Engineering Materials and Processes (ENMAT101A)

Associate Degree of Applied Engineering
(Renewable Energy Technologies)
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1. Introduction

1.1. Subject overview

The selection of a material in an engineering application entails an extensive range of attributes. Material properties, manufacturing processes, product performance, life cycle measurements, environmental costs, safety and economic concerns compete in the choice of a particular material a component or system.

In this core subject, students will form a foundation understanding of engineering materials based on their microstructures and behaviour, and develop familiarity with general classes of engineering materials in theory, in the laboratory, and in practice. Students will examine the modifications and processes that are used to produce successful components and products. This understanding will be used to evaluate selected renewable energy hardware and critique the choices of materials and processes made by the original engineering design team.

1.2. Pre requisites and Co requisites

Co requisite: Introductory Engineering Maths and Physics (ENEMP101A)

1.3. Units of credit

10 Units of credit

1.4. ASCED Field of Education

Australian Standard Classification of Education (ASCED) Code: 039999 Engineering and Related Technologies
2. Subject aims and objectives

Aims

Students should acquire knowledge of the materials, processes and tools available to support the development and management of renewable energy equipment, products and services to meet government, corporate and consumer wants and needs.

Students will investigate a range of analysis methods applied to engineering materials (e.g. microstructure, macro properties, process, product cost) as well as sustainable design parameters (e.g. lifecycle and environmental cost analysis), and apply these to the material attributes in the design or development of specific renewable energy product/s. They will investigate materials in a range of learning environments (e.g. lecture / laboratory / research / hands-on group projects / site visits).

Objective

The objective of this subject is for students to understand and apply the currently recognised parameters and attributes that underlie material and process selection in an engineering environment, especially with regard to renewable energy technology.
3. Subject learning outcomes

Students completing this subject will be able to:

A. Identify and describe the properties and processes related to a wide range of engineering materials.

B. Research, analyse and synthesise information related to a wide variety of materials and processes in existing product design/s.

C. Determine material properties using appropriate tests, and interpret the reliability of this data.

D. Develop an ethically, socially and environmentally sustainable framework for the responsible specification and application of materials for engineering design solutions.

E. Apply knowledge, specify materials and select processes for design project/s related to renewable energy technology.

Graduate attributes

As a result of successfully completing this subject, you will have developed the following graduate attributes that will enhance your employability and contribution to the workforce in Australia.

<table>
<thead>
<tr>
<th>Graduate attribute</th>
<th>Abilities</th>
</tr>
</thead>
</table>
| 1. Graduates of the Program will apply the knowledge, techniques, skills, and modern tools of the engineering discipline to defined renewable energy technology activities. | 1.1.2 Demonstrate use of appropriate engineering theories, techniques and tools  
1.1.3 Implement Workplace Health, Welfare and Safety and other statutory requirements. |
| 2. Graduates of the Program will apply knowledge of the engineering discipline and renewable energy to practical applications of principles and technologies in a variety of contexts. | 2.1.1 Investigate materials and processes applied in renewable energy technologies and components.  
2.1.2 Specify the renewable technology components, equipment or system required to meet a given objective in compliance with the relevant standards and codes. |
<table>
<thead>
<tr>
<th>Graduate attribute</th>
<th>Abilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Graduates of the Program will <strong>communicate</strong> honestly and effectively using</td>
<td>3.1.1 Make effective use of engineering terminology, symbols and accepted</td>
</tr>
<tr>
<td>written, oral, and graphical communication in both technical and non-technical</td>
<td>modes of communication.</td>
</tr>
<tr>
<td>environments.</td>
<td>3.1.2 Communicate effectively with clients and the community.</td>
</tr>
<tr>
<td>4. Graduates of the Program will function effectively within both technical and</td>
<td>4.1.3 Contribute to group discussion and decision-making, meet obligations</td>
</tr>
<tr>
<td>business <strong>teams</strong> in the completion of engineering activities.</td>
<td>as a member of a group.</td>
</tr>
<tr>
<td>5. Graduates of the Program will identify, analyse and develop <strong>creative solutions</strong> to renewable energy technology, engineering and business problems.</td>
<td>5.1.1 Identify technical and non-technical issues of renewable energy technology.</td>
</tr>
<tr>
<td></td>
<td>5.1.2 Investigate design requirements for renewable energy technology.</td>
</tr>
<tr>
<td>6. Graduates of the Program will engage in self-directed continuing <strong>professional development</strong>.</td>
<td>6.1.2 Improve non-engineering knowledge and skills to assist in achieving engineering outcomes.</td>
</tr>
<tr>
<td>7. Graduates of the Program will protect public health and safety in the course of his or her activities, meet all <strong>legal and regulatory requirements</strong> and respect environmental and cultural diversity.</td>
<td>7.1.1 Demonstrate an awareness of environmental, community and political issues relating to renewable energy technologies in local and international contexts.</td>
</tr>
<tr>
<td></td>
<td>7.1.2 Make reasoned judgements on the application of renewable energy technologies.</td>
</tr>
</tbody>
</table>
4. Approach to learning and assessment

