BOARD OF STUDIES
NEW SOUTH WALES

# Engineering Studies

## Stage 6

## Syllabus

**PLEASE NOTE**

The assessment and HSC examination requirements detailed in this syllabus refer to the 2009 HSC. New *Assessment and Reporting* information will apply to this syllabus for the 2010 HSC and beyond.

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# Contents

# 1 The Higher School Certificate Program of Study

The purpose of the Higher School Certificate program of study is to:

- provide a curriculum structure which encourages students to complete secondary education;

- foster the intellectual, social and moral development of students, in particular developing their:
  - knowledge, skills, understanding and attitudes in the fields of study they choose
  - capacity to manage their own learning
  - desire to continue learning in formal or informal settings after school
  - capacity to work collaboratively
  - respect for the cultural diversity of Australian society;

- provide a flexible structure within which students can prepare for:
  - further education and training
  - employment
  - full and active participation as citizens;

- provide formal assessment and certification of students' achievements;

- provide a context within which schools also have the opportunity to foster students' physical and spiritual development.

# 2 Rationale for Engineering Studies in Stage 6 Curriculum

In the 21st century, engineering will continue to be directed towards developing insight and understanding to the provision of infrastructure, goods and services needed for industry and the community.

No longer do engineers only formulate problems, provide solutions and integrate technical understanding. Key responsibilities for the profession now include responsible wealth creation, taking full responsibility of ethical considerations and the aim of sustainability in meeting the needs of society. With such key responsibilities, engineers now place increased importance on areas such as communication, synthesis and analysis of information, management skills and teamwork.

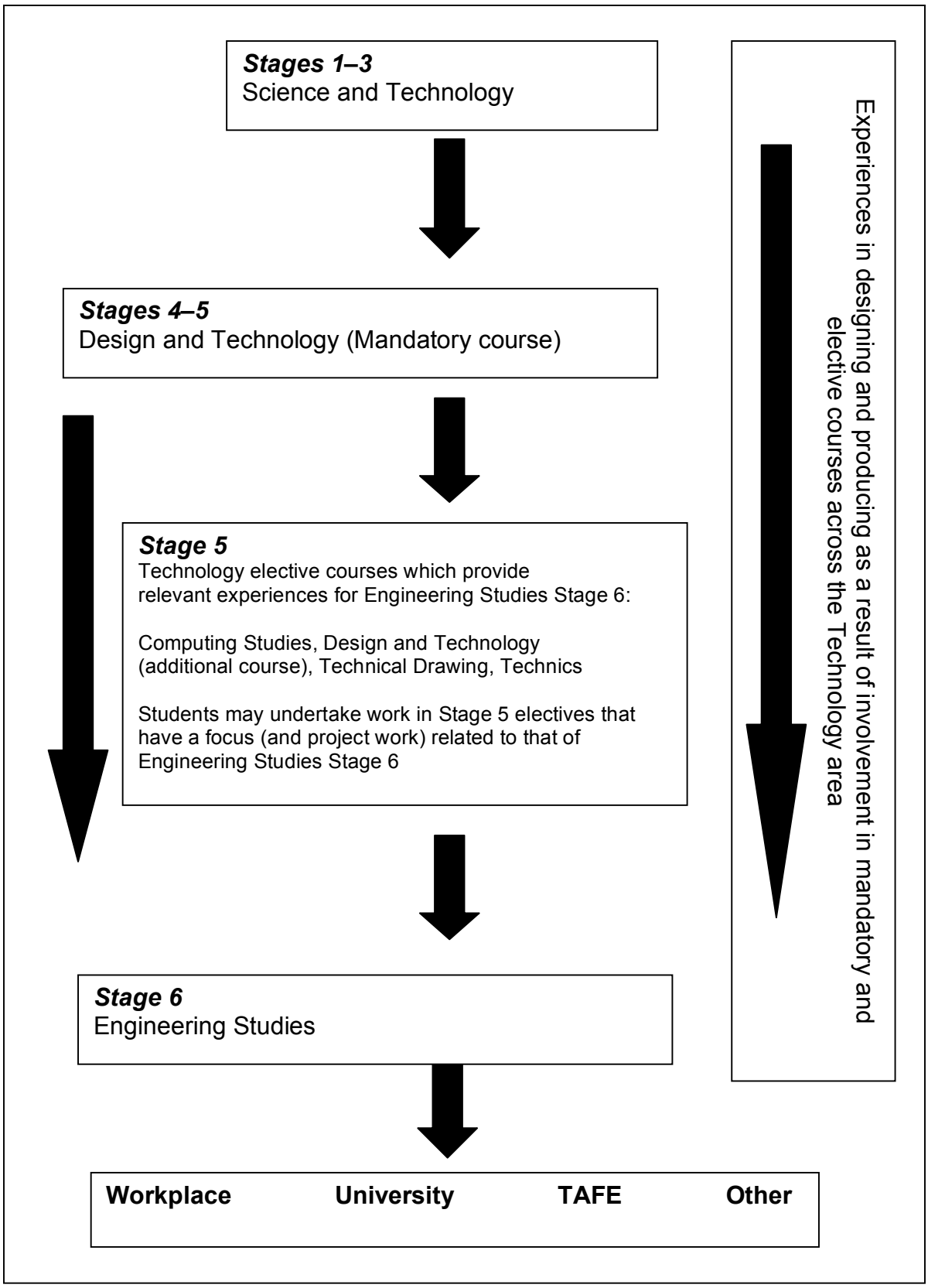
Professional engineering work is concerned with cost-effective, timely, reliable, safe, aesthetically pleasing and environmentally sustainable outcomes as well as maintaining a consciousness of ideals associated with social and ethical responsibilities and service.

Engineering Studies Stage 6 is directed towards the application and advancement of skills associated with mathematics, science and technology and is integrated with business and management. It will provide students with skills, knowledge and understanding associated with a study of engineering, its practices and associated methodologies. The subject promotes environmental, economic and global-awareness, problem-solving ability, engagement with information technology, self-directed learning, communication, management and skills in working as a team.

Engineering Studies Stage 6 is unique in that it develops knowledge and understanding of the profession of engineering. It also provides an opportunity to integrate the science and mathematics disciplines with societal development and change. The syllabus is inclusive of the needs, interests and aspirations of all students and provides opportunities and challenges to deal with engineering concepts.

