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# Bachelor of Engineering (Mechanical-Materials)

**BACHELOR OF ENGINEERING (MECHANICAL – MATERIALS)  
PROGRAMME SPECIFICATIONS**

|     |  |  |                      |
|-----|--|--|----------------------|
| 1.  | Programme Name   | Bachelor of Engineering (Mechanical – Materials) |                      |
| 2.  | Final Award  | Bachelor of Engineering (Mechanical – Materials) |                      |
| 3.  | Awarding Institution   | Universiti Teknologi Malaysia                    |                      |
| 4.  | Teaching Institution   | Universiti Teknologi Malaysia                    |                      |
| 5.  | Professional or Statutory Body of Accreditation  | Engineering Accreditation Council (EAC)          |                      |
| 6.  | Language(s) of Instruction   | Bahasa Melayu and English                        |                      |
| 7.  | Mode of Study (Conventional, distance learning, etc.)  | Conventional                                     |                      |
| 8.  | Mode of Operation (Franchise, self-govern, etc.)   | Self-govern                                      |                      |
| 9.  | Study Scheme (Full Time / Part Time)   | Full Time  |                      |
| 10. | Study Duration   | Minimum  | : 4 years            |
|     |  | Maximum  | : 6 years            |
|     | Type of Semester   | No of Semesters                                  | No of Weeks/Semester |
|     | Normal   | 8  | 14                   |
|     | Short  | 1  | 8                    |
| 11. | Entry Requirements   | Matriculation/STPM/Diploma or equivalent         |                      |
| 12. | <p>Programme Objectives (PEO)</p> <ul style="list-style-type: none"> <li>(i) Demonstrate academic and technological excellence professionally and globally, particularly in areas related to mechanical engineering practices and contribute innovatively to the nation's wealth creation.</li> <li>(ii) Career advancement by achieving higher levels of responsibility, leadership and acquiring professional and advanced academic qualifications.</li> <li>(iii) Recognize and practice professional, ethical, environmental and societal responsibilities and value different global and cultural aspects of the work and society.</li> <li>(iv) Adapt and communicate effectively and be successful working with multidisciplinary teams.</li> </ul> |  |                      |

| <b>13. Programme Learning Outcomes (PLO)</b>  |  |   |
|---|--|---|
| <b>(a) Technical Knowledge and Competencies</b>   |  |   |
| <b>Intended Learning Outcomes</b>   | <b>Teaching and Learning Methods</b>   | <b>Assessment</b>   |
| <b>PO1</b>  |  |   |
| Acquire and apply fundamental knowledge of mathematics, science and engineering principles to solve complex mechanical and materials engineering problems<br>Keywords: <b>Engineering Knowledge</b>   | Lectures, tutorials, laboratory works, seminars, studio works, directed reading, final year projects and problem-based learning. | Examinations, laboratory reports, seminar presentations, problem-based exercises, individual and group project reports. |
| <b>PO2</b>  |  |   |
| Identify, formulate and analyse complex mechanical and materials engineering problems<br>Keywords: <b>Problem Analysis</b>  | Lectures, tutorials, laboratory works, seminars, studio works, directed reading, final year projects and problem-based learning. | Examinations, laboratory reports, seminar presentations, problem-based exercises, individual and group project reports. |
| <b>PO3</b>  |  |   |
| Design solutions for complex mechanical and materials engineering problems that fulfil health, safety, societal, cultural and environmental needs<br>Keywords: <b>Design/Development of Solutions</b> | Lectures, tutorials, laboratory works, seminars, studio works, directed reading, final year projects and problem-based learning. | Examinations, laboratory reports, seminar presentations, problem-based exercises, individual and group project reports. |
| <b>PO4</b>  |  |   |
| Investigate complex mechanical and materials engineering problems using research-based knowledge and methods to produce conclusive results<br>Keywords: <b>Investigation</b>                          | Lectures, tutorials, laboratory works, seminars, studio works, directed reading, final year projects and problem-based learning. | Examinations, laboratory reports, seminar presentations, problem-based exercises, individual and group project reports. |

| <b>Intended Learning Outcomes</b>   | <b>Teaching and Learning Methods</b>   | <b>Assessment</b>   |
|---|--|---|
| <b>PO5</b>  |  |   |
| Use modern engineering and information technology (IT) tools in complex mechanical and materials engineering activities, with an understanding of limitations<br>Keywords: <b>Modern Tools Usage</b>  | Lectures, tutorials, laboratory works, seminars, studio works, directed reading, final year projects and problem-based learning. | Examinations, laboratory reports, seminar presentations, problem-based exercises, individual and group project reports. |
| <b>(b) Generic Skills</b>   |  |   |
| <b>PO6</b>  |  |   |
| Apply professional engineering practice and solutions to complex mechanical and materials engineering problems related to societal, health, safety, legal and cultural issues with full responsibility and integrity<br>Keywords: <b>The Engineer and Society</b> | Lectures, tutorials, seminars, group projects and industrial training.   | Industrial training and group project reports.  |
| <b>PO7</b>  |  |   |
| Evaluate the sustainability and impact of professional engineering work in the solutions of complex mechanical and materials engineering problems in societal and environmental contexts<br>Keywords: <b>Environment and Sustainability</b>                       | Tutorials, laboratory works, group assignments and projects, final year project presentations and problem-based learning.        | Group reports, learning logs/diaries and oral presentations.  |
| <b>PO8</b>  |  |   |
| Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice;<br>Keywords: <b>Ethics</b>   | Lectures, tutorials, seminars, group projects and industrial training.   | Industrial training and group project reports.  |

| <b>Intended Learning Outcomes</b>   | <b>Teaching and Learning Methods</b>           | <b>Assessment</b>   |                   |
|---|--|---|-------------------|
| <b>PO9</b>  |  |   |                   |
| Communicate effectively on complex mechanical and materials engineering activities both orally and in writing;<br>Keywords: <b>Communication</b>                                | Seminars, assignments and final year projects. | Report and theses.  |                   |
| <b>PO10</b>   |  |   |                   |
| Work productively as an individual, and as a member or leader in a team that may involve multi-disciplinary settings;<br>Keywords: <b>Team Working</b>                          | Lectures and project assignments.              | Demonstrations, reports, tests, examinations and presentations. |                   |
| <b>PO11</b>   |  |   |                   |
| Undertake lifelong learning and manage information including conducting literature study;<br>Keywords: <b>Life Long Learning</b>  | Lectures and project assignments.              | Demonstrations, reports, tests, examinations and presentations. |                   |
| <b>PO12</b>   |  |   |                   |
| Demonstrate and apply knowledge on finance and management principles and acquire entrepreneurship skill;<br>Keywords: <b>Project Management, Finance &amp; Entrepreneurship</b> | Lectures and project assignments.              | Demonstrations, reports, tests, examinations and presentations. |                   |
| <b>14. Classification of Courses</b>  |  |   |                   |
| <b>No.</b>  | <b>Classification</b>                          | <b>Credit Hours</b>   | <b>Percentage</b> |
| i.  | Programme Core                                 | 96  | 68.6              |
| ii.   | Programme Electives                            | 21  | 15.0              |
| iii.  | Compulsory University Courses                  | 23  | 16.4              |
| <b>Total</b>  |  | <b>140</b>  | <b>100</b>        |

| Classification of courses for engineering programme |                                      |            |            |
|---|--------------------------------------|------------|------------|
| A   | Engineering Courses                  | 117        | 83.6       |
|   | <b>Total credit hours for Part A</b> | <b>117</b> |            |
| B   | Non-Engineering                      | 23         | 16.4       |
|   | <b>Total credit hours for Part B</b> | <b>23</b>  |            |
| <b>Total credit hours for Part A and B</b>          |                                      | <b>140</b> | <b>100</b> |
| <b>15. Total Credit Hours to Graduate</b>           |                                      | <b>140</b> |            |

### Award Requirements

To graduate, students must:

- Attain a total of not less than 140 credit hours with a minimum CGPA of 2.00.
- Has passed all specified courses.
- Has applied for graduation and has been approved by the University.
- Has completed all four (4) short courses and one (1) test in UTM Professional Skills Certificate Programme.
- Other condition as specified.