4.1. Teaching and learning

4.1.1. Methods of teaching and learning

Teaching and learning strategies and/or activities for this subject include:

- Lectures;
- Small group tutorials;
- Guest lecturers and/or site visits;
- Online learning materials;
- Independent and/or group research activities;
- Group discussion;
- Case study and situational analysis;
- Laboratory practical activities;
- Use of computers as a research and documentation development tool;
- Co-operative teamwork;
- Attendance of relevant conference and/or trade shows.

4.1.2. Integration of Academic Foundations

Program academic staff will provide student academic consultation as an integrated component of this subject. The following topics will be discussed in class and/or in tutorials when new academic concepts arise and when assessment briefs are discussed. These should include but should not be limited to:

Study and learning patterns:
- organising time for independent study at home or the campus;
- timetabling study as a priority amongst work and other commitments;
- time management;
- independent study time and using it effectively; and
- forming study groups with other students.

Academic note taking:
- Benefits of making your own notes in lectures and tutorials;
- using meaningful abbreviations in your notes; and
- visualising concepts and using mind maps, flow charts and thumbnail sketches.
Conducting independent and group based research:

- reading for learning;
- sources other than the internet – books, journals, standards, databases;
- using the library, asking for assistance from librarians;
- creating a research log and/or using software applications such as EndNote for managing research data, sources and referencing;
- the TAFE NSW Higher Education Harvard Referencing schema; and
- plagiarism issues and penalties concerned with not including appropriate citations.

Starting to write an essay and/or report:

- where do I start? – analysing the brief requirements and roughly outline your key ideas and responses in accordance with the prescribed structure;
- getting your thoughts together and organising them logically into an introduction, body and conclusion;
- paraphrasing, quoting and summarising
- utilising and integrating supporting research data and acknowledging sources appropriately; and
- Engineers Australia report writing standards and schema.

Presentation skills:

- presenting for different audiences;
- creating a visual presentation – use of technology and preparation of visual aids;
- personal presentation; and
- anticipating questions that may be asked and rehearsing responses.

Critical thinking and analysis:

- critical reading and interpretation of texts and research;
- academic argument and argument construction;
- logical reasoning and identifying false logic;
- original thinking and expression; and
- critical and descriptive writing.

Examination techniques.

In addition to the in-class components describe above, additional individual or group consultation with students may take place for reasons including but not limited to:

- clarifying/explaining subject and/or assessment requirements;
• clarifying/explaining assessment task requirements;
• advising on progression rules and completion requirements;
• assisting students to catch up with content from any lectures and/or tutorials they may have missed;
• advising students on strategies to complete assessment tasks;
• applying for extension of assessment due dates;
• providing feedback on performance; and
• providing professional information/advice.

