamental concepts of stereochemistry. Infrared spectroscopy is included as a technique in characterizing the functional groups of compounds.

**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 electronic spectra and colour properties of the metal complexes will be explained. The substitution mechanistic pathways of metal complexes and its kinetics and how this mechanism is determined experimentally are illustrated. Spectroscopic characterization techniques of coordination compounds are also covered.

**SSCC 2841 - Physical Chemistry Practical II**
This course is design 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 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 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 2891 - Organic Chemistry Practical II**
This course introduces students to the techniques and knowledge required in the synthesis or preparation of isomeric compounds, *N*-heterocyclic 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 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 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 is first given followed by their basic principles of separation. Major separation methods and its applications discussed include extraction, chromatography and electrophoresis.

**SSCC 3323 - Principles of Polymer Science**
This course is to introduce the students about 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 polymer synthesis, the reaction of monomers to form polymers, copolymers or terpolymers either by chain-growth, step-growth (polycondensation), ring-opening polymerisations. Polymerization mechanisms and polymerization kinetics related to degree of polymerization and molecular weight control and molecular distributions will be discussed in detail. Physical aspect of polymer (polymer structures, morphology, amorphous state and glass-transitions temperature Tg, crystalline state and melting temperature Tm) will also be 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.

**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 balances, basic unit operations, basic separation processes and process controll. Dimension analysis stresses on the basic units, dimensions, conversions of units which is usually applied in scientific and engineering calculations. Material and energy balances discuss the fundamentals of material and energy balances calculations in non-reactive and reactive systems as well as recycle, by pass and purge on chemical process. Basic unit operations and separation processes include type of reactors, heat exchanger, distillation, absorption and filtration processes. Process controll discuss the process flow, flow-diagram and automation on chemical industries.

**SCC 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, Schrodingerwave 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; valencebond and molecular orbital theories; Huckel approximation; approximate techniques: variation and perturbation.

**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.

**SSCU 3623 - Research Methology and Data 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.

**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 3871 - Analytical Chemistry Practical II**
The course 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 flame emission photometry as well as liquid chromatography and gas chromatography**.**

**SSCU 3905 – Industrial Traning**
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 industrystaff. 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 oppurtunity 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.

**SSCC 4223 - Environmental Science**
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. Awareness and practical application of green technology will also be discussed.

**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 4253 - Food Analysis**

The subject is designed to provide students with an understanding of the principles and procedures for the analysis of the chemical components of food. Introduction to food chemistry, food regulations, sample handling and preparation for data collection, reporting and analysis of data are included. Key analytical and separation techniques are discussed, including proximate analysis, classical techniques, and relevant modern instrumental techniques.

**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 4273 – Forensic Science**
This course provides an introduction to 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, question document, drugs of abuse, blood, semen and saliva are covered in this course.

**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. Some industrial applications in industry will also be covered..

**SSCC 4353 - Consumer Chemistry**
The course introduces the students to the basic concepts of chemistry and examines the role of chemistry in consumer products. 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 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.

**SSCP 4403 Microscopic and Material Analysis**
This is an introductory course on microscopic techniques that deals with the basic working principles and schematic diagram of 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 will provide the students with necessary knowledge on the choice of microscope for study of materials.

**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 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 4483 - Corrosion Chemistry**
This subject introduces the concept of corrosion; which includes definition and importance of corrosion, the driving force for corrosion reactions, the rates of electrochemical reactions, rates of electrochemical corrosion reactions, characteristic forms of electrochemical corrosion, prevention and control of electrochemical corrosion and high temperature corrosion/oxidation and its control. Upon completion, students should be able to develop and apply knowledge to describe the electrochemical corrosion processes and its prevention. Students should also be able to rationalize the importance of corrosion effect in industrial application and our lives.

**SSCC 4493 – Surface and Colloid Chemistry**
This course is offered as an elective whereby students are introduced to the fundamentals of surface and colloid chemistry. The fundamental concept of the 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 colloid chemistry, the course will discuss the classification of colloid, mechanism of colloidal formation, colloidal phenomena and colloidal stability. The course will enable students to develop and apply knowledge in describing several absorption models and colloidal systems.

**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.

**SSCP 4603 – 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

**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, pericylic, 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 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 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 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 was first given 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 4693 – 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 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 4743 - 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 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 influences catalysts reactivity in both homogeneous and heterogeneous catalysis. Different methods of preparation and characterization of catalytic material 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 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 nanoschemistry 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.

**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. urvey/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 completetheexperimental 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, projct presentation, attendance and laboratory work.