### Entry Requirements

The minimum qualifications for candidates who intend to do a Bachelor of Engineering (Mechanical - Materials) are as follows:

1. Minimum results based on **the Malaysian High School Certificate (STPM)** (results would be based on the general requirements as well as other conditions as the pre-requisites for the programme set by the university).

#### University General Requirements:

- i. Passed Malaysian Certificate Examination (SPM) or its equivalent with a credit in Bahasa Melayu/Bahasa Malaysia or a credit in Bahasa Melayu/Bahasa Malaysia, July Paper.
- ii. Passed the Malaysian High School Certificate (STPM) or its equivalent and obtained the following:
  - a) **Grade C (NGMP 2.00)** General Studies/General Paper, and

- b) **Grade C (NGMP 2.00)** in two (2) other subjects
- iii. Passed the Malaysian University English Test (MUET) with minimum result of **Band 1**.

#### Programme Specific Requirements

- i. Obtained a **CGPA of 2.80**; and Passed with a minimum **Grade B- (NGMP 2.67)** in two (2) of the following subjects:
  - a) Mathematics T / Further Mathematics
  - b) Physics or Chemistry
- ii. Passed with at least a **Grade C** in Mathematics and Physics in the SPM level or equivalent.
- iii. Passed the Malaysian University English Test (MUET) with minimum result of **Band 2**.
- iv. Do not have any health problems that may affect their studies.

2. Minimum requirements for **Matriculation Certificates (KPM) / UM Science Foundation / UiTM Foundation** (fulfil the general requirements set by the university as well as other conditions of the programme).

#### General University Requirements

- i. Passed Malaysian Certificate Examination (SPM) or its equivalent with a credit in Bahasa Melayu/Bahasa Malaysia or a credit in Bahasa Melayu/Bahasa Malaysia, July Paper.
- ii. Passed the Matriculation Certificates (KPM) / UM Science Foundation / UiTM Foundation with a minimum **CGPA of 2.00** and passed all the core subjects.
- iii. Passed the Malaysian University English Test (MUET) with minimum result of **Band 1**.

#### Programme Specific Requirements

- i. Obtained a **CGPA of 2.80**; and Passed with a **Grade B- (2.67)** in two (2) of the following subjects:
  - a) Mathematics / Engineering Mathematics

- b) Physics / Engineering Physics or Chemistry / Engineering Chemistry
- ii. Passed with at least a **Grade C** in Mathematics and Physics in the SPM level or equivalent.
- iii. Passed the Malaysian University English Test (MUET) with minimum result of **Band 2**.
- iv. Do not have any health problems that may affect their studies.

3. Minimum qualifications for students with **Certificates/Diplomas** (fulfil the general requirements set by the university as well as specific requirements of the programme).

General University Requirements

- i. Obtained a Diploma or equivalent qualification recognised by the Malaysian Government and approved by the Senate.

or

- ii. Passed STPM examination in 2016 or before and obtained at least:

- a) **Grade C (NGMP 2.00)** General Studies/General Paper, and
- b) **Grade C (NGMP 2.00)** in two (2) other subjects

or

- iii. Passed the Matriculation Certificates (KPM) / UM Science Foundation / UiTM Foundation in 2017 or before and obtained minimum **CGPA of 2.00**.
- iv. Passed the Malaysian University English Test (MUET) with minimum result of **Band 1**.
- v. Passed Malaysian Certificate Examination (SPM) or its equivalent with a credit in Bahasa Melayu/Bahasa Malaysia or a credit in Bahasa Melayu/Bahasa Malaysia, July Paper.

Programme Specific Requirements

- i. Obtained a Diploma in Mechanical Engineering from UTM or equivalent with minimum **CGPA of 2.75**.

or

- ii. For those who obtained a **CGPA of less than 2.75** but have at least **two (2)**



years working experience in related field are eligible to apply.

or

- iii. Meet the minimum entry requirements as required for STPM holders.

or

- iv. Meet the minimum entry requirements as required for those who have completed the Matriculation Certificates (KPM) / UM Science Foundation / UiTM Foundation.
- v. Passed with at least a **Grade C** in Mathematics and Physics in the SPM level or equivalent.

or

- vi. Obtained at least a **C Grade (2.00)** in any one of the Mathematic courses at Diploma level.
- v. Passed the Malaysian University English Test (MUET) with minimum result of **Band 2**.
- vii. Do not have any health problems that may affect their studies.

**Note:**

Candidates are required to submit the results transcript of all their examinations taken during their Diploma study (semester one until the final semester) to UTM. A copy of the diploma or a letter of completion of study will also have to be submitted together with their applications.

**Year of entry and duration of study will be based on the credit exemptions approved by the UTM.**

**PROFESSIONAL SKILLS CERTIFICATE (PSC)**

Students are required to enrol in certificate programmes offered by the Centres of Excellence in the University and the School of Professional and Continuing Education (SPACE) during the duration of their studies in UTM. The four (4) short courses and one test are as follows:

1. How to Get Yourself Employed (HTGYE)
2. ISO 9001: 2008 Quality Management System Requirement (ISO)
3. Occupational Safety and Health Awareness (OSHA)
4. How to Manage Your Personal Finance (HTMYPF)
5. Test of English Communication Skills for Graduating Students (TECS):
  - (i) TECS 1001 (Paper I – Oral Interaction)
  - (ii) TECS 1002 (Paper II - Writing)

## **MOBILITY PROGRAMME (OUTBOUND)**

Universiti Teknologi Malaysia (UTM) is offering five (5) types of mobility programs which allow UTM Student to go abroad and join academic programs in universities, institutions or organizations in all over the world. The opportunities offered are as below:

**1. Study Abroad / Student Exchange**

Study Abroad/Student Exchange programme is a programme which allow student to spend one or two semesters at universities abroad and take courses in regular semester with credit transfer opportunity.

**2. Research Internship Abroad**

Research Internship is a program which allow student to join research study or internship under the supervision of an academic staff at universities or industries abroad from all over the world.

**3. Global Outreach Programme (GOP)**

GOP is a 7 to 14 days academic based program to experience various cultures in other countries. It includes immersion elements such as research & academic activities, social responsibility and cross cultural activities.