4.2. Assessment

4.2.1. Method of assessment

<table>
<thead>
<tr>
<th>Assessment Type</th>
<th>When assessed</th>
<th>Weighting</th>
<th>Learning Outcomes Assessed</th>
<th>Graduate Attributes Assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Short answer test</td>
<td>Week 5</td>
<td>15%</td>
<td>A, C</td>
<td>1, 2, 3, 6, 7</td>
</tr>
<tr>
<td>2. Portfolio and/or written report on practicum work and experiments.</td>
<td>Reviewed week 7 (15%), Submitted week 15 (15%)</td>
<td>30%</td>
<td>A, B, C, D, E</td>
<td>1, 2, 3, 5, 6, 7</td>
</tr>
<tr>
<td>3. Collaborative report (min. two person collaboration; max. 2,000 words) on product designs and materials.</td>
<td>Week 13</td>
<td>15%</td>
<td>B, C</td>
<td>1, 2, 3, 4, 5, 6, 7</td>
</tr>
<tr>
<td>4. Written short answer and short essay-based examination.</td>
<td>Week 15</td>
<td>40%</td>
<td>A, B, C, D, E</td>
<td>1, 2, 3, 5, 6, 7</td>
</tr>
</tbody>
</table>
4.2.2. Criteria for assessment grading

Grades for individual assessment events and the subject as a whole are awarded as follows:

**HD = High Distinction**: marks ranging from 85 – 100%

Where the student has demonstrated highly original, relevant and sophisticated applications of research, appraisal, enquiry and evaluation techniques resulting in innovative concepts that challenge existing conventions in the field of study.

**D = Distinction**: marks ranging from 75 to 84%

Where the student has demonstrated a high level of performance indicating depth and breadth in research, appraisal, enquiry and evaluation with broad application of knowledge of theoretical concepts, and applied analytical thought.

**C = Credit**: marks ranging from 65 – 74%

Where the student has undertaken an innovative and creative interpretation of assessment briefs, and has provided evidence of extended research and inquiry applied to assessment tasks.

**P = Pass**: marks ranging from 50 – 64%

Where the student has met all requirements of assessment briefs to a satisfactory level.

**F = Fail**: marks under 50%

Where the student has not demonstrated satisfactory performance in assessment tasks or has failed to meet subject requirements.

**EF = Fail**: Failure of a *must pass* event

Where the student has an overall mark for subject at a passing level, but has not demonstrated satisfactory performance in an event deemed a *must pass event*, resulting in failure of the subject as a whole. ‘Fail’ is reported for the subject on the Transcript of Academic Record.

**WN = Withdrawn no penalty**:

Where the student has withdrawn from the subject:

- on or before the Census Date.
- after consultation, without penalty or
- due to serious illness or misadventure.

**DA = Deferred assessment**:

For approved reasons, health or misadventure, a student is allowed to resubmit an assessment or sit an exam at a later date.
4.2.3. Submission requirements

Your teacher will advise you of the format required for each assessment task and the format for submission, which may be electronically. You should also refer to http://courses.highered.tafensw.edu.au for details of submission requirements.

Each assessment task must include a cover sheet, which you can download from http://courses.highered.tafensw.edu.au. Additional information about general requirements for the submission of assessments is provided in the Student Handbook for this course. Please ensure that you familiarise yourself with this information.

4.3. Additional expectations of student participation

4.3.1. Expected attendance pattern

In addition to attending lectures, tutorials and other classes, students are expected to undertake self-paced study, including reading, application of theoretical knowledge to practice, and completion of assessment tasks.

Where a student is unable to attend face to face learning activities, the student should:

- Notify the teacher and/or tutor if they know in advance that they will be unable to attend lectures and/or tutorials.

- Provide a Medical Practitioner’s Certificate as evidence of their inability to attend a lecture and/or tutorial due to illness.

4.3.2. Supplementary learning activities

Students are expected to:

- Complete any pre-reading specified prior to attending lectures and tutorials.

- Attend relevant exhibitions, conferences, seminars and events nominated by their teachers and tutors.

- Access the subject website at least once per week to obtain information, instructions and updates on class activities from teachers and tutors.

- Access their institutional email accounts at least once per day to obtain information, instructions and updates on events and activities from faculty, teachers and tutors.