Students undertaking Engineering Studies will have the opportunity to follow a number of pathways. These include tertiary, vocational education and training, and the world of work. For those following a pathway of further study, the insight and experience associated with a study of engineering will be beneficial in their presumed knowledge of the area of study. Those going into the world of work will benefit from understanding what engineers do, as the work of engineers affects us all.

# 3 Continuum of Learning for Engineering Studies Stage 6 Students



# 4 Aim

The aim of Engineering Studies Stage 6 is to develop students' understanding and appreciation of the nature and significance of engineering and its impact on society with an emphasis on the application of engineering methodology.

# 5 Objectives

Students will develop:

1. understanding of the scope of engineering and the role of the engineer;

2. knowledge and understanding of engineering principles and an appreciation of the responsibilities of engineers in society;

3. communication skills appropriate to engineering practices;

4. knowledge and understanding of developments in technology and an appreciation of their influence on people and engineering practice;

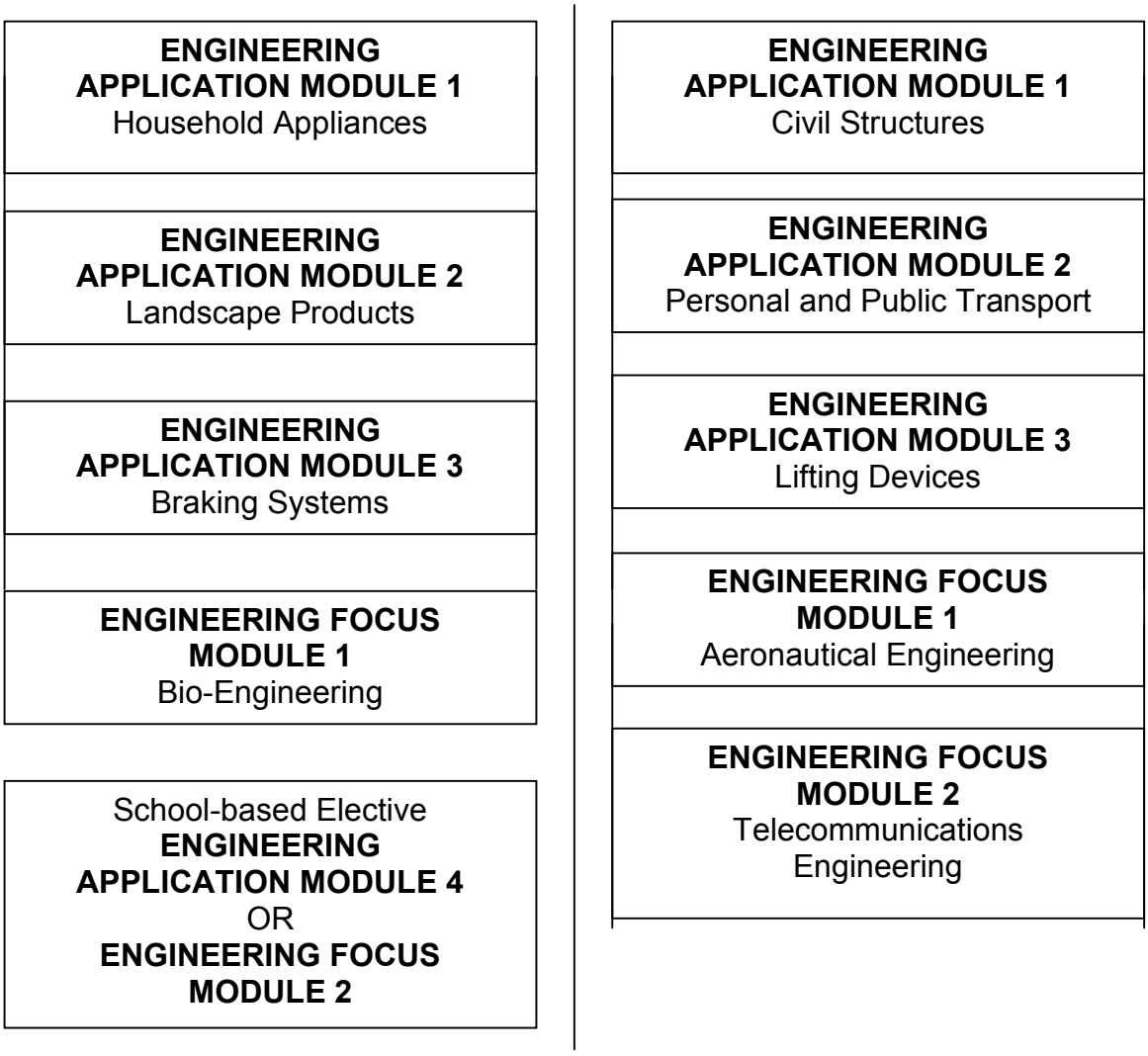
5. management and problem-solving skills in engineering contexts;

6. skills in the application of engineering methodology.

# 6 Course Structure

Engineering Studies Stage 6 comprises a Preliminary course made up of 4 compulsory modules and one elective module, and an HSC course made up of 5 compulsory modules.

**Schematic view of Engineering Studies Syllabus Structure**




* Each module is of 24 hours indicative time

## 6.1 Modules

A module is a discrete unit of study that integrates knowledge and understanding of various elements of engineering.

### Types of Modules

Two types of module are used to facilitate learning in the subject. These are **engineering application modules** and **engineering focus modules**.

An engineering application module develops knowledge and understanding of engineering concepts and impacts through the study of engineered products.

An engineering focus module develops a knowledge and appreciation of the role of engineers by emphasising a study of the nature of the engineering profession and the scope of engineering activities in a given field.

Three application modules and one focus module are prescribed for the Preliminary course, together with one module that will be developed as a school-based elective. If a focus module is selected by a school for study as the elective in the Preliminary course, it is to be developed from the engineering fields given below, but must not include any of the prescribed focus modules for the Preliminary and HSC years.