**4. International Invitation Programme**

Students participate in program organised by international institutions/ organisations with the following themes:

- (i) Seminar, Conference or Paper Presentation
- (ii) Cultural Exhibition and Conference
- (iii) Student Development Activity

**5. Summer School Abroad**

Summer School program is a program which is designed to provide educational opportunities in 4 to 8 weeks during summer holiday abroad. It is related to environment, local community, heritage and tradition.

Details and appropriate forms and procedures can be reached at **UTM International link:** <http://www.utm.my/international/outbound-mobility-programs/>

## COURSE MENU

| YEAR 1: SEMESTER 1      |   |   |   |     |           |               |
|-------------------------|---|---|---|-----|-----------|---------------|
| CODE                    | COURSE  | L | T | P/S | CREDIT    | PRE-REQUISITE |
| SEMM 1203               | Statics*  | 3 | 1 | 0   | 3         |               |
| SEMM 1503               | Engineering Drawing                                     | 2 | 0 | 3   | 3         |               |
| SEMM 1911               | Experimental Methods                                    | 1 | 0 | 0   | 1         |               |
| SEMM 1921               | Introduction to Mechanical Engineering                  | 1 | 0 | 0   | 1         |               |
| SSCE 1693               | Engineering Mathematics 1                               | 3 | 1 | 0   | 3         |               |
| SKEU 1002               | Electrical Technology                                   | 2 | 1 | 0   | 2         |               |
| ULAB 1122               | Academic English Skills                                 | 3 | 0 | 0   | 2         |               |
| UICI 1012/<br>UHAK 1022 | Islamic and Asian Civilisation/<br>Malaysian Studies 3# | 2 | 0 | 0   | 2         |               |
| <b>Total</b>            |   |   |   |     | <b>17</b> |               |

| YEAR 1: SEMESTER 2     |   |   |   |     |           |               |
|------------------------|---|---|---|-----|-----------|---------------|
| CODE                   | COURSE  | L | T | P/S | CREDIT    | PRE-REQUISITE |
| SEMM 1013              | Programming for Engineers                                     | 3 | 0 | 3   | 3         |               |
| SEMM 1113              | Mechanics of Solid I*   | 3 | 1 | 0   | 3         | SEMM 1203     |
| SEMM 1213              | Dynamics*   | 3 | 1 | 0   | 3         | SEMM 1203     |
| SEMM 1513              | Introduction to Design  | 2 | 0 | 3   | 3         | SEMM 1503     |
| UHAS 1172/<br>ULAM1012 | Malaysian Dynamics/<br>Malay Language for<br>Communication 2# | 2 | 0 | 0   | 2         |               |
| UHAK 1012              | Graduate Success<br>Attributes                                | 2 | 0 | 0   | 2         |               |
| UKQX xxx2              | Co-curriculum and Service<br>Learning Elective                | 2 | 0 | 0   | 2         |               |
| <b>Total</b>           |   |   |   |     | <b>18</b> |               |

| YEAR 2: SEMESTER 1 |                                    |   |   |     |           |                         |
|--------------------|------------------------------------|---|---|-----|-----------|-------------------------|
| CODE               | COURSE                             | L | T | P/S | CREDIT    | PRE-REQUISITE           |
| SEMM 2123          | Mechanics of Solids II*            | 3 | 1 | 0   | 3         | SEMM 1113               |
| SEMM 2313          | Mechanics of Fluids I*             | 3 | 1 | 0   | 3         | SEMM 1203,<br>SEMM 1013 |
| SEMM 2413          | Thermodynamics*                    | 3 | 1 | 0   | 3         |                         |
| SEMM 2921          | Laboratory I                       | 0 | 0 | 2   | 1         | SEMM 1911               |
| SSCE 1993          | Engineering Mathematics II         | 3 | 1 | 0   | 3         | SSCE 1693               |
| ULAB 2122          | Advanced Academic English Skills   | 3 | 0 | 0   | 2         | ULAB 1122               |
| UICL 2302          | Thinking of Science and Technology | 2 | 0 | 0   | 2         |                         |
| <b>Total</b>       |                                    |   |   |     | <b>17</b> |                         |

| YEAR 2: SEMESTER 2 |  |   |   |     |           |               |
|--------------------|--|---|---|-----|-----------|---------------|
| CODE               | COURSE                                   | L | T | P/S | CREDIT    | PRE-REQUISITE |
| SEMM 2223          | Mechanics of Machines and Vibration*     | 3 | 1 | 0   | 3         | SEMM 1213     |
| SEMM 2323          | Mechanics of Fluids II*                  | 3 | 1 | 0   | 3         | SEMM 2313     |
| SEMM 2433          | Applied Thermodynamic and Heat Transfer* | 3 | 1 | 0   | 3         | SEMM 2413     |
| SEMM 2613          | Materials Science                        | 3 | 1 | 0   | 3         |               |
| SEMM 2713          | Manufacturing Process                    | 3 | 1 | 0   | 3         |               |
| SSCE 1793          | Differential Equations                   | 3 | 1 | 0   | 3         | SSCE 1693     |
| <b>Total</b>       |  |   |   |     | <b>18</b> |               |

| YEAR 3: SEMESTER 1 |                                  |   |   |     |           |                             |
|--------------------|----------------------------------|---|---|-----|-----------|-----------------------------|
| CODE               | COURSE                           | L | T | P/S | CREDIT    | PRE-REQUISITE               |
| SEMB 3613          | Physical Metallurgy              | 3 | 0 | 0   | 3         | SEMM 2613**                 |
| SEMM 3233          | Control Engineering              | 3 | 0 | 0   | 3         | SEMM 1213**,<br>SSCE 1793** |
| SEMM 3523          | Component Design                 | 2 | 0 | 3   | 3         | SEMM 2123**,<br>SEMM 1513   |
| SEMM 3813          | Industrial Engineering           | 3 | 0 | 0   | 3         |                             |
| SEMM 3931          | Laboratory II                    | 0 | 0 | 2   | 1         | SEMM 2921                   |
| SKEU 2012          | Electronic                       | 2 | 0 | 0   | 2         | SKEU 1002                   |
| UHAK 1032          | Introduction to Entrepreneurship | 2 | 0 | 0   | 2         |                             |
| <b>Total</b>       |                                  |   |   |     | <b>17</b> |                             |

| YEAR 3: SEMESTER 2 |  |   |   |     |           |                         |
|--------------------|--|---|---|-----|-----------|-------------------------|
| CODE               | COURSE                                       | L | T | P/S | CREDIT    | PRE-REQUISITE           |
| SEMB 3623          | Mechanical Properties of Materials           | 3 | 0 | 0   | 3         | SEMM 2613**             |
| SEMM 3023          | Applied Numerical Methods                    | 3 | 0 | 0   | 3         | SEMM 1013,<br>SSCE 1793 |
| SEMM 3242          | Instrumentation                              | 1 | 0 | 3   | 2         | SKEU 2012**             |
| SEMM 3823          | Engineering Management, Safety and Economics | 3 | 0 | 0   | 3         |                         |
| SEMM 3941          | Laboratory III                               | 0 | 0 | 3   | 1         | SEMM 3931               |
| SSCE 2193          | Engineering Statistics                       | 3 | 1 | 0   | 3         |                         |
| ULAB 3162          | English for Professional Purposes            | 3 | 0 | 2   | 2         | ULAB 1122,<br>ULAB 2122 |
| <b>Total</b>       |  |   |   |     | <b>17</b> |                         |