4.3.3. Student purchases and equipment required

Your teacher will advise you of any special equipment or requirements for the completion of this subject.
5. Subject schedule

<table>
<thead>
<tr>
<th>WEEK NO:</th>
<th>TOPICS AND ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Lecture (2 hrs): Ref 1, Ch 1: Engineering materials; Ref 1 Ch 2: Properties of materials. Laboratory 1 (2 hrs): Hardness test <strong>Readings:</strong> Callister: Ch 1, 2, 18-21 Ashby 1: Ch 1, 2 Ashby 2: Ch 1</td>
</tr>
<tr>
<td>Week 2</td>
<td>Lecture (2 hrs): Ref 1, Ch 3: Mechanical testing; Ref 1, Ch 4: The crystal structure of metals. Laboratory 2 (2 hrs): Tensile Test <strong>Readings:</strong> Callister: Ch 3, 6 Ashby 1: Ch 3, 4, 5 Ashby 2: Ch 2</td>
</tr>
<tr>
<td>Week 3</td>
<td>Lecture (2 hrs): Ref 1, Ch 5: Casting process; Ref 1, Ch 6: Mechanical deformation of metals; Ref 1, Ch 7: The mechanical shaping of metals. Laboratory 3 (2 hrs): Metal Casting <strong>Readings:</strong> Callister: Ch7, 11 Ashby 2: Ch 14</td>
</tr>
<tr>
<td>Week 4</td>
<td>Lecture (2 hrs): Ref 1, Ch 8: Alloys; Ref 1, Ch 9: Equilibrium diagrams; Ref 1, Ch 10: Practical microscopy Laboratory 4 (2 hrs): Microscopy / Welding samples <strong>Readings:</strong> Callister: Ch 9, 10 Ashby 2: Ch 2, 3, 4</td>
</tr>
<tr>
<td>WEEK NO</td>
<td>TOPICS AND ACTIVITIES</td>
</tr>
<tr>
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</tbody>
</table>
| Week 5  | Lecture (2hrs): Ref 1, Ch 11: Iron and steel; Ref 1, Ch 12: The heat-treatment of plain-carbon steels; Ref 1, Ch 13: Alloy steels; Ref 1, Ch 14: The surface hardening of steels; Ref 1, Ch 15: Cast iron; Laboratory 5 (2 hrs): Heat Treatment  
Readings:  
Callister: Ch 9, 10, 11  
Ashby 1: Ch 8, 9, 10  
Ashby 2: Ch 11, 12, 13 |
| Week 6  | Lecture (2hrs): Ref 1, Ch 16: Copper and its alloys; Ref 1, Ch 17: Aluminium and its alloys; Ref 1, Ch 18: Other non-ferrous metals and their alloys  
Laboratory 6 (2 hrs): Torsion, Bending Tests  
Readings:  
Callister: Ch 9, 10, 11  
Ashby 2: Ch 10 |
| Week 7  | Examination Week A:  
Assessment 1: Short answer test on content from lectures 1 to 5 - Material Structure and Steel: 15%  
Assessment 2 due: Portfolio of Laboratory Reports 1, 2, 3, 4 - 15% |
| Week 8  | Lecture (2hrs): Ref 1, Ch 19: Plastics materials and rubbers; Ref 1, Ch 20: Properties of plastics; Ref 1, Ch 21: Ceramics; Ref 1, Ch 22: Glasses; Ref 1, Ch 23: Composite materials; Ref 1, Ch 24: Fibre-reinforced composite materials;  
Laboratory 7 (2 hrs): Polymer tensile test, epoxy FRC, thermoforming  
Callister: Ch 13, 14, 15, 16  
Ashby 1: Ch 30, 31  
Ashby 2: Ch 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26 |
| Week 9  | Lecture (2hrs): Ref 1, Ch 25: Methods of joining materials; Ref 1, Ch 26: Causes of failure; Site Visit: e.g. Rolling Mill, Materials process/testing  
Callister: Ch 17  
Ashby 1: Ch 13, 14, 17, 18, 20, 22, 24  
Ashby 2: Ch 27, 28 |
| Week 10 | Lecture (2hrs): NDT; Material Standards  
Laboratory 8: Dye, Mag, Ultrasound |
| Week 11 | Lecture (2 hrs): Materials Selection and Design. Economic, Environmental, Social Issues  
Laboratory 9: Product Study  
Callister: Ch 22, 23 |
| Week 12 | Lecture (2 hrs): Materials and Processes in RE technology – Case studies 1-Solar technologies  
Laboratory 9 (2 hrs): Product Study (continued) |
<table>
<thead>
<tr>
<th>WEEK NO.</th>
<th>TOPICS AND ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 13</td>
<td>Lecture (2 hrs): Materials and Processes in RE technology – Case studies 2-Wind and other Assessment 3 due: Collaborative Report (Product Study) 20%</td>
</tr>
<tr>
<td>Week 14</td>
<td>Study Week</td>
</tr>
<tr>
<td>Week 15</td>
<td>Examination Week B: Assessment 2 due: Portfolio of Laboratory Reports 5, 6, 7, 8, 9 - 15% Assessment 4: Written examination: 35%</td>
</tr>
</tbody>
</table>
6. Recommended reference materials