## PROGRAMME SPECIFICATION

**BACHELOR OF SCIENCE (MATHEMATICS)**

| | |
|---|---|
| **1. Awarding Institution** | UTM |

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|---|---|---|---|---|
| **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<br>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:<br><br>STPM/MATRICULATION/SCIENCE FOUNDATION<br><br>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. be mathematically competent professionals able to apply their knowledge and skills in related industries notably in teaching, research and development of new knowledge.
2. have the proficiency in both writing and oral communication to disseminate mathematical knowledge effectively.
3. have the skills and motivation for continued life-long education in the acquisition of new mathematical knowledge and skills in depth and in breath.

| **14. Programme Learning Outcomes (PO)** | | | |
|---|---|---|---|
| | Intended Learning Outcomes | Teaching and Learning Methods | Assessment |
| **(a) Technical Knowledge and Competencies** | | | |
| **PO1 Fundamental Knowledge of Mathematics** | Ability to acquire knowledge on fundamental mathematical concepts, theories and techniques related to current issues. (C2, P2, A2) | Lectures, tutorials, directed reading. | Examinations, tests, quizzes, assignments. |
| **PO2 Application of Mathematical** | Ability to apply and practice skills in mathematical | Lectures, tutorials, projects (PSM, Group/individual), directed reading, hands-on | Examinations, quizzes, tests, computing output, presentations, project |

| | | | |
|---|---|---|---|
| **Knowledge and Computational Techniques and Analysis** | reasoning, construct mathematical proofs and display proficiency in using a variety of mathematical techniques in carrying out mathematical analysis<br>(C4, P4, A3) | computer-based exercises, simulation exercises, research training. | reports, research training report. |
| **PO3<br>Discrimination and organization of mathematical concepts** | Ability to evaluate and demonstrate proficiency in choosing appropriate methods to solve theoretical and applied problems in mathematical sciences<br>(C6, P6, A3) | Lectures, projects (Undergraduate Project (PSM), Group/individual), directed reading, computer-based exercises, problem-based learning and research training. | Examinations, quizzes, tests, computing output, presentations, project reports and research training report. |
| **(b) Generic Skills** | | | |
| **PO4<br>Critical Thinking and Problem Solving** | Ability to understand, extract, analyse and identify problems from a variety of sources and develop approaches based on mathematical knowledge to solve problems.<br>(P4) | Active learning, projects (PSM, Group/individual), research training. | Written assignments, oral presentations, project reports, learning portfolio, research training report. |
| **PO5<br>Communication Skills** | Ability to convey ideas and mathematical knowledge clearly and effectively in both written and oral forms to a range of audiences.<br>(P4) | Active learning, projects (PSM, Group/individual), research training. | Oral presentations, project reports, research training report. |
| **PO6<br>Team Working** | Ability to adapt and work collaboratively as part of a team.<br>(A3) | Active learning, projects (PSM, Group), research training. | Oral presentations, project reports, peer evaluation, research training report. |
| **PO7<br>Lifelong Learning and Information Management** | Ability to seek independent study and demonstrate the awareness for continuous personal and professional development.<br>(A3) | Active learning, projects (PSM, Group/individual), professional development courses (Degree ++), research training. | Written assignments, oral presentations, project reports, learning portfolio, research training report. |
| **PO8<br>Leadership Skills** | Ability to demonstrate leadership, to take actions and to influence others in order to achieve common goals.<br>(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, research training. | PSM reports, learning portfolio, research training report. |
| **PO10 Entrepreneurship** | Ability to acquire awareness of business and entrepreneurship and career opportunities. (P2) | Lectures, assignments, case studies, PSM, seminar, workshop, co-curricular activities, group work. | Written assignments, oral presentations, PSM reports, examination, research training report. |

**15. Classification of Subjects**

| No. | Classification | Credit Hours | Percentage(%) |
|---|---|---|---|
| i. | Basic Sciences and Mathematics | 9 | 57.9 |
| ii. | Programme Core | 64 | |
| iii. | Programme Electives | 33 | 26.2 |
| iv | Compulsory University Subjects<br>• Humanity<br>• English Language<br>• Co-curriculum<br>• Entrepreneurship | <br>10<br>6<br>2<br>2 | 15.9 |
| | **1.3 Total** | **126** | **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 Subjects | | |
| | (a) Lecture | 95 | 75.4 |
| | (b) Research Training | 5 | 3.9 |
| | (c) Final Year Project | 6 | 4.8 |
| | Total Credit Hours for Part A | 106 | 84.1 |
| B | Related Subjects | | |
| | (a) Humanities/Ethics | 10 | 7.9 |
| | (b) Co-curriculum | 2 | 1.6 |
| | (c) English | 6 | 4.8 |
| | (d) Entrepreneurship | 2 | 1.6 |
| | Total Credit Hours for Part B | 20 | 15.9 |
| | **Total Credit Hours for Part A and B** | **126** | **100** |

| | |
|---|---|
| **16. Total credit hours to graduate** | **126 credit hours** |

**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 1 | | | SEMESTER 2 | | |
|---|---|---|---|---|---|
| | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| UICI 1012 | Islamic and Asian Civilizations (TITAS) | 2 | ULAB 1122 | Academic English Skills | 2 |
| | | | UHAS 1172/<br><br>UHAS 1162 / UHAK1022 | Malaysia Dynamics (Local Students)*<br>Arts, Custom and Beliefs (International Students)* | 2 |
| | | | UHAK1032 | Introduction to Entrepreneurship | 2 |
| SSCM 1012 | Introduction to Mathematics Program | 2 | SSCM 1033 | Mathematical Methods II | 3 |
| SSCM 1023 | Mathematical Methods I | 3 | SSCM 1313 | Computer Programming | 3 |
| SSCP 1143/ SSCC 1003 | Mechanics/ Principles of Chemistry | 3 | SSCM 1523 | Linear Algebra | 3 |
| SSCM 1103 | Statistics | 3 | SSCM 1703 | Differential Equations I | 3 |
| SSCM 1303 | Computer Literacy | 3 | | | |
| | **Total Credit Hours** | **16** | **Total Credit Hours** | | **18** |