| YEAR 3 : SHORT SEMESTER |                     |   |   |     |          |  |
|-------------------------|---------------------|---|---|-----|----------|--|
| CODE                    | COURSE              | L | T | P/S | CREDIT   | PRE-REQUISITE  |
| SEMM 3915               | Industrial Training |   |   |     | 5        | ## SEMM 2123**,<br>SEMM 2223**,<br>SEMM 2323**,<br>SEMM 2433** |
| <b>Total</b>            |                     |   |   |     | <b>5</b> |  |

| YEAR 4: SEMESTER 1      |                                 |   |   |     |           |   |
|-------------------------|---------------------------------|---|---|-----|-----------|---|
| CODE                    | COURSE                          | L | T | P/S | CREDIT    | PRE-REQUISITE   |
| SEMB 4613               | Materials Characterization      | 3 | 0 | 0   | 3         | SEMM 2613**   |
| SEMB 4623               | Corrosion and Corrosion Control | 3 | 0 | 0   | 3         |   |
| SEMB 46x3               | Elective I                      | 3 | 0 | 0   | 3         |   |
| SEMM 4533               | System Design                   | 2 | 0 | 3   | 3         | SEMM 3523   |
| SEMM 4912               | Undergraduate Project I         | 0 | 0 | 6   | 2         | SEMM 2123**,<br>SEMM 2223**,<br>SEMM 2323**,<br>SEMM 2433** |
| UHAK 2xx2/<br>UICL 2XX2 | Elective Cluster 2@3            | 2 | 0 | 0   | 2         |   |
| <b>Total</b>            |                                 |   |   |     | <b>16</b> |   |

| YEAR 4: SEMESTER 2 |   |   |   |     |           |                              |
|--------------------|---|---|---|-----|-----------|------------------------------|
| CODE               | COURSE                                      | L | T | P/S | CREDIT    | PRE-REQUISITE                |
| SEMB 4633          | Materials Selection in Mechanical Design    | 2 | 0 | 2   | 3         |                              |
| SEMB 46x3          | Elective II                                 | 3 | 0 | 0   | 3         |                              |
| SEMM 4902          | Engineering Professional Practice           | 1 | 0 | 3   | 2         | Must be 3 <sup>rd</sup> year |
| SEMM 4924          | Undergraduate Project II                    | 0 | 0 | 12  | 4         | SEMM 4912                    |
| ULAX 1112          | Language Skills Elective (Foreign Language) | 2 | 0 | 0   | 2         |                              |
| UKQE 3001          | Extra-Curricular Experiential Learning      | 1 | 0 | 0   | 1         |                              |
| <b>Total</b>       |   |   |   |     | <b>15</b> |                              |

Subject to changes:

\* Core Courses – minimum passing grade is C (50%)

# University general course for international student only, international students are not required to take UICI 1012 (semester 1) and UHAS 1172 (semester 2).

\*\* Minimum grade D- (30%) in the pre-requisite courses

## Obtained minimum of 80 credits

Notes: L – Lecture, T – Tutorial, P/S – Practical/Studio

### Elective Courses

|    |           |                                    |
|----|-----------|------------------------------------|
| 1. | SEMB 4643 | Non Destructive Testing            |
| 2. | SEMB 4653 | Surface Engineering                |
| 3. | SEMB 4663 | Advanced and Functional Materials  |
| 4. | SEMB 4673 | Materials Processing               |
| 5. | SEMB 4683 | Nanomaterials                      |
| 6. | SEMB 4693 | Modelling in Materials Engineering |

## GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

| NO                                    | COURSE CODE | COURSE NAME                            | CREDIT EARNED (JKD) | CREDIT COUNTED (JKK) | TICK (/) IF PASSED |
|---------------------------------------|-------------|--|---------------------|----------------------|--------------------|
| <b>MECHANICAL ENGINEERING COURSES</b> |             |  |                     |                      |                    |
| 1                                     | SEMM 1013   | Programming for Engineers              | 3                   | 3                    |                    |
| 2                                     | SEMM 1113   | Mechanics of Solids I                  | 3                   | 3                    |                    |
| 3                                     | SEMM 1203   | Statics                                | 3                   | 3                    |                    |
| 4                                     | SEMM 1213   | Dynamics                               | 3                   | 3                    |                    |
| 5                                     | SEMM 1503   | Engineering Drawing                    | 3                   | 3                    |                    |
| 6                                     | SEMM 1513   | Introduction to Design                 | 3                   | 3                    |                    |
| 7                                     | SEMM 1911   | Experimental Methods                   | 1                   | 1                    |                    |
| 8                                     | SEMM 1921   | Introduction to Mechanical Engineering | 1                   | 1                    |                    |
| 9                                     | SEMM 2123   | Mechanics of Solids II                 | 3                   | 3                    |                    |
| 10                                    | SEMM 2223   | Mechanics of Machines & Vibration      | 3                   | 3                    |                    |
| 11                                    | SEMM 2313   | Mechanics of Fluids I                  | 3                   | 3                    |                    |
| 12                                    | SEMM 2323   | Mechanics of Fluids II                 | 3                   | 3                    |                    |
| 13                                    | SEMM 2413   | Thermodynamics                         | 3                   | 3                    |                    |
| 14                                    | SEMM 2433   | Applied Thermodynamics & Heat Transfer | 3                   | 3                    |                    |
| 15                                    | SEMM 2613   | Materials Science                      | 3                   | 3                    |                    |
| 16                                    | SEMM 2713   | Manufacturing Processes                | 3                   | 3                    |                    |
| 17                                    | SEMM 2921   | Laboratory I                           | 1                   | 1                    |                    |
| 18                                    | SEMM 3023   | Applied Numerical Methods              | 3                   | 3                    |                    |
| 19                                    | SEMM 3233   | Control Engineering                    | 3                   | 3                    |                    |
| 20                                    | SEMM 3242   | Instrumentation                        | 2                   | 2                    |                    |
| 21                                    | SEMM 3523   | Component Design                       | 3                   | 3                    |                    |
| 22                                    | SEMM 3813   | Industrial Engineering                 | 3                   | 3                    |                    |