6.1. Prescribed text


6.2. Readings


6.3 Journals and other publications


7. Online support

Learning materials for this subject will be available at [URL here].

Your teacher will provide additional materials such as handouts and podcasts of presentations by lecturers and guest speakers depending on availability, copyright and confidentiality arrangements. Your teacher will give you more information about this.

**Online resources**

8. Important information

Professional conduct and academic standards

TAFE NSW Higher Education encourages high standards of professional behaviour and academic conduct. You must conduct all work associated with this course in a manner that is environmentally, socially and culturally responsible, so as not to cause harm or disrespect to the environment, people or their values and beliefs.

You shall hold confidential all information about any specific organisation and their business or business activities, which may be divulged in the process of a work placement, lecture or tutorial, including lectures given by industry guest lecturers.

It is the policy of TAFE NSW Higher Education that respect and acknowledgement is given to intellectual property created by academics, writers, practitioners and other students whose work is cited in your submissions, or used to illustrate them.

It is therefore important to use Harvard citation system and include a bibliography with every submission, to acknowledge the intellectual property of others that you have used to support your own proposals or position.

Further information about Harvard citation format, Professional Conduct and Academic Standards is provided in the Student Handbook for this course. Please ensure that you familiarise yourself with this information.

Health, safety and environmental information

Information regarding emergency procedures, workplace health and safety and environmental responsibility are detailed in the Student Handbook for this course.

Please ensure that you familiarise yourself with this information and know where your emergency evacuation assembly areas are located.

Continuous improvement

Information will be collected from teachers and students throughout the subject and subsequently from graduates and other stakeholders to evaluate course effectiveness and efficiency, and adjustments will be made to ensure that the subjects remain current and relevant. Further details about the process of continuous improvement are contained in the Student Handbook for this course.

Finally

Talk to your teacher if you need clarification about anything included in this Subject Guide.
Appendix

A.1. Assessment - general submission requirements

Your teacher will advise you of the format required for each assessment task as well as how to submit, which may be electronically. The Higher Ed online area [http://courses.highered.tafensw.edu.au](http://courses.highered.tafensw.edu.au) also contains information on specific assessment requirements.

Each assessment task must include a cover sheet, which you can download from [http://courses.highered.tafensw.edu.au](http://courses.highered.tafensw.edu.au). Information about general requirements for the submission of assessments is provided in the Student Handbook for this course. Please ensure that you familiarise yourself with this information.

Refer to section 4.2.2 Criteria for assessment grading for the range of marks equating to High Distinction (HD), Distinction (D), Credit (C), Pass (P) or Fail (F).

A.2. Assessment schedule for Semester 1, 2014

Assessment 1: Short Answer Test - Weighting 15%
Learning Outcomes: A, C
Graduate Attributes: 1, 2, 3, 6, 7
Held: Week 7

For this assessment, you will be required to undertake a short answer test on topics related to learning outcomes A, B, and C.