| SEMESTER 3 | | | SEMESTER 4 | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| UICL 2302 | Scientific and Technological Thinking | 2 | ULAB 2122 | Advanced Academic English Skills | 2 |
| | | | UHAK 1012 | Graduate Success Attributes | 2 |
| 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 Modeling I | 3 |
| SSCM 2793 | Vector Calculus | 3 | SSCM 2833 | Linear Programming | 3 |
| SSCM 3533 | Set Theory and Logic | 3 | | | |
| **Total Credit Hours** | | **17** | **Total Credit Hours** | | **16** |

| SEMESTER 5 | | | SEMESTER 6 | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| UKQA 2092 | Science and Community | 2 | ULA*1112 | Foreign Language Elective | 2 |
| ULAB 3162 | English for professional purposes | 2 | | | |
| UHAK 2**2 | Soft Skills Elective | 2 | | | |
| SSCM 3703 | Partial Differential Equations | 3 | SSCM 3423 | Numerical Methods II | 3 |
| | | | SSCU3623 | Research methodology & information retrieval | 3 |
| **Elective (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** | | **14** |

| SHORT SEMESTER | Credit |
|---|---|
| Research Training (HW) | 5 |
| **Total Credit Hours** | **5** |

| SEMESTER 7 | | | SEMESTER 8 | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| SSCU 4902 | Undergraduate Project I | 2 | SSCU 4904 | Undergraduate Project II | 4 |
| **Elective (Choose 12 credits)** | | | **Elective (Choose 9 credits)** | | |
| SSCM 4163 | Stochastic Process | 3 | SSCM3153 | Inferential Statistics | 3 |
| SSCM 4633 | Fuzzy Set Theory | 3 | SSCM4623 | Non-Euclidean Geometry | 3 |
| SSCM 4653 | Applied Abstract Algebra | 3 | SSCM4733 | Dynamical Systems | 3 |
| SSCM 4683 | Topology | 3 | SSCM4783 | Quantum Mechanics | 3 |
| SSCM 4763 | Computational Fluid Dynamics | 3 | SSCM4813 | 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 | Mathematical Application | Mathematical Analysis | Critical Thinking and Problem Solving | Communication | Team Working | Lifelong Learning | Leadership Skills | Ethics and Integrity | Entrepreneurship |
| **Code** | **Course Name** | PO1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO8 | PO 9 | PO1 0 |
| **Core Subjects** | | | | | | | | | | | |
| 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 | ✓ | ✓ | | ✓ | | | | | | |
| SSCM2673 | Discrete Mathematics | ✓ | ✓ | | | | ✓ | | | | |
| SSCM2793 | Vector Calculus | ✓ | ✓ | | ✓ | | | | | | |
| SSCM2773 | Differential Equations II | ✓ | ✓ | | | | ✓ | | | | |
| SSCM2043 | Mathematical Methods III | ✓ | ✓ | | ✓ | | | | | | |
| SSCM2613 | Advanced Calculus | ✓ | ✓ | | | ✓ | | | | | |
| SSCM2803 | Mathematical Modelling I | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | | |
| SSCM2833 | Linear Programming | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | |
| SSCM3423 | Numerical Methods II | ✓ | ✓ | | ✓ | | | | | | |
| SSCM3703 | Partial Differential Equations | ✓ | ✓ | | ✓ | | | | | | |
| SSCU3623 | Research Methodology & Information Retrieval | ✓ | ✓ | | | | | ✓ | | ✓ | |
| SSCU3915 | Research Training (HW) | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | ✓ |
| SSCU4902 | Undergraduate Project I | ✓ | ✓ | | ✓ | ✓ | | ✓ | | ✓ | |
| SSCU4904 | Undergraduate Project II | ✓ | ✓ | | ✓ | ✓ | | ✓ | | ✓ | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UKQL3012 | Service Learning | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Elective Subjects** | | | | | | | | | | | |
| SSCM3503 | Complex Variables | ✓ | ✓ | ✓ | | | | | | | |
| SSCM3533 | Set Theory and Logic | ✓ | ✓ | | ✓ | | | | | | |
| SSCM3793 | Calculus of Variations | ✓ | ✓ | | | ✓ | | | | | |
| SSCM3523 | Modern Algebra | ✓ | ✓ | | ✓ | | | | | | |
| SSCM3753 | Fluid Mechanics | ✓ | ✓ | | | ✓ | | | | | |
| SSCM3353 | C++ Programming | ✓ | ✓ | | | | | ✓ | | | |
| SSCM3553 | Fields and Rings Theory | ✓ | ✓ | | | | ✓ | | | | |
| SSCM3543 | Number Theory | ✓ | ✓ | | | | | ✓ | | | |
| SSCM3673 | Functional Analysis | ✓ | ✓ | | ✓ | | | | | | |
| 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 Subjects** | | | | | | | | | | | |
| UICI1012 | Islamic and Asian Civilizations (TITAS) | ✓ | | | ✓ | | | | | ✓ | |
| UICI2022 | Science Technology & Human | ✓ | | | | | | | | | |
| UHAS1172 | Malaysia Dynamics | ✓ | | | | | | | | | |
| UHAS 1162 | Arts, Custom and Belief of Malaysian | | | | | | | | | | |
| ULAM 1112 | Bahasa Malaysia | | | | | | | | | | |
| UHAS2122 | Critical and Creative Thinking | ✓ | | | ✓ | ✓ | | | | | |
| UHAS3012 | Entrepreneurship and Enterprise Development | ✓ | | | | ✓ | | | | | ✓ |
| UKQU2202 | Innovation and Creativity | ✓ | | | | | | | | | |
| UHAS2092 | Professional Ethics | ✓ | | | | ✓ | | | | ✓ | |
| UHAS2032 | Technocrat & Development | ✓ | | | | | | | | | |
| ULAB1122 | Academic English Skills | ✓ | | | | ✓ | | ✓ | | | |
| ULAB2122 | Advanced English for Academic Skills | ✓ | | | | ✓ | | | | | |
| ULAB3162 | English for Professional Purposes | ✓ | | | | ✓ | | | | | |