|  |           |  |            |           |  |
|--|-----------|--|------------|-----------|--|
| 23   | SEMM 3823 | Engineering Management, Safety & Economics | 3          | 3         |  |
| 24   | SEMM 3915 | Industrial Training                        | 5          | HL        |  |
| 25   | SEMM 3931 | Laboratory II                              | 1          | 1         |  |
| 26   | SEMM 3941 | Laboratory III                             | 1          | 1         |  |
| 27   | SEMM 4533 | System Design                              | 3          | 3         |  |
| 28   | SEMM 4902 | Engineering Professional Practice          | 2          | 2         |  |
| 29   | SEMM 4912 | Undergraduate Project I                    | 2          | 2         |  |
| 30   | SEMM 4924 | Undergraduate Project II                   | 4          | 4         |  |
| 31   | SEMB 3613 | Physical Metallurgy                        | 3          | 3         |  |
| 32   | SEMB 3623 | Mechanical Properties of Materials         | 3          | 3         |  |
| 33   | SEMB 4613 | Materials Characterization                 | 3          | 3         |  |
| 34   | SEMB 4623 | Corrosion & Corrosion Control              | 3          | 3         |  |
| 35   | SEMB 4633 | Materials Selection in Mechanical Design   | 3          | 3         |  |
| 36   | SEMB 46x3 | Elective I                                 | 3          | 3         |  |
| 37   | SEMB 46x3 | Elective II                                | 3          | 3         |  |
| <b>TOTAL CREDIT FOR MECHANICAL ENGINEERING COURSES (A)</b>       |           |  | <b>101</b> | <b>96</b> |  |
| <b>ELECTRICAL COURSES<br/>(School of Electrical Engineering)</b> |           |  |            |           |  |
| 1  | SKEU 1002 | Electrical Technology                      | 2          | 2         |  |
| 2  | SKEU 2012 | Electronics                                | 2          | 2         |  |
| <b>TOTAL CREDIT FOR ELECTRICAL COURSES (B)</b>                   |           |  | <b>4</b>   | <b>4</b>  |  |
| <b>MATHEMATICS COURSES<br/>(Faculty of Science)</b>              |           |  |            |           |  |
| 1  | SSCE 1693 | Engineering Mathematics I                  | 3          | 3         |  |
| 2  | SSCE 1793 | Differential Equations                     | 3          | 3         |  |
| 3  | SSCE 1993 | Engineering Mathematics II                 | 3          | 3         |  |
| 4  | SSCE 2193 | Engineering Statistics                     | 3          | 3         |  |

|   |           |  |           |           |  |
|---|-----------|--|-----------|-----------|--|
| <b>TOTAL CREDIT FOR MATHEMATICS COURSES (C)</b>                   |           |  | <b>12</b> | <b>12</b> |  |
| <b>UNIVERSITY GENERAL COURSES</b>                                 |           |  |           |           |  |
| <b>CLUSTER 1: APPRECIATION OF PHILOSOPHY, VALUE &amp; HISTORY</b> |           |  |           |           |  |
| 1   | UICI 1012 | Islamic & Asian Civilization<br>(for local students only)                  | 2         | 2         |  |
|   | UHAK 1022 | Malaysian Studies 3<br>(for international students only)                   |           |           |  |
| 2   | UHAS 1172 | Malaysian Dynamics<br>(for local students only)                            | 2         | 2         |  |
|   | ULAM 1012 | Malay Language for<br>Communication 2<br>(for international students only) |           |           |  |
| <b>CLUSTER 2: GENERIC SKILLS</b>                                  |           |  |           |           |  |
| 1   | UHAK 1012 | Graduate Success Attributes  | 2         | 2         |  |
| 2   | UHAK 2xx2 | Generic Skills Elective#   | 2         | 2         |  |
| <b>CLUSTER 3: KNOWLEDGE EXPANSION</b>                             |           |  |           |           |  |
| 1   | UICL 2302 | Thinking of Science &<br>Technology  | 2         | 2         |  |
| 2   | UICL 2xx2 | Knowledge Expansion Elective#  | 2         | 2         |  |
| <b>CLUSTER 4: CO-CURRICULUM &amp; SERVICE LEARNING</b>            |           |  |           |           |  |
| 1   | UKQX xxx2 | Co-curriculum & Service<br>Learning Elective                               | 2         | 2         |  |
| 2   | UKQE 3001 | Extra Curricular Experiential<br>Learning                                  | 1         | 1         |  |
| <b>CLUSTER 5: LANGUAGE SKILLS</b>                                 |           |  |           |           |  |
| 1   | ULAB 1122 | Academic English Skills  | 2         | 2         |  |
| 2   | ULAB 2122 | Advanced Academic English<br>Skills  | 2         | 2         |  |
| 3   | ULAB 3162 | English for professional<br>Purposes                                       | 2         | 2         |  |
| 4   | ULAX 1112 | Language Skills Elective<br>(Foreign Language)                             | 2         | 2         |  |
| <b>CLUSTER 6: ENTREPRENEURSHIP</b>                                |           |  |           |           |  |
| 1   | UHAK 1032 | Introduction to<br>Entrepreneurship  | 2         | 2         |  |

|  |   |   |            |  |
|--|---|---|------------|--|
| <b>TOTAL CREDIT FOR UNIVERSITY GENERAL COURSES (D)</b> |   | <b>23</b>   | <b>23</b>  |  |
| <b>TOTAL CREDIT TO GRADUATE (A + B + C + D)</b>        |   | <b>140</b>  | <b>135</b> |  |
| Note: # Choose either UHAK 2xx2 or UICL 2xx2           |   |   |            |  |
| <b>OTHER COMPULSORY COURSES</b>                        |   |   |            |  |
| <b>PROFESSIONAL SKILLS CERTIFICATE (PSC)</b>           |   |   |            |  |
| 1  | GLL 1001                                    | How To Get Yourself Employed                        |            |  |
| 2  | GLL 1029                                    | ISO 9001:2008 Quality Management System Requirement |            |  |
| 3  | GLL 1040                                    | Occupational Safety, Health and Environment         |            |  |
| 4  | GLL 1041                                    | How to Manage Your Personal Finance                 |            |  |
| 5  | Test of English Communication Skills (TECS) |   |            |  |
|  | TECS 1001                                   | Oral Interaction                                    |            |  |
|  | TECS 1002                                   | Writing   |            |  |

## COURSE SYNOPSIS

### COURSE SYNOPSIS FOR B. ENG (MECHANICAL - MATERIALS)

#### CORE COURSES

##### **SEMM 1013 Programming for Engineers**

This course formally introduces the concept of computers, algorithms, programming languages, pseudo-code, and design of programs for solution to computational engineering problems. The two programming languages introduced in this course are C and MATLAB. Topics covered in this course include data types, constants, variables, arithmetic operations, assignment statement, looping, formatted I/O, functions, arrays, matrix operations, data structures, plotting and model building.

##### **SEMM 1113 Mechanics of Solids I**

The course provides students with the knowledge to determine the strength and stiffness of engineering structures being used. The structures that will be used in this course are bars, pins, bolts, shafts and beams and the types of applied loadings are axial forces, deformations due to the change in temperature, torsional loads, transverse loads and combination of these loads. At the end of the course, students should be able to determine the mechanical properties of the materials with respect to their strength and stiffness. Students should be able to calculate stresses, strains and deformations in structures due to various types of loading conditions. In addition, they should be able to solve problems related to statically determinate and indeterminate structures.

### **SEMM 1203 Statics**

This course introduces students to the part of mechanics which is a pre-requisite for most engineering courses including SEMM 1213, SEMM 2313 and SEMM 1113. The course enables student to acquire the essential basic knowledge of resultant and equilibrium of forces. It will examine key elements in producing free body diagrams for particles and rigid bodies, as essential first step in solving applied mechanics problems. Exposure to the concept of moment and equilibrium equations with reference of Newton's Law enhances the relevance of friction, trusses, frames and machines applications. Students are also introduced to the concept of distributed forces, which include centroid and centre of gravity and the generated surface area and volume of revolution. Hence, students will be able to demonstrate and apply the knowledge in continuing subjects which requires the analytical skills developed in this subject.