The prescribed focus modules in the Preliminary and HSC courses will be replaced periodically with modules developed from the following list:

- Aerospace Engineering
- Aeronautical Engineering
- Agricultural Engineering
- Automotive Engineering
- Bio-Engineering
- Chemical Engineering
- Civil/Structural Engineering
- Electrical/Electronic Engineering
- Environmental Engineering
- Marine Engineering
- Manufacturing Engineering
- Materials Engineering
- Mechanical Engineering
- Mechatronic Engineering
- Mining Engineering
- Nuclear Engineering
- Telecommunications

## 6.2 The Engineering Report

In the engineering profession an Engineering Report contributes to the effective management, communication, decision-making and teamwork by providing a synthesis of the various elements that are relevant to a given project. The report can be developed by individuals or different members of a team.

An Engineering Report can be developed for a new project which involves the synthesis of a new design, or it can be prepared as a result of the analysis of an existing engineering application. Engineering Reports may be related to individual components, complex engineered products or engineered systems.

The process of reporting on investigation and practical activities in this subject will be through the preparation of Engineering Reports that must be prepared for each module in the Preliminary and HSC courses. Reports will be less detailed in the Preliminary course than those required for the HSC course. Engineering Reports may include:

- introduction to the purpose of the report
- appropriate research
- analysis/synthesis of related issues
- conclusions and/or recommendations
- references.

The Engineering Reports for the Preliminary course should be based on an analysis of one or more areas of the module content.

Reports developed in the HSC course should encompass a degree of both analysis and synthesis of one or more areas of relevant content, and reflect actual engineering practice.

Each module is to generate at least one Engineering Report. One Engineering Report from the Preliminary course and one from the HSC course must be the result of collaborative work.

# 7 Objectives and Outcomes

## 7.1 Table of Objectives and Outcomes

| **Objectives**<br><br>**Students will develop:** | **Preliminary Course Outcomes**<br><br>**A student:** | **HSC Course Outcomes**<br><br>**A student:** |
|---|---|---|
| 1. understanding of the scope of engineering and the role of the engineer | P1.1 identifies the scope of engineering and recognises current innovations<br><br>P1.2 describes the types of materials, components and processes and explains their implications for engineering development | H1.1 describes the scope of engineering and critically analyses current innovations<br><br>H1.2 differentiates between properties of materials and justifies the selection of materials, components and processes in engineering |
| 2. knowledge and understanding of engineering principles and an appreciation of the responsibilities of engineers in society | P2.1 explains the relationship between properties, uses and applications of materials in engineering<br><br>P2.2 describes the nature of engineering in specific fields and its importance to society | H2.1 determines suitable properties, uses and applications of materials in engineering<br><br>H2.2 analyses and synthesises engineering applications in specific fields and reports on the importance of these to society |
| 3. communication skills appropriate to engineering practices | P3.1 uses mathematical, scientific and graphical methods to solve problems of engineering practice<br><br>P3.2 develops written, oral and presentation skills and applies these to engineering reports<br><br>P3.3 applies graphics as a communication tool | H3.1 demonstrates proficiency in the use of mathematical, scientific and graphical methods to analyse and solve problems of engineering practice<br><br>H3.2 uses appropriate written, oral and presentation skills in the preparation of detailed engineering reports<br><br>H3.3 develops and uses specialised techniques in the application of graphics as a communication tool |

| **Objectives**<br><br>**Students will develop:** | **Preliminary Course Outcomes**<br><br>**A student:** | **HSC Course Outcomes**<br><br>**A student:** |
|---|---|---|
| 4. knowledge and understanding of developments in technology and an appreciation of their influence on people and engineering practice | P4.1 describes developments in technology and their impact on engineering products<br><br>P4.2 describes the influence of technological change on engineering and its effect on people<br><br>P4.3 identifies the social, environmental and cultural implications of technological change in engineering | H4.1 investigates the extent of technological change in engineering<br><br>H4.2 applies knowledge of history and technological change to engineering- based problems<br><br>H4.3 appreciates social, environmental and cultural implications of technological change in engineering and applies them to the analysis of specific problems |
| 5. management and problem-solving in engineering contexts | P5.1 demonstrates the ability to work both individually and in teams<br><br>P5.2 applies management and planning skills related to engineering | H5.1 works individually and in teams to solve specific engineering problems and in the preparation of engineering reports<br><br>H5.2 selects and uses appropriate management and planning skills related to engineering |
| 6. skills in the application of engineering methodology | P6.1 applies knowledge and skills in research and problem-solving related to engineering<br><br>P6.2 applies skills in analysis, synthesis and experimentation related to engineering | H6.1 demonstrates skills in research and problem-solving related to engineering<br><br>H6.2 demonstrates skills in analysis, synthesis and experimentation related to engineering |

## 7.2 Key Competencies

Engineering Studies provides a context within which to develop general competencies considered essential for the acquisition of effective, higher-order thinking skills necessary for further education, work and everyday life.

Key competencies are embedded in the Engineering Studies syllabus to enhance student learning. The key competencies of ***collecting, analysing and organising information*** and ***communicating ideas and information*** reflect core processes of inquiry and reporting which are explicit in the objectives and outcomes of Engineering Studies. The other key competencies are developed through the methodologies of the syllabus and through classroom pedagogy. Students work as individuals and as members of groups to conduct investigations into engineered products and systems and through this, the key competencies ***planning and organising activities*** and ***working with others and in teams*** are developed. When students solve problems related to engineering and analyse data they become competent in ***using mathematical ideas and techniques.*** When students analyse, synthesise and report on engineered products and systems they will be involved in a specific study and application of a range of technologies and they will develop competency in ***using technology.*** Finally, the exploration of issues and investigation of the nature of engineered products and systems contributes towards the students' development of the key competency ***solving problems.***

# 8. Content: Engineering Studies Preliminary Course

## ENGINEERING APPLICATION MODULE 1

### HOUSEHOLD APPLIANCES

### 24 Hours Indicative Time

Select one or more household appliances as an introduction to Engineering Applications. Possible examples of household appliances include: kettles, ovens, washing machines, refrigerators, cooktops, portable power tools, telephones, irons, vacuum cleaners.