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
- Staff student ratios for teaching of 1:15
- Extensive library and other learning resources and facilities.
- All students are allocated with personal advisors whose role is to assist them in education planning and personal problems

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

1. Students performance in terms of:
   - KS/KB
   - CPA
   - Graduating students performance
   - Graduate on time, GOT
   - Completion rate
   - Analysis of course performance

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

3. Lecturer's performance
   - Teaching evaluation by students (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** | **1.3.1.1 Grade** | **1.3.1.2 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** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LO1 | LO 2 | LO 3 | LO 4 | LO 5 | LO 6 | LO 7 | LO 8 | LO 9 | LO10 | | |
| e- Portfolio | x | x | x | x | x | x | x | x | x | x | continuous | Student |
| Course outcome survey | x | x | x | x | x | x | x | x | x | x | End of sem | Lecturer |
| Course outcome report | x | x | x | x | x | x | x | x | x | x | End of sem | Lecturer |
| Final Year Project survey | x | x | x | x | x | | x | | x | | End of sem | Faculty |
| PO survey by final year students | x | x | x | x | x | x | x | x | x | x | End of sem | Faculty |
| 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<br>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:<br><br>STPM/MATRICULATION/SCIENCE FOUNDATION<br>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<br><br>IPLOMA<br>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. |

**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<br>• Humanity<br>• English Languages<br>• Co-Curriculum<br>• Entrepreneurship | 10<br>6<br>2<br>2 | 15.5 |
| | **1.4 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<br>(a) Lectures<br>(b) Industrial Training<br>(c) Undergraduate projects | <br>98<br>5<br>6 | <br>76<br>3.9<br>4.7 |
| | Total credit hours for Part A | 109 | 84.5 |
| B | Related Courses<br>(a) Humanities/Ethics<br>(b) Co-curriculum<br>(c) English Languages<br>(d) Entrepreneurship | <br>10<br>2<br>6<br>2 | <br>7.8<br>1.5<br>4.7<br>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** | **129** credit hours |

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

The course is offered on full-time mode and is based on a two 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 industrial training.
- Complete and pass the undergraduate project.

| SEMESTER 1 | | | SEMESTER 2 | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| UICI 1012 | Islamic and Asian Civilization | 2 | ULAB 1122 | Academic English Skills | 2 |
| | | | UHAS 1172<br><br>UHAS 1162 / UHAK 1022 | Malaysia Dynamics (Local Students)*<br>Arts, Custom and Beliefs (International Students)* | 2 |
| | | | UHAK 1032 | Introduction to Entrepreneurship | 2 |
| SSCM 1002 | Introduction to Industrial Mathematics Program | 2 | SSCM 1033 | Mathematical Methods II | 3 |
| SSCM 1023 | Mathematical Methods I | 3 | SSCM 1313 | Computer Programming | 3 |
| SSCP 1143/ SSCC 1003 | Mechanics/Principles of Chemistry | 3 | SSCM 1523 | Linear Algebra | 3 |
| SSCM 1103 | Statistics | 3 | SSCM 1703 | Differential Equations I | 3 |
| SSCM 1313 | Computer Literacy | 3 | | | |
| **Total Credit Hours** | | **16** | **Total Credit Hours** | | **18** |

| SEMESTER 3 | | | SEMESTER 4 | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| UICL 2302 | Scientific and Technological Thinking | 2 | ULAB 2122 | Advanced Academic English Skills | 2 |
| | | | UHAK 1012 | Graduate Success Attributes | 2 |
| SSCM 2103 | Mathematical Statistics | 3 | SSCM 2043 | Mathematical Methods III | 3 |
| SSCM 2423 | Numerical Methods I | 3 | SSCM 2613 | Advanced Calculus | 3 |
| SSCM 2793 | Vector Calculus | 3 | SSCM 2803 | Mathematical Modeling I | 3 |
| SSCM 3533 | Set Theory and Logic | 3 | SSCM 2833 | Linear Programming | 3 |
| SSCM 2773 | Differential Equations II | 3 | | | |
| **Total Credit Hours** | | **17** | **Total Credit Hours** | | **16** |

| SEMESTER 5 | | | SEMESTER 6 | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| ULAB 3162 | English for Professional Purposes | 2 | ULA* 1112 | Foreign Language Electives | 2 |