### **SEMM 1213 Dynamics**

The course is an extension to SEMM 1203, which is the pre-requisite to this course. It introduces students to the part of mechanics which considers the action of forces in producing motion. This course provides an exposure to students on the theory of the kinetics and kinematics of particles and rigid bodies. The concepts of energy, work, momentum and impulse are also introduced. At the end of the course students should be able to apply the principles to study and analyse the behaviour and responses of dynamical systems. They should also be able to solve the dynamic problems related to the determination of forces energy and power to move a body.

### **SEMM 1503 Engineering Drawing**

This subject introduces student to the use of technical drawing in an effective way for communicating and integrating with engineering concepts. Such environment will provide a platform where the engineer can share and exchange information. This subject will also enlighten the student on the significant changes in the engineering and technical graphic due to the use of computer and CAD (Computer Aided Design) software. At the end of the course, student should be able to apply the skill and knowledge of engineering drawing to interpret design, using graphics method such as geometric drawing, orthographic projection, isometric, machine drawing, detailed drawing, and basic CAD software.

### **SEMM 1513 Introduction to Design**

This course is designed to introduce students to the concepts and methods of engineering design process in solving engineering design problems, creatively and effectively. The design process introduces problem background, concept generations and selections, development of selected concept and testing of selected concept by constructing and testing a prototype. This course serves as a preparation for students to proceed to higher level design classes.

### **SEMM 1911 Experimental Methods**

This course is conducted via lectures and experimental case study data. Students are exposed to the experimental method theory for the initial weeks and then followed by case study data. The lecture contents shall cover the fundamental of experimental method and the basic principles in measurements, instrumentation and analysis of results. It shall focus on the design of mechanical experiments, selection of sensors and transducers, estimation of errors and display of results. It shall also cover the analysis of results and how to prepare proper report writing. Student comprehension will be tested in two written tests. Based on the given experimental data, students are also expected to conduct statistical analysis of results and write the experimental outcome in a report.

### **SEMM 1921 Introduction to Mechanical Engineering**

This course comprises of two modules intended to introduce students to the field of mechanical engineering. The first module raises the student's awareness to the importance

and necessity of developing habits of systematic analysis in solving engineering problems. It introduces the UTM graduate attributes and highlights the importance of generic skills to engineers. It also provides students with a clear overview of different fields within Mechanical Engineering and a description of the mechanical engineer's work and professional responsibilities. It discusses the education requirements for today's mechanical engineers as well as exposes the students to the skill required for an engineer entrepreneur. This course introduces students to the field of mechanical engineering. It raises the student's awareness to the importance and necessity of developing habits of systematic analysis in solving engineering problems. It introduces the UTM graduate attributes and highlights the importance of both technical and generic skills to mechanical engineers. It also provides students with a clear overview of different fields within mechanical engineering and a description of the mechanical engineer's work and professional responsibilities. It discusses the education requirements for today's mechanical engineers as well as exposes the students to the skills required for an engineering entrepreneur.

### **SEMM 2123 Mechanics of Solids II**

The course is an extension to SEMM 1113, which is the pre-requisite to this course. It aims to extend the student's knowledge and understanding of the behaviour of materials and structures under a variety of loading conditions. The course starts off with plane stress and plane strain transformation, following which several elastic failure criteria's are investigated. The course provides an opportunity to investigate thick cylinders, structural deformation behaviour by using the energy method, instability problems of struts and elasto-plastic bending of beams. Determinate and indeterminate problems will be examined. At the end of the course, students should be able to calculate and evaluate stress, strain and deformation of structures in torsion and bending. They should also be able to evaluate failure modes and estimate fracture life of structures and components. The aspect of designing safe components and structures shall also be emphasized to the students.

### **SEMM 2223 Mechanics of Machines and Vibration**

The course requires SEMM 1213 as the pre-requisite. It is designed to expose students to the application of concepts in mechanics (statics and dynamics) to solve real world mechanical engineering problems pertaining to various machines which include belt and pulley systems, gears, flywheels, governors and gyroscopes. Students will also be exposed to the methods of balancing rotating masses and parts of a combustion engine. The concept of vibration with respect to one-degree-freedom is also studied. At the end of the course, the students should be able to solve problems related to various mechanical systems. In addition, they should be able to evaluate analytically the parameters of components of various machines under study.

### **SEMM 2313 Mechanics of Fluids I**

The principle aim of this course is to provide students with an understanding of the properties of fluids and to introduce fundamental laws and description of fluid behaviour and flow. It will emphasize on the concept of pressure, hydrostatic pressure equation and its application in the measurement of pressure, static force due to immersed surfaces, floatation and buoyancy analysis. Dynamic flow analysis inclusive of technique in solving flow problems is introduced especially to solve flow measurement, mass or volumetric flow rate, momentum in flow and loss in pipe network. Lastly, some basic dimensional analysis and similarities will be introduced. At the end of the course, the student should be able to demonstrate an ability to analyze whether statically, dynamically or kinematically problems related directly to fluids.

### **SEMM 2323 Mechanics of Fluids II**

This course is designed to enhance the basic knowledge that has been developed in the first stage of Fluid Mechanics and expose the students in analysing hydrodynamically the

flow field. It will emphasize on the analysis and the importance of ideal, boundary layer, and compressible flow in a practical engineering applications. The course will also provide the analysis of flow through fluid machines such as pump and turbine. At the end of the course, students should be able to demonstrate and apply the theory to solve problem related to flow of fluids.

### **SEMM 2413 Thermodynamics**

Thermodynamics is a basic science that deals with energy. This course introduces students to the basic principles of thermodynamics. It will discuss basic concepts and introduces the various forms of energy and energy transfer as well as properties of pure substances. A general relation for the conservation of energy principle expressed in the First Law of Thermodynamics will be developed and applied to closed systems and extended to open systems. The second law of thermodynamics will be introduced and applied to cycles, cyclic devices and processes.

### **SEMM 2433 Applied Thermodynamics & Heat Transfer**

This course aims to develop a fundamental understanding of the processes by which heat and energy are inter-related and converted and by which heat is transferred. The course will review major principles of energy conversion and the modes of heat transfer. The basic laws of thermodynamics and the governing equations for heat transfer and thermodynamics will be introduced and subsequently used to solve practical engineering problems involving thermodynamics and heat transfer. The course will also cover fundamental principles of power generation systems.

### **SEMM 2613 Materials Science**

This course introduces students to the fundamentals of materials science and engineering with emphasis on atomic bonding, crystal structures and defects in metals. It will introduce students to the various classes of materials including metals, ceramics, polymers and composites and their fundamental structures. The course will also provide basic diffusion mechanisms, metal solidification phase diagrams and heat treatment processes. At the end of the course, students should be able to apply the knowledge of atomic bonding and crystal structures to predict the physical and mechanical behaviour of materials, and use the principles of phase diagrams and heat treatments to the design of materials and their properties.