### Outcomes

A student:

P1.2 describes the types of materials, components and processes and explains their implications for engineering development

P2.1 explains the relationship between properties, uses and applications of materials in engineering

P3.2 develops written, oral and presentation skills and applies these to engineering reports

P3.3 applies graphics as a communication tool

P4.1 describes developments in technology and their impact on engineering products

P4.2 describes the influence of technological change on engineering and its effect on people

P4.3 identifies the social, environmental and cultural implications of technological change in engineering.

| Students learn about | Students learn to: |
|---|---|
| **Historical and societal influences:**<br>• historical developements of household appliances<br>• the effect of engineering innovation on people's lives | • outline historical uses and appropriateness of materials in the design and production of household appliances |
| **Engineering mechanics and hydraulics**<br>• mass and force<br>• scalar and vector quantities | • use mathematical and/or graphical methods to solve engineering problems in household appliances |
| **Engineering materials**<br>• classification of materials<br>• properties of materials<br>– physical and mechanical properties<br>• structure of materials<br>– atomic structure<br>– bonding<br>• metals<br>– ferrous metals including mild steel<br>– non-ferrous metals including copper, brass and bronze<br>– joining and cutting methods<br>• polymers<br>– thermoplastics<br>– thermosets<br>• ceramics<br>– types used | • classify a variety of materials<br>• identify the properties of materials and explain the reason for their selection<br>• describe the structure and bonding of materials<br>• distinguish between and explain reasons for the use of ferrous and non-ferrous metals as components in household appliances<br>• compare the suitability of joining and cutting methods used on metals<br>• distinguish between thermoplastics and thermosets<br>• identify the types of ceramics used in household appliances |
| **Engineering electricity/electronics**<br>• basic principles<br>– potential difference<br>– current<br>– simple circuits and components<br>• electrical safety<br>– related Australian electrical standards<br>• magnetic induction | • explain the basic electrical principles of operation appropriate to household appliances<br>• appreciate the importance of safety when using electrical household appliances<br>• explain the working of an induction motor |

| | |
|---|---|
| • fundamental AC and DC circuits<br>• electric motors<br><br>**Communication**<br>• freehand sketching<br>• research methods including the Internet, CD-ROM and libraries<br>• collaborative work practices<br>• Engineering Report writing | • distinguish between AC and DC circuits<br><br><br><br>• draw freehand, three-dimensional objects<br>• conduct research using computer technologies and other resources<br>• complete an Engineering Report based on the analysis of one or more household appliances, integrating the use of computer software |

## ENGINEERING APPLICATION MODULE 2

## LANDSCAPE PRODUCTS

### 24 Hours Indicative Time

Select one or more landscape products as an introduction to Engineering Applications. Possible examples of landscape products include: wheelbarrows, sprinklers, garden implements, garden mulchers, lawn-mowers.

### Outcomes

A student:

P1.1 identifies the scope of engineering and recognises current innovations

P2.1 explains the relationship between properties, uses and applications of materials in engineering

P3.1 uses mathematical, scientific and graphical methods to solve problems of engineering practice

P3.2 develops written, oral and presentation skills and applies these to engineering reports

P3.3 applies graphics as a communication tool

P4.1 describes developments in technology and their impact on engineering products

P4.2 describes the influence of technological change on engineering and its effect on people

P4.3 identifies the social, environmental and cultural implications of technological change in engineering

P5.1 demonstrates the ability to work both individually and in teams.

| Students learn about: | Students learn to: |
|---|---|
| **Historical and societal influences**<br>• the historical development of landscape products<br>• the effect of engineering innovation on people's lives<br>• environmental implications from the application of landscape products | • discuss the social implications of technological change in engineering as applied to landscape products |
| **Engineering mechanics and hydraulics**<br>• forces<br>– nature and type of forces<br>– addition of vectors<br>– space and freebody diagrams<br>– resultants and equilibrants<br>– transmissibility of forces<br>– 3 force rule for equilibrium<br>– moments of a force<br>– force/couple systems<br>– equilibrium of concurrent forces<br>• simple mechanisms – inclined plane, lever, screws, wheel and axle, pulley, gears | • apply mathematical and/or graphical methods to solve problems related to landscape products<br>• investigate and interpret the concept of equilibrium in the mechanics of landscape products<br>• examine and analyse the function of simple mechanisms |
| **Engineering materials**<br>• modification of materials<br>– work hardening<br>– heat treatment<br>– nature of composites<br>• engineering applications of materials<br>• recyclability of materials<br>– implications for recycling<br>– recyclable materials including steel, aluminium, brass, plastics and rubber<br>– costs and benefits of recycling materials | • conduct simple tests aimed at improving materials' properties through work hardening, heat treatment and composites<br>• analyse the properties, uses and appropriateness of materials for landscape products<br>• explain the benefits of recycling materials |
| **Communication**<br>• orthogonal drawings<br>• Australian Standards AS1100<br>• dimensioning<br>• materials lists<br>• introduction to computer assisted drawing (CAD) | • produce orthogonal assembly drawings applying appropriate Australian Standard (AS 1100) |

| | |
|---|---|
| • research methods including the Internet, CD-ROM and libraries | • conduct research using computer technologies and other resources |
| • collaborative work practices | • work with others and appreciate the value of collaborative working |
| • Engineering Report writing | • complete an Engineering Report based on the analysis of one or more landscape products, incorporating the use of computer software |

## ENGINEERING APPLICATION MODULE 3

## BRAKING SYSTEMS

### 24 Hours Indicative Time

Select one or more products related to braking systems as an introduction to Engineering Applications. Possible examples include: the band brake, drum brake, disc brake, multiple disc brakes system and regenerative braking systems.