| | | | | | |
|---|---|---|---|---|---|
| UHAK 2**2 | Soft Skills Electives | 2 | UKQA 2092 | Science and Community | 2 |
| SSCM 3133 | Statistical Quality Control | 3 | SSCM 3103 | Design of Experiments | 3 |
| SSCM 3803 | Mathematical Modeling II | 3 | SSCM 3423 | Numerical Methods II | 3 |
| **Elective (Choose 6 credits)** | | | **Elective (Choose 6 credits)** | | |
| SSCM 3143 | Decision Theory | 3 | SSCM 3123 | Multivariate Analysis | 3 |
| SSCM 2673 | Discrete Mathematics | 3 | SSCM 3353 | C++ Programming | 3 |
| SSCM 3703 | Partial Differential Equations | 3 | SSCM 3753 | Fluid Mechanics | 3 |
| SSCM 3883 | Multi-Objective Decision Making | 3 | SSCM 3843 | Optimization Methods | 3 |
| SSCM 3793 | Calculus of Variations | 3 | SSCM 3153 | Inferential Statistics | 3 |
| SHAD 1043 | Organizational Behavior | 3 | SHAF 1013 | Principles of Marketing | 3 |
| **Total Credit Hours** | | **16** | **Total Credit Hours** | | **16** |

| **SHORT SEMESTER** | | **Credit** |
|---|---|---|
| SSCU 3905 | Industrial Training (HW) | 5 |
| **Total Credit Hours** | | **5** |

| **SEMESTER 7** | | | **SEMESTER 8** | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| SSCU 4902 | Undergraduate Project I | 2 | SSCU 4904 | Undergraduate Project II | 4 |
| **Elective (Choose 12 credits)** | | | **Elective (Choose 9 credits)** | | |
| SSCM 3523 | Modern Algebra | 3 | SSCM 4863 | Financial Mathematics | 3 |
| SSCM 3503 | Complex Variables | 3 | SSCM 4213 | Generalized Linear Model | 3 |
| SSCM 4763 | Computational Fluid Dynamics | | SSCM 4813 | Optimal Control | 3 |
| SSCM 4163 | Stochastic Process | 3 | SSCM 4833 | Discrete Event Simulation | 3 |
| SSCM 4113 | Time Series | 3 | SSCM 4243 | Sampling Techniques | 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 Mathematical techniques | Analytical Computational Skills | Critical Thinking and Problem Solving | Communication | Team Working | Lifelong Learning | Leadership Skills | Ethics and Integrity | Entrepreneurship |
| **Code** | **Course Name** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| **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 | ✓ | ✓ | | ✓ | | | | | | |
| SSCM2673 | Discrete Mathematics | ✓ | ✓ | | | | ✓ | | | | |
| 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 | ✓ | ✓ | | ✓ | ✓ | | ✓ | | ✓ | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UKQL3012 | Service Learning | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Elective Courses** | | | | | | | | | | | |
| SSCM3143 | Decision Theory | ✓ | ✓ | | | | ✓ | | | | |
| SSCM3533 | Set Theory and Logic | ✓ | ✓ | | ✓ | | | | | | |
| 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 | ✓ | ✓ | ✓ | | ✓ | | | | | |
| SHAS1523 | Organizational Behaviour | | | | ✓ | ✓ | ✓ | | | | |
| SHAS1113 | Principles of Marketing | | | | ✓ | ✓ | ✓ | | | | |
| SHAD1033 | Principles of Management | | | | | ✓ | ✓ | | | ✓ | |
| **University Courses** | | | | | | | | | | | |
| UICI1012 | Islamic and Asian Civilizations (TITAS) | ✓ | | | ✓ | | | | | ✓ | |
| UICI2022 | Science Technology & Human | ✓ | | | | | | | | | |
| UHAS1172 | Malaysia Dynamics | ✓ | | | | | | | | | |
| UHAS 1162 | Arts, Custom and Belief in Malaysian | | | | | | | | | | |
| ULAM 1112 | Bahasa Malaysia | | | | | | | | | | |
| UHAS2122 | Critical & Creative Thinking | ✓ | | | ✓ | ✓ | | | | | |
| UHAS3012 | Entrepreneurship and Enterprise Development | ✓ | | | | ✓ | | | | | ✓ |
| UKQU2202 | Innovation and Creativity | ✓ | | | | | | | | | |
| UHAS2092 | Professional Ethics | ✓ | | | | ✓ | | | | ✓ | |
| UHAS2032 | Tehonocrat & Development | ✓ | | | | | | | | | |
| ULAB1122 | Academic English Skills | ✓ | | | | ✓ | | ✓ | | | |
| ULAB2122 | Advanced English for Academic Skills | ✓ | | | | ✓ | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ULAB3162 | English for Professional Purposes | ✓ | | | | ✓ | | | | | |

**19. Programme Uniqueness**

- 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.

**20. Career Prospects and Career Path**

Graduates of this programme can work as

- 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.