Grades will be awarded on the basis of marks achieved, as follows:

- High Distinction - 85 – 100%
- Distinction - 75 – 84%
- Credit - 65 – 74%
- Pass - >50 – 64%
- Fail - <50%
Assessment 2: Portfolio and/or written report on practicum work and experiments - Weighting 30%
Learning Outcomes: A, B, C, D, E
Graduate Attributes: 1, 2, 3, 5, 6, 7
Due: Week 7 (Review) and Week 15 (Final submission)

For this assessment, students will be required perform laboratory tasks in the testing of engineering materials, and submit a report documenting each laboratory session.

Documentation of laboratory work will be consistently monitored through laboratory sessions by your lecturer and/or tutor, and handed in for marking in weeks 7 and 15.

Written submissions should be professionally presented in electronic format (no paper), with supporting visuals including diagrams, sketches, photos and other relevant illustrations embedded into a single file (original Word format plus Adobe PDF format).

All submissions must comply with the requirements listed in the Student Handbook.

Criteria for marking this individual assessment are given on the following page.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Marking Criteria</th>
</tr>
</thead>
</table>
| High Distinction 85 – 100% | • Used articulate and sophisticated visual and written modes of expression to communicate confidently and effectively.  
• Sophisticated theory, skills and knowledge of research methodology was applied confidently and effectively.  
• Analysed and interrogated theory, skills and knowledge and used outcomes to realise a creative and original response to the brief.  
• Reflected on critical observations, comments and feedback from peers, teachers and lecturers to improve working methods and realise a creative and original response.  
• Contributed ideas, critical observations, comments and feedback generously and confidently to peers. |
| Distinction 75 – 84% | • Communicated confidently and effectively using visual and written modes of expression.  
• Theory, skills and knowledge of research methodology were applied confidently and effectively.  
• Analysed theory and knowledge to the brief resulting in a range of innovative solutions.  
• Sought and responded critically to observations, comment and feedback from peers, teachers and lecturers to improve own working methods. |
# Engineering Materials and Processes (ENMAT101A)

## Grade Marking Criteria

<table>
<thead>
<tr>
<th>Grade</th>
<th>Marking Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Credit</strong></td>
<td>65 – 74%</td>
</tr>
<tr>
<td></td>
<td>• Communicated effectively using visual and written modes of expression.</td>
</tr>
<tr>
<td></td>
<td>• Theory, skills and knowledge of research methodology were applied effectively and efficiently.</td>
</tr>
<tr>
<td></td>
<td>• Applied and interpreted theory, skills and knowledge effectively in proposing innovative solutions in response to the brief.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pass</th>
<th>50 – 64%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Communicated clearly using visual and written modes of expression.</td>
</tr>
<tr>
<td></td>
<td>• Theory, skills and knowledge of research methodology were applied to a satisfactory level.</td>
</tr>
<tr>
<td></td>
<td>• Applies sustainability theory, skills and knowledge to development of solutions in response to the brief.</td>
</tr>
<tr>
<td></td>
<td>• Proposes workable solutions in response to the brief.</td>
</tr>
<tr>
<td></td>
<td>• Responded adequately to critical feedback.</td>
</tr>
<tr>
<td></td>
<td>• Observed and recorded work activities clearly and logically.</td>
</tr>
<tr>
<td></td>
<td>• Observed and evaluated their own work performance objectively.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fail</th>
<th>&lt;50%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Communication is insufficient, incoherent, superficial or inadequate.</td>
</tr>
<tr>
<td></td>
<td>• Theory, skills and knowledge of research methodology were not understood or applied.</td>
</tr>
<tr>
<td></td>
<td>• The response to the brief is superficial, inadequate or incomplete.</td>
</tr>
<tr>
<td></td>
<td>• Unable to take direction or respond to critical feedback.</td>
</tr>
<tr>
<td></td>
<td>• Lack of an established work methodology.</td>
</tr>
</tbody>
</table>

## Assessment Event 3 – Collaborative Report - Product Study (max. 1,500 words) - Weighting 15%

**Learning Outcomes:** B, C

**Graduate Attributes:** 1, 2, 3, 4, 5, 6, 7

**Due:** Week 7

For this assessment, a group (typically three students) will be required to produce a report on a chosen product that has components made from a range of materials and components. This must include various metals and plastics, and possibly ceramics. Most electrical appliances and electric tools are very suitable.