### Outcomes

A student:

P1.1 identifies the scope of engineering and recognises current innovations

P2.1 explains the relationship between properties, uses and applications of materials in engineering

P3.1 uses mathematical, scientific and graphical methods to solve problems of engineering practice

P3.2 develops written, oral and presentation skills and applies these to engineering reports

P3.3 applies graphics as a communication tool

P4.1 describes developments in technology and their impact on engineering products

P4.2 describes the influence of technological change on engineering and its effect on people

P5.1 demonstrates the ability to work both individually and in teams

P6.2 applies skills in analysis, synthesis and experimentation related to engineering.

| Students learn about: | Students learn to: |
|---|---|
| **Historical and societal influences**<br>• historical developments of braking systems<br>• the effect of engineering innovations on people's lives<br>• environmental implications from the use of materials in braking systems | • examine the changing applications of materials to components in braking systems<br>• discuss the social implications of technological change in braking systems |
| **Engineering mechanics and hydraulics**<br>• friction (without calculations)<br>• stress and strain<br>– stress (tensile and compression)<br>– load/extension diagram<br>– strain (tensile and compression)<br>• work, power, energy (without calculations)<br>• fluid mechanics<br>– Pascal's and Archimedes' principles<br>– hydrostatic pressure<br>– applications to braking systems | • distinguish between force, stress and strain<br>• experiment with and apply the basic principles of fluid mechanics to simple braking systems<br>• investigate the structure and properties of appropriate materials used in braking systems |
| **Engineering materials**<br>• materials for braking systems<br>– steels<br>– cast irons<br>– composites<br>– manufacturing/forming processes of composites<br>• testing of materials<br>– tensile and compression test<br>– hardness test | • describe the manufacturing processes and application of composites to friction materials<br>• conduct relevant mechanical tests on materials |
| **Communication**<br>• pictorial, orthogonal and detail drawings<br>• Australian Standard AS1100, including dimensioning<br>• graphical mechanics graphical solutions to simple mechanical problems<br>• computer graphics, computer assisted drawing (CAD)<br>• research methods including the Internet, CD-ROM and libraries | • produce pictorial, orthogonal and detail drawings of braking systems and braking components applying appropriate Australian Standard (AS 1100)<br>• produce simple computer assisted drawing(s)<br>• conduct research using appropriate computer technologies |

| | |
|---|---|
| • collaborative work practices<br>• Engineering Report writing | • work with others and appreciate the value of collaborative working<br>• complete an Engineering Report based on the analysis of one type of brake or a component of a braking system, integrating computer software |

## ENGINEERING FOCUS MODULE

## BIO-ENGINEERING

### 24 Hours Indicative Time

This module will provide an introduction to the study of engineering focus modules.

One or more examples of bio-engineering must be used to develop an understanding of the scope and nature of this profession.

Possible examples include:
artificial joints, surgical equipment, artificial limbs, the bionic ear and artificial hearts.

### Outcomes

A student:

P1.1 identifies the scope of engineering and recognises current innovations

P1.2 describes the types of materials, components and processes and explains their implications for engineering development

P2.2 describes the nature of engineering in specific fields and its importance to society

P3.1 uses mathematical, scientific and graphical methods to solve problems of engineering practice

P3.2 develops written, oral and presentation skills and applies these to engineering reports

P3.3 applies graphics as a communication tool

P4.1 describes developments in technology and their impact on engineering products

P4.3 identifies the social, environmental and cultural implications of technological change in engineering

P5.2 applies management and planning skills related to engineering

P6.1 applies knowledge and skills in research and problem-solving related to engineering.

| Students learn about: | Students learn to: |
|---|---|
| **Scope of the profession**<br>• nature and range of work done<br>• current projects and innovations<br>• health and safety matters<br>• training for the profession<br>• career prospects<br>• relations with the community<br>• technologies unique to the profession<br>• ethics and engineering<br>• engineers as managers | • conduct research on the nature and range of work done by bio-engineers<br>• identify the health and safety issues relevant to bio-engineering<br>• appraise the training requirements and career prospects<br>• debate social and ethical issues relating to bio-engineering |
| **Historical and societal influences**<br>• historical background to bio-engineering<br>• historical developments of products<br>• the effect of bio-engineering on people's lives | • discuss the impact of bio-engineering on people's lives |
| **Engineering mechanics and hydraulics**<br>• orders of levers<br>• mechanical advantage and velocity ratio<br>• stress and strain (tensile and compression forces) | • apply mathematical and/or graphical methods to solve problems of bio-engineering practice |
| **Engineering materials**<br>• forming methods<br>– forging<br>– casting<br>– fabrications<br>• structure and properties of appropriate materials | • describe forming processes for materials used in bio-engineering<br>• compare the macrostructure and properties of materials used in bio-engineering. |
| **Communication**<br>• sectioning of orthogonal drawings<br>• Australian Standards AS1100<br>• dimensioning<br>• research methods including the Internet, CD-ROM and libraries<br>• collaborative work practices | • produce orthogonal drawings applying appropriate Australian Standard (AS 1100)<br>• construct quality graphical solutions<br>• work with others and appreciate the value of collaborative working |

| | |
|---|---|
| • Engineering Report writing | • complete an Engineering Report on the bio-engineering profession with reference to:<br>– the nature and range of work done<br>– ethics related to the profession<br>• apply appropriate technologies to produce a report |

## SCHOOL-BASED ELECTIVE MODULE

## ENGINEERING APPLICATION MODULE or ENGINEERING FOCUS MODULE

### 24 Hours Indicative Time

The fifth module in the Preliminary course is a school-based elective module. It may be either an Engineering Application module or an Engineering Focus module.

The module will be determined by the school provided that it is not a duplication of any other module in the Preliminary or HSC courses. It is to be focused on a new product or another field of engineering.

Areas of content which are of particular interest or which need to be reinforced should be addressed in this module. Schools should endeavour to study applications or fields of engineering which hold particular relevance to the local community.

An Engineering Application module can be developed by the school, based on a product that has not been covered in the previous modules, OR an Engineering Focus module can be developed by the school, based on any field of engineering except those already covered in the specified Focus modules.

Outcomes: this module provides an opportunity for teachers to revise, refine or extend students in relation to any of the Preliminary course outcomes.