**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
   - Alumini 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 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 |

## SYNOPSES 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 strengthen student in term 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 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, Crammer'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 rigourously 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. I continues with classification and method of solving the equation by reducing to canonical fprm for variable coefficients equations and solving one-dimentioanal 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 coordinates 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 $\alpha$ - cut, Extension Principle, and operation on Fuzzy sets. Fuzzy Arithmetic on Fuzzy Numbers including Operations on Intervals and Fuzzy Numbers, Lattice of Fuzzy Numbers are also thoroughly highlighted. Fuzzy Relations and Fuzzy Graphs are also discussed. Lastly we deal with Fuzzy Analysis and Uncertainty Modelling. In general, the course provides on the general concepts of fuzzy sets and its operations. The emphasis is also given for its applications in Uncertainty Modelling

**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.

**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 | |
| **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<br>Maximum : 6 yrs | |
| Type of Semester | No. of Semesters | | No. of weeks per semester | |
| | Full Time | Part Time | | Full Time |
| Normal | 8 | - | Normal | 8 |
| Short | - | - | Short | - |
| **12. Entry Requirement** | Fulfills University requirements and the following program requirements:<br><br>STPM/MATRICULATION/SCIENCE FOUNDATION<br><br>Minimum CGPA 2.80 and passed with Grade B in Physics and Grade B- in ONE (1) of the following subjects : Biology/Mathematics/ Chemistry | | | |

**13. Program Educational Objectives (PEO)**

The objectives of Bachelor of Science in Physics are to provide the knowledge, skills and attributes that should be achieved by the graduate for a successful career. The program is designed to:

1. Prepare graduates to work as a capable physicist in research and development 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.

| 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**<br>**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,<br>research training report. |
| **PO7**<br>**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<br>training report. |
| **PO8**<br>**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<br>report |
| **PO9**<br>**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<br>year project reports, research training |
| **PO10**<br>**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<br>a. Humanity<br>b. Language<br>c. Co-curriculum<br>d. Entrepreneurship | <br>10<br>6<br>2<br>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<br>(a) Lectures<br>(b) Laboratory/Workshop<br>(c) Final Year Project<br>(d) Research training | <br>77<br>6<br>6<br>5 | <br>60.6<br>4.7<br>4.7<br>3.9 |
| | Total credit hours for Part A | **94** | 72.9 |
| B | Related Courses<br>(a) Mathematics<br>(b) Humanities/Ethics<br>(c) Co-Curriculum<br>(d) English<br>(e) Entrepreneurship | <br>15<br>10<br>2<br>6<br>2 | <br>11.6<br>7.8<br>1.6<br>4.7<br>1.6 |
| | Total credit hours for Part B | **33** | **25.6** |
| | Total Credit Hours for Parts A and B | **129** | **100%** |

| | |
|---|---|
| **16. Total credit hours to graduate** | **129** credit hours |

**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 1 | | | SEMESTER 2 | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| UICI 1012 | Islamic and Asian Civilizations (TITAS) | 2 | ULAB 1122 | Academic English Skills | 2 |
| | | | UHAS 1172 | Malaysia Dynamics (Local Students)* | 2 |
| | | | UHAK 1022 | Arts, Custom and Beliefs (International Students)* | 2 |
| SSCP 1102 | Introduction to Physics | 2 | SSCP 1163 | Sound, Waves and Optics | 3 |
| SSCP 1143 | Mechanics | 3 | SSCP 1223 | Modern Physics | 3 |
| SSCP 1153 | Electricity and Magnetism | 3 | SSCM 1523 | Linear Algebra | 3 |
| SSCM 1023 | Mathematical Method I | 3 | SSCM 1033 | Mathematical Method II | 3 |
| SSCP 1811 | Practical Physics I | 1 | SSCP 1821 | Practical Physics II | 1 |
| **Total Credit Hours** | | **14** | **Total Credit Hours** | | **17** |

| SEMESTER 3 | | | SEMESTER 4 | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| UICL 2302 | Scientific and Technological Thinking | 2 | ULAB 2122 | Advanced Academic English Skills | 2 |
| | | | UHAK 1012 | Graduate Success Attributes | 2 |
| | | | UKQA 2092 | Science and Community | 2 |
| 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 | | | |
| **Total Credit Hours** | | **15** | **Total Credit Hours** | | **16** |

| SEMESTER 5 | | | SEMESTER 6 | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| ULAB 3162 | English for Professional Purposes | 2 | ULA* 1112 | Foreign Language Elective | 2 |
| UHAK 2**2 | Soft Skills Elective | 2 | | | |

| | | | | | |
|---|---|---|---|---|---|
| SSCP 3113 | Electromagnetism | 3 | SSCP 3643 | Quantum Mechanics I | 3 |
| SSCM 3503 | Complex Variables | 3 | SSCP 3821 | Practical Physics V | 1 |
| SSCP 3123 | Classical Mechanics | 3 | | | |
| SSCP 3133 | Thermal and Statistical Physics | 3 | | | |
| SSCP 3811 | Practical Physics V | 1 | | | |
| | | | **Elective (Choose 9 credits)** | | |
| | | | SSCP3163 | Energy and Environmental Physics | 3 |
| | | | SSCP3333 | Computational Physics | 3 |
| | | | SSCP3523 | Modern Physics | 3 |
| | | | SSCP 3143 | Relativity | 3 |
| | | | SSCP 3153 | Elementary Particles | 3 |
| **Total Credit Hours** | | **17** | **Total Credit Hours** | | **15** |

| **SHORT SEMESTER** | | **Credit** |
|---|---|---|
| SSCU 3915 | Research Training (HW) | 5 |
| **Total Credit Hours** | | **5** |