Written submissions should be professionally presented in electronic format (no paper), with supporting visuals including diagrams, sketches, photos and other relevant illustrations embedded.
into a single file (original Word format + Adobe PDF format). All submissions must comply with the requirements listed in the Student Handbook.

**Report Instructions**

- Choose a product that has components made from a range of materials and components. This must include various metals and plastics, and possibly ceramics. Most electrical appliances and electric tools are very suitable.

- No less than 25 components per student. (This may require sub-components to be taken "apart". For example: An electric motor contains many internal components of various materials and manufacturing processes). The ideal product would be something like a discarded power tools (e.g. A small angle grinder), appliances or small equipment (e.g. printers). Most things with a motor should be suitable. Unsuitable are products that tend to be made from one type of material, such as mostly hardened steel (e.g. hydraulic motor, gearbox components), mostly sheet metal (e.g. filing cabinet, computer case) or mostly plastic (e.g. lego, toys). Micro electronic products (e.g. phones) are not ideal since the miniature components are tricky to photograph and analyse. A larger product (e.g. photocopier) may be considered for a larger group at discretion of teacher.

- Divide the workload between each student in the team and come up with a consistent layout and identification system. Describe this demarcation in the final (combined) report.

**Example products**

Most electrical appliances and hand power tools are very suitable. Do not pull apart electrical products if you are not competent to reassemble them safely - which is why it is preferable that the product is discarded. Look for something that has components that are machined, cast, injection moulded, possibly sheet metal. Special treatment processes such as hardness are found in most cutters, tools and bearings. Powder metallurgy is common in bronze bearings. Die castings are common in tool and appliance gearboxes, motors. Injection moulded components are seen almost anywhere plastic is used. Many components are plated for corrosion resistance and appearance. Take note of "hidden" materials such as platings, coatings, adhesives and printing. Take note of "hidden" processes such as heat treatment, plating, finishing such as polishing.

Larger products could also be used, but this may be a problem if you have parts to bring in for identification.

**Part 1:** List all the components. (There should be at least 25 parts). Give every part a number, and also make up names for each component - an interesting task in itself! Designers and engineers often get the job of making up a name for something, and it’s not always easy. Try to make each name unique.

**Part 2:** Identify/estimate/assume the material that each component is made of. State how you made your identification. List some alternative materials that could have been used instead.

**Part 3:** Identify/estimate/assume and describe the processes that were probably used to produce each component listed in Part 2 - from the semi-finished materials. (i.e. Don’t describe the process of making a steel spring from iron ore, but from steel wire) Identify post-treatment processes such as heat treatment, coating, plating, painting etc for any relevant components.
Example exploded assembly drawing from a manual: (This is an angle grinder)

A student's photograph of a disassembled carburettor. This photo would have numbers or letters added for identification for reference in the report.