| Students learn about: | Students learn to: |
|---|---|
| **Scope of the profession**<br>This area would only be included in the content of the course if a Focus module was identified for study.<br>Content relating to the Focus module would include:<br>• nature and range of work done in the identified engineering field<br>• health and safety matters associated with the identified engineering field<br>• training for the profession<br>• career prospects<br>• relations with the community<br>• technologies unique to the engineering field<br>• ethics and engineering<br>• engineers as managers | • identify the scope of the selected field of engineering and describe its implications on health and safety issues<br>• appraise the training requirements and the career prospects<br>• identify the technologies used in the particular engineering field |
| **Historical and societal influences**<br>• historical development of the Application or Focus module<br>• the effects of the Application or Focus on people's lives and living standards<br>• the environmental implications of the Application or Focus | • recount the historical development of the Application or Focus<br>• describe the effects of the Application or Focus on people's lives |
| **Engineering mechanics and hydraulics**<br>• mechanics and hydraulics applicable to the Application or engineering field | • identify and experiment with applicable mechanics and hydraulics topics to the Application or Focus<br>• apply mechanics and hydraulics topics to the Application or Focus |
| **Engineering materials**<br>• materials applicable to the Application or Focus<br>• material structure and properties applicable to the Application or Focus<br>• joining methods of materials applied to the Application or Focus | • identify applicable materials and their properties to the Application or Focus<br>• describe the structure and properties for materials used in the Application or Focus<br>• investigate applicable joining methods of materials applied to the Application or Focus |

| | |
|---|---|
| **Engineering electricity/electronics**<br>• concepts of electricity and electronics applicable to the Application or Focus<br><br>**Communication**<br>• orthogonal drawings to AS1100 standards<br>• research methods including the Internet, CD-ROM and libraries<br>• collaborative work practices<br>• Engineering Report writing | • explain electrical concepts used in the Application or Focus<br>• identify components and related electrical/electronic hardware to the Application or Focus<br><br>• produce orthogonal drawings applying appropriate Australian Standard (AS 1100)<br>• construct quality graphical solutions<br>• work with others and appreciate the value of working with others<br>• complete an Engineering Report to describe the impact on society of the Application or Focus you have studied, specifically mentioning related environmental issues<br>• use appropriate computer software |

# 9 Content: Engineering Studies HSC Course

### Engineering application module 1

### CIVIL STRUCTURES

### 24 Hours Indicative Time

Select one or more civil structures in this module. Possible examples of civil structures include: bridges, roads, buildings, community centres, parklands, children's playgrounds and equipment

Outcomes

A student:

H1.2 differentiates between properties of materials and justifies the selection of materials, components and processes in engineering

H2.1 determines suitable properties, uses and applications of materials in engineering

H3.1 demonstrates proficiency in the use of mathematical, scientific and graphical methods to analyse and solve problems of engineering practice

H3.2 uses appropriate written, oral and presentation skills in the preparation of detailed engineering reports

H3.3 develops and uses specialised techniques in the application of graphics as a communication tool

H4.1 investigates the extent of technological change in engineering

H4.3 appreciates social, environmental and cultural implications of technological change in engineering and applies them to the analysis of specific problems

H5.1 works individually and in teams to solve specific engineering problems and in the preparation of engineering reports

H6.1 demonstrates skills in research and problem-solving related to engineering

H6.2 demonstrates skills in analysis, synthesis and experimentation related to engineering.

| Students learn about: | Students learn to: |
|---|---|
| **Historical and societal influences**<br>• historical developments of civil structures<br>• engineering innovation in civil structures and their effect on people's lives<br>• construction and processing materials used in civil structures over time<br>• environmental implications from the use of materials in civil structures | • outline the history of technological change as applied to civil structures<br>• investigate the construction processes and materials used in civil structures from a historical point of view<br>• critically examine the impact of civil structures on society and the environment |
| **Engineering mechanics and hydraulics**<br>• stress and strain<br>– shear stress<br>– engineering and working stress<br>– yield stress, proof stress, toughness, Young's modulus, Hooke's law, engineering applications<br>– factor of safety<br>– stress/strain diagram | • apply mathematical and/or graphical methods to solve problems related to the design of civil structures |
| • truss analysis<br>– method of joints<br>– method of sections<br>• bending stress induced by point loads only<br>– concept of shear force and bending moment<br>– shear force and bending moment diagrams<br>– concept of neutral axis and outer fibre stress<br>– bending stress calculation (second moment of area given) | • evaluate the importance of the stress/strain diagram in understanding the properties of materials<br>• calculate the bending stress on simply supported beams involving vertical point loads only |
| • uniformly distributed loads<br>• crack theory<br>– crack formation and growth<br>– failure due to cracking<br>– repair and/or elimination of failure due to cracking | • describe the effect of uniformly distributed loads on a simple beam, without calculations<br>• examine how failure due to cracking can be repaired or eliminated |

| | |
|---|---|
| **Engineering materials**<br>• testing of materials<br>– x-ray<br>– specialised testing of engineering materials and/or systems<br>• ceramics<br>– structure and property relationship, applications<br>– glass<br>– cement<br>• composites<br>– timber<br>– concrete (reinforced and pre-stressed)<br>– asphalt<br>– laminates<br>– geotextiles<br>• corrosion<br>– corrosive environments<br>– dry corrosion, wet corrosion, stress corrosion<br>• recyclability of materials | • describe basic testing conducted on civil structures<br>• examine the properties, uses and appropriateness of materials used in civil structures<br>• make appropriate choices of materials and processes for use in civil structures<br>• investigate the structure and property relationships in materials<br>• explain the special properties produced by composite materials<br>• experiment with simple pre-tensioned and post-tensioned structures<br>• evaluate the significance of corrosion problems in civil structures<br>• describe methods used for recycling materials when civil structures are replaced |
| **Communication**<br>• Australian Standard AS1100<br>• orthogonal assembly drawings<br>• development<br>– development of transition pieces<br>• graphical mechanics<br>– graphical solutions to complex engineering problems<br>• computer graphics<br>• research methods including the Internet, CD-ROM and libraries<br>• collaborative work practices<br>• Engineering Report writing | • produce orthogonal drawings applying appropriate Australian Standard (AS 1100)<br>• apply appropriate computer technology to the preparation of reports<br>• construct the development of non-circular transition pieces<br>• apply graphical methods to the solutions of relevant problems<br>• apply research methods to collect and analyse data<br>• work with others and appreciate the value of collaborative working<br>• complete an Engineering Report based on the analysis and synthesis of an aspect of civil structures using appropriate software |

## Engineering application module 2

## PERSONAL and PUBLIC TRANSPORT

### 24 Hours Indicative Time

Select one or more forms of transport in this module. Possible examples include: the bicycle, motor vehicles, boats, motor cycles, buses, trains, trams.