### **SEMM 2713 Manufacturing Processes**

This course discusses the fundamental aspect of various traditional and non-traditional manufacturing processes for metal and non-metal components. It starts from the overall introduction on manufacturing aspects followed by polymer shaping processes, casting processes, joining processes, metal forming processes and machining processes including CNC and CAM. At the end of this course, the students should be able to select suitable manufacturing processes to produce a part/product. The knowledge gained from this course also allows students to make right decision in designing products based on process requirements.

### **SEMM 2921 Laboratory I**

This course is introduced in the second year of the Mechanical Engineering programme involving two hours per week session and experimental based courses. It consists of six laboratories; Strengths of Materials Laboratory, Materials Science Laboratory, Mechanics of Machines Laboratory, Electrical Laboratory and Fluid Laboratory. Students will be grouped into 5 to 6 people for each experiment. It is based on the theory that have been learned in the particular courses at the same semester. In general, every student has to carry out a total of twelve experiments. At the end of the session, students have to submit a report for each experiment and will be evaluated based on this report.

### **SEMM 3023 Applied Numerical Methods**

This course formally introduces the steps involved in engineering analysis (mathematical modelling, solving the governing equation, and interpretation of the results). Examples of case studies in applied mechanics, strength of materials, thermal science, and fluid mechanics are presented. Methods for solving the nonlinear equations, simultaneous linear algebraic equations, eigenvalue problem, interpolation, numerical differentiation, numerical integration, initial value problems, boundary value problem and partial differential equation are introduced.

### **SEMM 3233 Control Engineering**

The course shall cover the essential and basic theory of control engineering. It shall cover the followings: open and closed-loop systems, manipulation of block diagram, signal flow graph and *Mason's* rule, concept of transfer function, time response analysis, classification of system, control action, stability analysis, *Routh* criteria, root locus method, frequency analysis, *Nyquist* and *Bode* plots, relative stability from *Nyquist* and *Bode* diagrams and design of control system. MATLAB and Simulink software package shall be taught and used as a tool in solving control engineering problems where appropriate.

### **SEMM 3242 Instrumentation**

The course shall cover the essential and basic theory of instrumentation for undergraduate. It shall cover the following: fundamentals and components of instrumentation system, characteristics of instrumentation system, signal conditioning and application of sensors in measurements.

### **SEMM 3523 Components Design**

This course is designed to expose students in analysing machine design element failure theories. This includes failure due to static and fatigue loads. It involves fatigue strength and endurance level, modified stress Goodman diagram and fatigue design under tensile and combined stresses. The content will encompass the design and selection of bolts, welding, spring, ball and roller bearing, gears and belts. At the end of the course, students should have the capabilities to identify, analyse and design the machine elements in the perspective of static and fatigue failure aspect.

### **SEMM 3813 Industrial Engineering**

This course introduces students to various theories, principles and the importance in the area of industrial engineering and project management. It covers issues related to productivity, quality, work study, ergonomics, facilities planning and project scheduling. The contents give some brief exposure on the concept and application of overall discipline for an industrial engineer. Some calculations or measurements are introduced as an approach before deciding the best alternative. Students should be able to describe fundamental aspects of project management and integrate knowledge in engineering and project management. In project management, students are exposed to several steps in developing project plan, managing risks, scheduling resources reducing project duration, and progress and performance measurement. At the end of the course, students should be able to apply various concept and tools in selecting the best alternative in terms of man, machine, materials, method and management and planning and monitoring engineering projects.

### **SEMM 3823 Engineering Management, Safety and Economics**

This course aims to prepare students with basic management knowledge, safety and engineering economy. The management part will examine key issues in management and organization, past management and today, strategic management, organizational structure and design, human resource management, motivating employees and leadership. Major topics covered under safety are OSHA 1994, Factories and Machinery Act 1967, hazard identification, risk assessment and control, basic principles of accident prevention and occupational health. In engineering economy, students are exposed to

engineering economic principles and methods of engineering economic analysis. At the end of the course, students should be able to describe fundamental aspects of management; integrate knowledge in engineering and management in making business decisions; apply the principles of hazard identification, risk assessment/control; plan, design and implement an effective safety program; and also perform engineering economic analysis to solve problems and evaluate engineering investment/projects.

### **SEMM 3915 Industrial Training**

Industrial training exposes students to the real work setting in various industries for 12 weeks. The students are placed in industries that best suit their area of studies. It is an experiential learning that requires the students to learn the process and able to apply their knowledge acquired in class in actual industrial setting. The knowledge acquired during practical training may be used later in final year classes as well as to equip them with sufficient knowledge for job interviews.

### **SEMM 3931 Laboratory II**

This course is introduced in the third year of Mechanical Engineering programme involving two hours per week and experimental based courses. It consists of six laboratories; Strength of Materials Laboratory, Thermodynamics Laboratory, Materials Science Laboratory, Mechanics of Machines Laboratory, Electrical Laboratory and Fluids Laboratory. Students will be grouped into 5 to 6 for each experiment. It is based on the theory learned in the particular courses at the same semester. In general, every student has to carry out a total of twelve experiments. At the end of the session, students have to submit a report for each experiment and will be evaluated based on this report.

### **SEMM 3941 Laboratory III**

This course is introduced in the third year of the Mechanical Engineering programme involving two hours per week session and experimental based courses. It is divided into two parts; experimental work at System & Control and Vibration Laboratories and a problem- based-learning (PBL) laboratory (module) depending on the topics/labs facilitated by a lecturer. Students have to produce a short report for the experimental work similar to those in Laboratory I and II. The second part, i.e., the lab module is based on the PBL concept. Student have to plan and design their own experimental work right from the very beginning until the end of the module based on the topics given by the lecturer. Students will be grouped into 5 to 6 for each module. In general, every group have to conduct two experimental works and two modules. At the end of the session, students have to submit two short reports and two formal reports.

### **SEMM 4533 System Design**

This course is designed for students to gain detailed topical exposure to design methodologies and principles specific to the practice of mechanical design. Emphasis is on developing efficient and effective design techniques as well as project-oriented skills from both technical and non-technical considerations. At the end of this course, students should be able to identify and apply appropriate methodologies in performing design tasks, recognize the fundamental principles of mechanical designs and practices, formulate and apply general problem-solving strategies in the analysis of situations and potential problems and apply relevant industry standards in design. Student should also be able to communicate ideas and solutions in verbal and written forms by means of oral presentation and technical report.

### **SEMM 4902 Engineering Professional Practice**

This course introduces students to engineering ethics and an engineer's responsibilities towards safety, health and welfare of the public. It emphasizes on the engineer as a professional man, engineers & society, code of ethics and professional conduct, standards, laws and regulations pertaining to professional engineering practice. The course will also introduce students to organize, in a group, community service activities in a planned and



structured manner. At the end of the course, students should be able to demonstrate and apply engineering professional ethics in their career as an engineer.

### **SEMM 4912 Undergraduate Project I**

This course introduces the final year students on how to do academic research on their own by applying knowledge and skills they acquired from other courses. Given a topic on a project, students have to identify a problem, gather relevant information to the problem and propose solutions to problems. In this course, students have to do some literature surveys in order to understand the nature of the problem and investigate work done by other researchers in line with their work. The students are also required to propose a methodology on how to solve the problems. By the end of this course, the students are expected to submit and present their research proposal to be assessed by their supervisors and panel of assessors.