Criteria for marking this group assessment are given on the next page.
<table>
<thead>
<tr>
<th>Grade</th>
<th>Marking Criteria</th>
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</table>
| **High Distinction** 85 – 100% | • Group members used articulate and sophisticated visual and written modes of expression to communicate confidently and effectively.  
• Sophisticated research skills and methodologies were applied confidently and effectively.  
• Group members analysed and interrogated theory, skills and knowledge and used the outcomes to realise a creative and original response to the brief.  
• Group members led and initiated experimentation using a range of self-directed and team-based approaches.  
• Group members initiated potential direction and responded to critical feedback.  
• Group members collaborated enthusiastically in team work, demonstrating strong leadership of and cooperation with others in the team.  
• Group members contributed ideas generously and confidently, organised and facilitated the work of self and others. |
| **Distinction** 75 – 84% | • Group members communicated confidently and effectively using visual and written modes of expression.  
• Research skills and methodologies were applied confidently and effectively.  
• Group members analysed theory and knowledge to the brief and presented a range of innovative solutions in response.  
• Suggests and facilitates experimentation using a range of team-based approaches.  
• Group members proposed potential team initiatives and responded to critical feedback.  
• Group members observed and recorded work activities effectively and reflected on work tasks performed to refine own methodologies.  
• Group members observed and evaluated the individual and team work performance and offered suggestions to resolve issues and problems encountered by self and others in the team. |
| **Credit** 65 – 74% | • Group members communicated effectively with each other and lecturers and tutors using visual and written modes of expression.  
• Research skills and methodologies were applied effectively and efficiently.  
• Group members applied and interpreted theory, skills and knowledge effectively in proposing innovative solutions in response to the brief. |
<table>
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| Pass 50 – 64% | - Group members encouraged and participated in experimentation using a range of team-based approaches.  
- Group members contributed toward team direction, responded to critical feedback and worked collaboratively as member of a team.  
- Group members collaborated confidently with others in the team and contributed ideas generously to the brief response.  
- Group members observed and recorded work activities clearly and logically.  
- Group members observed and evaluated individual and team work and presented objective observations to improve their own working methods and those of others.  
- Group members communicate clearly using visual and written modes of expression.  
- Research skills and methodology were applied to a satisfactory level.  
- Knowledge of sustainability is applied to development of responses to the brief.  
- Workable solutions are proposed in response to the brief.  
- Group members worked collaboratively as member of a team.  
- Group members experimented with a range of team-based approaches to responding to the brief.  
- Group members responded to requests, direction and critical feedback from lecturers and tutors.  
- Group members observed and recorded their work activities clearly and logically.  
- Group members observed and evaluated individual and team work performance objectively. |
| Fail <50%    | - Communication/reporting is insufficient, superficial or inadequate.  
- Theory, skills and knowledge of research methodology are not understood or applied.  
- The response to the brief is inadequate or incomplete.  
- Group members have not engaged with a team-based approach.  
- Group members did not follow directions, respond to critical feedback and/or worked collaboratively as a team. |
Assessment Event 4 - Written examination - Weighting 40%
Learning Outcomes: A, B, C, D, E
Graduate Attributes: 1, 2, 3, 5, 6, 7
Held: Week 15

Criteria for marking this individual assessment are given below.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Marking Criteria</th>
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</thead>
</table>
| High Distinction 85 – 100% | • Used articulate and sophisticated modes of expression to communicate confidently and effectively.  
                             • Theory, skills and knowledge of engineering materials and processes were applied in a sophisticated manner.  
                             • Applied and interpreted theory, skills and knowledge creatively to propose original solutions in response to questions.  
                             • Proposed creative and often original solutions in response to given scenarios. |
| Distinction 75 – 84% | • Communication was confident and effective in response to the questions.  
                             • Theory, skills and knowledge of engineering materials and processes were applied confidently and effectively.  
                             • Applied and interpreted theory, skills and knowledge effectively in proposing creative solutions in response to the questions.  
                             • Proposed innovative and often creative solutions in response to given scenarios. |
| Credit 65 – 74% | • Communication was accurate and effective in response to the questions.  
                            • Theory, skills and knowledge of engineering materials and processes were applied effectively and efficiently.  
                            • Applied and interpreted theory, skills and knowledge effectively in proposing innovative solutions in response to questions.  
                            • Proposed workable and often innovative solutions in response to given scenarios. |
| Pass 50 – 64% | • Communication was coherent, clear and accurately in response to the questions.  
                            • Theory, skills and knowledge of engineering materials and processes were applied to a satisfactory level.  
                            • Applied theory, skills and knowledge to the development of logical answers in response to questions.  
                            • Proposed workable solutions in response to given scenarios. |
| Fail <50% | • Communication was incoherent, insufficient, superficial or inadequate.  
                            • Theory and knowledge of engineering materials and processes was not understood or applied.  
                            • The response to examination questions and scenarios was superficial, inadequate or incomplete. |

Acknowledgement: The development of marking criteria is adapted from guidelines created by Professor Richard J. Murnane, Harvard Graduate School of Education  