| **SEMESTER 7** | | | **SEMESTER 8** | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| 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 II | 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** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **LEARNING OUTCOMES** | | | | | | | | | |
| **COURSES OFFERED** | | ***Fundamental Knowledge*** | ***Application of Physics knowledge*** | ***Scientific Study and Research*** | ***Critical Thinking and Problem Solving*** | ***Communication Skills*** | ***Team working*** | ***Lifelong Learning*** | ***Leadership*** | ***Ethics & Integrity*** | ***Entrepreneurship*** |
| 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 | ✓ | ✓ | | | ✓ | | | | | |
| SSCP 3343 | Instrumentation and Data Acquisition | ✓ | ✓ | ✓ | ✓ | | | | | | |
| 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 | | | | | | | | | | |
| UICI2022 | Science, Technology and Humanity | | | | | | | | | | |
| UHAS2092 | Professional Ethics | ✓ | | | | ✓ | | | | ✓ | |
| UHAS2032 | Technocrat and Development | | | | | | | | | | |
| UHAS2122 | Critical and Creative thinking | ✓ | | | ✓ | ✓ | | | | | |
| UKQU2202 | Innovation and creativity | | | | | | | | | | |
| UHAS3012 | Entrepreneurship and Enterprise Development | ✓ | | | | ✓ | | | | | ✓ |
| ULAB1122 | Academic English Skills | ✓ | | | | ✓ | | ✓ | | | |
| ULAB2122 | Advanced English for Academic Skills | ✓ | | | | ✓ | | | | | |
| ULAB3162 | English for Professional Purposes | | | | | | | | | | |
| UKQL3012 | Service Learning | ✓ | | | | ✓ | ✓ | | | | |

**Key:**

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

**19. Our Uniqueness**

This program stresses on the research skill and experience in research training in contemporary pure physics for the graduates.
Established links with local and international universities/research institutions

**20. Career Prospects and Career Paths**

Graduates of the program can work as

- 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

**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 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.

**23. Facilities available**

A: Laboratories:

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
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 Spectometer
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 Nilaian |
|---|---|---|
| 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 | PO1 0 | | |
| 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 | |
| **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<br>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** | Fulfills University requirements and the following program requirements:<br><br><u>STPM/MATRICULATION/SCIENCE FOUNDATION</u><br><br>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<br><br><u>DIPLOMA</u><br><br>Minimum CGPA of 3.00 and passed with credits in Mathematics in the SPM/equivalent examination. | | | |

**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 |
| **PO5 Communication Skills** | Ability to communicate effectively and with confidence in writing and oral (P4) | Supervised project, lectures, laboratory works, individual assignment, Industrial training. | Final Year Project report, examination, laboratory report, presentation, written assignment, industrial training report. |
| **PO6 Team Working** | Ability to function effectively as a member in a team to achieve common | Final year project, laboratory work, | Laboratory report, final year project report, |

| | | | |
|---|---|---|---|
| | goals and adapt to changing situations and priorities (A3) | group assignment, Industrial training | industrial 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, industrial training | Final year project report, written assignment, industrial training report. |
| **PO8 Leadership skills** | Ability to function effectively and with responsibility as a leader in a team to achieve common goals (A3) | Projects, tutorials, group assignments, laboratory work, | Oral presentation, group 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, final year project, industrial training | Written assignments, final year project report, industrial training report. |
| **PO10 Entrepreneurship** | Awareness of business, entrepreneurship and career opportunities (P2) | Lectures, project, industrial training. | Written assignment, project report, industrialtraining report. |

| **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<br>• Humanity<br>• English Language<br>• Co-curriculum<br>• Entrepreneurship | <br>10<br>6<br>2<br>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 (%)** |
| | Physics Courses: | | |

| | | | |
|---|---|---|---|
| A | (a) Lectures<br>(b) Laboratory/Workshop/<br>(c) Final Year Project<br>(d) Industrial training | 71<br>6<br>6<br>5 | 55.0<br>4.7<br>4.7<br>3.8 |
| | **Total credit hours for Part A** | **88** | **68.2** |
| B | Related Courses:<br>(a) Mathematics<br>(b) Management and marketing<br>(c) Humanities/Ethics<br>(d) Co-Curriculum<br>(e) English<br>(f) Entrepreneurship | <br>12<br>9<br>10<br>2<br>6<br>2 | <br>9.3<br>7.0<br>7.8<br>1.6<br>4.7<br>1.6 |
| | **Total credit hours for Part B** | **41** | **31.8** |
| | **Total credit hours for Parts A and B** | **129** | **100%** |

| | |
|---|---|
| **16. Total credit hours to graduate** | **129 credit hours** |

**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 129 credit hours with minimum CPA of 2.00.
- Pass industrial training.
- Complete and pass the undergraduate Final Year Project.