### Outcomes

A student:

H1.2 differentiates between properties of materials and justifies the selection of materials, components and processes in engineering

H2.1 determines suitable properties, uses and applications of materials in engineering

H3.1 demonstrates proficiency in the use of mathematical, scientific and graphical methods to analyse and solve problems of engineering practice

H3.2 uses appropriate written, oral and presentation skills in the preparation of detailed engineering reports

H3.3 develops and uses specialised techniques in the application of graphics as a communication tool

H4.2 applies knowledge of history and technological change to engineering-based problems

H4.3 appreciates social, environmental and cultural implications of technological change in engineering and applies them to the analysis of specific problems

H5.1 works individually and in teams to solve specific engineering problems and in the preparation of engineering reports

H6.1 demonstrates skills in research, and problem-solving related to engineering

H6.2 demonstrates skills in analysis, synthesis and experimentation related to engineering.

| Students will learn about: | Students to: |
|---|---|
| **Historical and societal influence**<br>• historical developments in transport systems<br>• effects of engineering innovation in transport on people's lives<br>• construction and processing materials over time<br>• environmental effects of transport systems<br>• environmental implications from the use of materials in transport | • investigate the history of technological change related to transport and its impact on society<br>• identify design features in the engineering of transport systems over time<br>• critically examine the impact of developments in transport systems on the environment |
| **Engineering mechanics and hydraulics**<br>• static friction<br>– concept of friction and its use in engineering<br>– coefficient of friction<br>– normal force<br>– friction force<br>– angle of static friction<br>– angle of repose<br>• energy, power<br>– potential energy, kinetic energy, work, power | • apply mathematical and/or graphical methods to solve engineering problems related to transport<br>• analyse problems involving static friction<br>• differentiate between the concepts of energy and power and apply appropriate calculations |
| **Engineering materials**<br>• testing of materials<br>– x-ray<br>– specialised testing of engineering materials and/or systems<br>• Heat treatment of ferrous metals<br>– heat treatment of steels<br>– annealing<br>– normalising<br>– hardening and tempering<br>– structure property relationships<br>• structure/property relationship in the material forming processes<br>– forging<br>– rolling<br>– casting<br>– extrusion<br>– powder forming | • explain the properties, uses, testing and appropriateness of materials used in transportation<br>• identify appropriate heat treatment processes<br>• justify appropriate choices for ferrous materials and processes used in transportation parts and systems<br>• experiment with metals to reinforce the concepts of heat treatment<br>• explain the method and applications of various ferrous metal forming processes |
| • non-ferrous metals | • justify appropriate choices of non-ferrous |

| | |
|---|---|
| – aluminium and its alloys, aluminium silicon, aluminium copper, aluminium silicon-magnesium<br>– brass, bronze<br>– structure/property relationship<br>– annealing, strengthening<br>• ceramics and glasses<br>– semi-conductors<br>– laminating and heat treatment of glass<br>• polymers<br>– structure/property relationships and applications<br>– engineering textiles<br>– manufacturing processes for polymer component | materials and processes for use in transportation parts and systems based on relevant structure/property relationships<br>• justify appropriate choices of ceramics and glasses used in transportation parts and systems<br>• identify the types and function of common semiconductors used in the electronics of the transport industry<br>• justify appropriate choices of polymers and their manufacturing processes used in transportation parts and systems |
| **Engineering electricity/electronics**<br>• power generation/distribution<br>– electrical energy and power<br>• AC/DC circuits<br>• electric motors used in transport systems<br>– principles<br>– applications<br>• control technology<br>– digital technology | • identify the electrical systems used in the transport industry<br>• investigate the principles and application of electric motors used in the transport industry<br>• analyse the basic principles of control technology as applied to the transport industry<br>• explain elementary digital logic |
| **Communication**<br>• freehand sketching, designs, pictorial, orthogonal<br>• Australian Standard AS1100<br>• computer graphics, Computer Assisted Drawing applications solving problems<br>• research methods including the Internet, CD-ROM and libraries<br>• collaborative work practices<br>• Engineering Report writing | • produce orthogonal drawings applying appropriate Australian Standard (AS 1100)<br>• produce quality graphics<br>• apply dimensioning to AS1100 standards<br>• apply appropriate research methods to collect and analyse data<br>• work with others and appreciate the value of collaborative working<br>• complete an Engineering Report based on the analysis and synthesis of an aspect of personal and public transport using appropriate software |

## Engineering application module 3

## LIFTING DEVICES

### 24 Hours Indicative Time

Select one or more lifting devices in this module. Possible examples include: cranes, jacks, levers, lifts, hydraulic ram, forklifts, block and tackle.

### Outcomes

A student:

H1.2 differentiates between properties of materials and justifies the selection of materials, components and processes in engineering

H2.1 determines suitable properties, uses and applications of materials in engineering

H3.1 demonstrates proficiency in the use of mathematical, scientific and graphical methods to analyse and solve problems of engineering practice

H3.2 uses appropriate written, oral and presentation skills in the preparation of detailed engineering reports

H4.1 investigates the extent of technological change in engineering

H4.2 applies knowledge of history and technological change to engineering-based problems

H4.3 appreciates social, environmental and cultural implications of technological change in engineering and applies them to the analysis of specific problems

H5.1 works individually and in teams to solve specific engineering problems and in the preparation of engineering reports

H6.2 demonstrates skills in analysis, synthesis and experimentation related to engineering.

| Students will learn about: | Students to: |
|---|---|
| **Historical and societal influences**<br>• historical development of lifting devices<br>• engineering innovation in lifting devices and their effect on people's lives | • research the history of technological change in lifting devices<br>• examine the impact of lifting devices on engineering construction methods |
| **Engineering mechanics and hydraulics**<br>• conditions of equilibrium for non-concurrent coplanar forces<br>• fluid mechanics<br>– Archimedes' and Pascal's principles<br>– hydrostatic pressure<br>– applications to lifting devices | • use mathematical and/or graphical methods to solve problems related to lifting devices<br>• apply concepts of hydraulics in the solution of problems relating to types of lifting devices |
| **Engineering materials**<br>• testing of materials used in lifting devices<br>– tension, compression<br>– hardness<br>– impact<br>• structure/property relationships in heat treatment processes<br>– normalising<br>– hardening and tempering<br>• structure/property relationships in forming processes<br>– forging<br>– casting<br>– extrusion<br>– rolling<br>– powder forming | • describe the properties, uses and appropriateness of materials used in lifting devices<br>• evaluate manufacturing processes for components used in lifting devices<br>• investigate impact testing<br>• experiment with and assess structure/property relationships, before and after heat treatment<br>• analyse the structure/property relationship developed through forming processes |
| **Engineering electricity/electronics**<br>• applications found in appropriate lifting devices<br>– motors<br>– motor control<br>• electrical safety | • describe the basic principles and applications of electrical components to lifting devices |