### **SEMM 4924 Undergraduate Project II**

This course is the continuation of Undergraduate Project (UGP) I. It enhances the students' knowledge and ability to identify and solve problems through academic research. It will provide an exercise for the student in carrying out research with minimum supervision and the ability to plan and manage their work effectively. This course will also develop the students' capability to present, discuss and analyze results of the research clearly, effectively and confidently in both oral presentation and in dissertation.

### **SEMB 3613 Physical Metallurgy**

The course introduces the student to the basics of materials crystal structures and stereographic projection. It also provides students with knowledge of atom diffusion in solids, phase diagrams and phase transformation. The course will provide detailed knowledge on steels using the Fe-C phase diagram and various heat treatments and the effect on mechanical properties. At the end of the course students should be able to apply knowledge acquired on phase diagrams and atomic diffusion to read, construct and predict the materials structure and mechanical properties and design suitable heat treatments that would give the optimum performance through the use of the interrelationship between microstructure-mechanical properties and processes.

### **SEMB 3623 Mechanical Properties of Materials**

This course introduces students to the fundamentals of dislocation theory and the role of these dislocations in predicting the metal's ability to deform plastically. It will focus on the mechanical behavior of all classes of materials (metals, polymers, ceramics and composites) under different stressing conditions such as fatigue, creep, and fracture. The course will also provide students with the principles of fracture mechanics and its application. The students also will be able to simulate and predict the mechanical behavior of materials using modern tools. At the end of the course the student should be able to link between the behaviour of materials and their structures and design procedures to control failure of materials.

### **SEMB 4613 Materials Characterisation**

This course will give an overview and the basic principles of the widely used materials characterisation techniques, namely, microstructure analysis using optical and electron microscopy, structure determination by x-ray diffraction and electron diffraction, chemical analysis by X-ray application, surface analysis by spectroscopy techniques and thermal analysis methods.

### **SEMB 4623 Corrosion and Corrosion Control**

This course introduces students to the basic principles of electrochemical and aqueous corrosion and oxidation of metals. The course will provide the principles that lead to metal corrosion and oxidation based on thermodynamics and Pourbaix diagrams, mixed potential theory and theory and application of passivity. The course will also provide knowledge on

the various forms of corrosion and methods to control namely, by design, materials selection, cathodic protection, coatings and the use of inhibitors. At the end of the course students should be able to apply the knowledge to determine whether corrosion will occur in any given environment and recognize the different types of corrosion as well as able to suggest a corrosion control system for protection against corrosive environment.

### **SEMB 4633 Materials Selection in Mechanical Design**

This course introduces students to the basic concepts of materials selection and provides systematic methodology for materials and process selection in engineering design. The course will emphasize on describing the relationship between component design and materials selection and how materials selection fits into the design process from concept to the final details. The interaction between the manufacturing process and material selection and the need to adopt concurrent engineering approach is described. The effect of environment and economic impact on materials and process selection is also introduced. The course provides students with case studies and project in which the methodology of materials and process selection utilizing computer and specialized software is used. By the end of the course students should be able to perform the necessary calculations, identify the design/functional requirements of materials properties and perform the selection of candidate materials.

## **ELECTIVE COURSES**

### **SEMB 4643 Non Destructive Testing**

This course aims to develop an understanding of the working principles associated with established and widely used techniques for non-destructive testing (NDT), specifically dye penetration, magnetic particle, eddy current, ultrasonic and radiography. Upon completion of this course, the students will be able to understand the working principle, needs and the technique to conduct the testing. This course will elaborate on the theory of each method, the probes needed, the mechanism to detect either surface or subsurface defects, the properties of materials to be tested, the test methods involved and the advantages and disadvantages of each method.

### **SEMB 4653 Surface Engineering**

This course covers the aspects of surface engineering, to develop fundamental understanding and the role of materials to allow surface selection for mechanical contacts and their surrounding environmental conditions. The course will explore a range of surface treatments and advanced coatings that are designed to minimize wear, friction and surface oxidation / corrosion. Applications and economics of surface treatments/coatings will be addressed by means of industrial case studies. The lectures will draw on examples from applications within the marine, oil and gas, aerospace and biomedical sectors. Emphasis will be placed on gaining sustainability through correct surface engineering technology. The economics of surface selection will be discussed for various examples, e.g. subsea components, machine tool coatings and thermal barrier coatings for aerospace.

### **SEMB 4663 Advanced and Functional Materials**

This course introduces students to the recent developments on the various classes of advanced and functional materials used in applications such as aerospace, automotive, biomedical and electronic industries. It will emphasize on the important properties exhibited by metallic, polymeric, ceramics and composite materials that make them selected for high-end and advanced applications. The physical and mechanical properties of the various classes of advanced materials (super alloys, titanium and aluminium alloys, intermetallic, biomaterials, electronic and magnetic materials) will be detailed as well as the processing techniques associated with producing these materials. The course will also cover smart materials such as shape memory alloys, Solar cell materials, fuel cells, high density energy storage batteries, Green materials, Smart sensors and actuators. The

students are enabled to describe structural setup and function of advanced and functional materials. They command modern synthesis techniques and are able to apply these techniques to the preparation of new compounds. The students can interpret and evaluate the results of various methods for structural analysis of functional materials and apply the knowledge to select suitable materials for a given engineering project.

### **SEMB 4673 Materials Processing**

This course introduces students to the manufacturing methods of engineering materials into the desired shapes. It starts with the basic concepts of manufacturing and processing and their applications to metals as it introduces students to solidification in casting, powder metallurgy, deformation processes. The course will examine the various processing methods for metals, ceramics, polymers and composite materials, including joining and recycling processes for metals, polymer and ceramics. The course emphasis on the role played by materials and their properties in selecting the optimum manufacturing method. At the end of the course students should be able to demonstrate the ability to relate structure of materials to properties and processing method.

### **SEMB 4683 Nanomaterials**

This course introduces students to fundamental aspects of nanomaterials and nanotechnology. The importance of the nanoscale materials and their improved properties compare to conventional materials. The principles and relative merits of a range of techniques for the fabrication of nanostructures in one dimensional and two dimensional materials including single atomic layer and multilayers are discussed. The analytical and imaging characterization techniques and the recent applications of nanomaterials in engineering such as electronics, energy devices and biomaterials will be briefly discussed.

### **SEMB 4693 Modelling in Materials Engineering**

This course introduces students to the basic concepts of computer modelling in materials science and engineering. The course covers basic principle in establishing numerical simulation for the evaluation of material properties and phenomena during material processing. It will emphasize on atomistic, mesoscopic and microscopic evaluation of material properties and behavior by computer simulations. In detail, molecular dynamic method will be given as an example of atomistic evaluation method, whereas discrete dislocation dynamics will be used for mesoscopic simulation method. For microscopic scale evaluation, phase-field method will be introduced as an example. At the end of the course students should be able to construct simple numerical modelling both in atomistic, mesoscopic and microscopic scale.