| **SEMESTER 1** | | | **SEMESTER 2** | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| UICI 1012 | Islamic and Asian Civilizations (TITAS) | 2 | ULAB 1122 | Academic English Skills | 2 |
| | | | UHAS 1172 | Malaysia Dynamics (Local Students) | 2 |
| | | | UHAK 1022 | Arts, Custom and Beliefs (International Students) | 2 |

| | | | | | |
|---|---|---|---|---|---|
| SSCP 1102 | Introduction to Physics Program | 2 | SSCM 1033 | Mathematical Methods II | 3 |
| SSCM 1023 | Mathematical Methods I | 3 | SSCM 1523 | Linear Algebra | 3 |
| SSCP 1143 | Mechanics | 3 | SSCP 1163 | Sound, Wave and Optics | 3 |
| SSCP 1153 | Electricity and Magnetism | 3 | SSCP 1223 | Modern Physics | 3 |
| SSCP 1811 | Practical Physics I | 1 | SSCP 1821 | Practical Physics II | 1 |
| **Total Credit Hours** | | **14** | **Total Credit Hours** | | **17** |

| **SEMESTER 3** | | | **SEMESTER 4** | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| UICL 2302 | Scientific and Technological Thinking | 2 | UKQA 2092 | Science and Community | 2 |
| UHAK 1032 | Introduction to entrepreneurship | 2 | ULAB 2122 | Advanced Academic English Skills | 2 |
| | | | UHAK 1012 | Graduate Success Attributes | 2 |
| 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 | | | |
| **Total Credit Hours** | | **17** | **Total Credit Hours** | | **16** |

| **SEMESTER 5** | | | **SEMESTER 6** | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| ULAB 3162 | English for professional purposes | 2 | ULA* 1112 | Foreign Language Elective | 2 |
| UHAK 2**2 | Soft Skills Elective | 2 | | | |
| | | | | | |
| SSCP 3113 | Electromagnetism | 3 | SSCP 3343 | Instrumentation and Data Acquisition | 3 |
| SSCP 3133 | Thermal and Statistical Physics | 3 | SSCP 3613 | Quantum Mechanics I | 3 |
| SSCP 3323 | Advanced Electronics | 3 | SSCP 3821 | Practical Physics VI | 1 |
| SSCP 3811 | Practical Physics V | 1 | | | |
| **Elective (Choose 3 credits)** | | | **Elective (Choose 6 credits)** | | |
| SHAC 1163 | Principles of Accounting | 3 | SHAF 1013 | Principles of Marketing | 3 |
| SHAD 1033 | Principles of Management | 3 | SHAD 1043 | Organizational Behaviors | 3 |

| | | | | | |
|---|---|---|---|---|---|
| | | | SSCP 3433 | Quality Control | 3 |
| | | | | | |
| | | | | | |
| **Total Credit Hours** | | **17** | **Total Credit Hours** | | **15** |

| **SHORT SEMESTER** | | **Credit** |
|---|---|---|
| SSCU 3905 | Research Training (HW) | 5 |
| **Total Credit Hours** | | **5** |

| **SEMESTER 7** | | | **SEMESTER 8** | | |
|---|---|---|---|---|---|
| **Code** | **Course Name** | **Credit** | **Code** | **Course Name** | **Credit** |
| 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 | Photometric | 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**

| | | LEARNING OUTCOMES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| COURSES OFFERED | | ***Fundamental Knowledge*** | ***Application of Physics knowledge*** | ***Scientific Study and Research*** | ***Critical Thinking and Problem Solving*** | ***Communication Skills*** | ***Team working*** | ***Lifelong Learning*** | ***Leadership*** | ***Ethics & Integrity*** | ***Entrepreneurship*** |
| Code | **Courses** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| **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 (Choose 33 credits)** | | | | | | | | | | | |
| **Management Electives Courses (Choose 9 Credits)** | | | | | | | | | | | |
| SSCP 3433 | Quality Control | ✓ | ✓ | | | | | ✓ | | | |
| SHAD 1043 | Organizational Behaviors | ✓ | | | | ✓ | ✓ | ✓ | | | |
| SHAC 1023 | Cost Accounting | ✓ | | | | ✓ | ✓ | | | | |
| SHAF 1013 | Principles of Marketing | ✓ | | | ✓ | ✓ | | | | | |
| SHAD 1033 | Principles of Management | ✓ | | | | ✓ | ✓ | | | ✓ | |
| **Physics Electives (Chose 24 Credits from a Group)** | | | | | | | | | | | |
| **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 | | | | | | | | | | |
| UICI 2022 | Science, Technology and Humanity | | | | | | | | | | |
| UHAS 2092 | Professional Ethics | ✓ | | | | ✓ | | | | ✓ | |
| UHAS 2023 | Technocrat and Development | | | | | | | | | | |
| UHAS 2122 | Critical and Creative thinking | ✓ | | | ✓ | ✓ | | | | | |
| UKQU 2201 | Innovation and creativity | | | | | | | | | | |
| UHAS 3012 | Entrepreneurship and Enterprise Development | ✓ | | | | ✓ | | | | | ✓ |
| ULAB 1122 | Academic English Skills | ✓ | | | | ✓ | | | | | |
| ULAB 2122 | Advanced English for Academic Skills | ✓ | | | | ✓ | | | | | |
| ULAB 3162 | English for Professional Purposes | | | | | | | | | | |
| UKQL 3012 | Service Learning | ✓ | | | | ✓ | ✓ | | | | |

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**

This 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 Spectometer
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**

| 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 |
| 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. |

## SYNOPSES 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 scince 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. lt 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, Crammer'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 it 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 mater and mechanism of nuclear reaction are covered. Basic concepts on radioactivity including radioactive decay law, radioactive decay series and radioactive equilibriums 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 ralativiy 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 phi 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 sudents 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. Sudent 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 highlited. 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 courses starts with dicussion 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 survayed. 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 it 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 measument 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, begining 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, Langavin 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 highlited. 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 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 crystalization, 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 it 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 thse 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 theraphy, 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.