| | |
|---|---|
| **Communication**<br>• Australian Standard AS1100<br>• sectioning of orthogonal views<br>• orthogonal assembly drawings<br>• computer graphics/computer assisted drawing<br>• research methods including the Internet, CD-ROM and libraries<br>• work collaboratively when appropriate<br>• Engineering Report writing | • produce orthogonal drawings applying appropriate Australian Standard (AS 1100)<br>• apply dimensions to AS1100 standard<br>• work with others and appreciate the value of collaborative working<br>• complete an Engineering Report based on the analysis and synthesis of an aspect of lifting devices using appropriate software and computer assisted drawing |

## ENGINEERING FOCUS MODULE 1

## AERONAUTICAL ENGINEERING

### 24 Hours Indicative Time

One or more examples of aeronautical engineering must be used to develop an understanding of the scope and nature of this profession.

Possible examples include:
design and construction of recreational aircraft, general aviation aircraft, military aircraft, agricultural aircraft, helicopters and home-built aircraft.

Outcomes

A student:

H1.1 describes the scope of engineering and critically analyses current innovations

H1.2 differentiates between properties of materials and justifies the selection of materials, components and processes in engineering

H2.2 analyses and synthesises engineering applications in specific fields and reports on the importance of these to society

H3.2 uses appropriate written, oral and presentation skills in the preparation of detailed engineering reports

H4.1 investigates the extent of technological change in engineering

H4.3 appreciates social, environmental and cultural implications of technological change in engineering and applies them to the analysis of specific problems

H5.2 selects and uses appropriate management and planning skills related to engineering

H6.2 demonstrates skills in analysis, synthesis and experimentation related to engineering.

| Students learn about: | Students learn to: |
|---|---|
| **Scope of the profession**<br>• nature and scope of the aeronautical engineering profession<br>• current projects and innovations<br>• health and safety issues<br>• training for the profession<br>• career prospects<br>• unique technologies in the profession<br>• legal and ethical implications<br>• engineers as managers<br>• relations with the community | • define the responsibilities of the aeronautical engineer<br>• describe the nature and range of work done in this profession<br>• examine projects and innovations from within the aeronautical profession<br>• analyse the training and career prospects within aeronautical engineering |
| **Historical and societal influences**<br>• historical developments in aeronautical engineering<br>• the effects of aeronautical innovation on people's lives and living standards<br>• environmental implications of flight | • research the history of flight in Australia and understand the way it has impacted on people's lives<br>• examine safety issues related to flight and flying |
| **Engineering mechanics and hydraulics**<br>• forces – lift drag, weight, thrust<br>• basic aerodynamics<br>– Bernouli's principle<br>• bending stress – airframes<br>• propulsion systems (jet, turboprop)<br>• fluid mechanics<br>– hydrostatic and dynamic pressure<br>– applications to aircraft components<br>– application to aircraft instruments | • apply mathematical and graphical methods to solve flight-related problems<br>• outline Bernouli's principle as applied to flight<br>• investigate the nature and effect of bending stresses, applying appropriate mathematical methods<br>• apply mathematical methods to solve hydraulics-related problems |
| **Engineering materials**<br>• specialised testing of aircraft materials<br>– dye penetrant<br>– x-ray<br>– magnetic particles<br>– ultrasonic<br>• aluminium and its alloys used in aircraft<br>– aluminium silicon, aluminium silicon<br>– magnesium, aluminium copper | • describe non-destructive tests used with aircraft materials and components<br>• analyse structure, properties, uses and appropriateness of materials in aeronautical engineering applications |

| | |
|---|---|
| – structure/property/application relationships<br>– heat treatment of applicable alloys<br><br>• polymers<br>– structure/property relationships and applications<br>– modifying materials for aircraft applications<br>– engineering textiles<br>• composites<br>– types and applications in aircraft<br>– structure/property relationships<br>• corrosion<br>– common corrosion mechanisms in aircraft structures<br>– pit and crevice corrosion<br>– stress corrosion<br><br>**Communication**<br>• freehand and technical drawing<br>– pictorial and orthogonal projections<br>• Australian Standard AS1100<br>• graphical mechanics<br>– graphical solution to basic aerodynamic problems<br>• computer graphics, computer assisted drawing (CAD)<br>• research methods including the Internet, CD-ROM and libraries<br>• collaborative work practices<br>• Engineering Report writing | • investigate the effects of heat treatment on the structure and properties of aluminium alloys<br>• select and justify materials and processes used in aeronautical engineering<br>• outline the mechanism of corrosion common to aircraft components<br>• produce orthogonal drawings applying appropriate Australian Standard (AS 1100)<br>• construct quality graphical solutions<br>• work with others and appreciate the value of collaborative working<br>• complete an Engineering Report on the aeronautical engineering profession with reference to the following aspects:<br>– current projects and innovations<br>– heath and safety issues<br>– relations with the community<br>– career prospects |

## ENGINEERING FOCUS MODULE 2

## TELECOMMUNICATION

### 24 Hours Indicative Time

One or more examples of telecommunication engineering must be used to develop an understanding of the scope and nature of this profession.

Possible examples include:
telephone systems (fixed and mobile), radio systems, television systems and satellite communication systems.

### Outcomes

A student:

H1.1 describes the scope of engineering and critically analyses current innovations

H1.2 differentiates between properties of materials and justifies the selection of materials, components and processes in engineering

H2.2 analyses and synthesises engineering applications in specific fields and reports on the importance of these to society

H3.2 uses appropriate written, oral and presentation skills in the preparation of detailed engineering reports

H4.1 investigates the extent of technological change in engineering

H4.3 appreciates social, environmental and cultural implications of technological change in engineering and applies them to the analysis of specific problems

H5.2 selects and uses appropriate management and planning skills related to engineering

H6.2 demonstrates skills in analysis, synthesis and experimentation related to engineering.

| Students learn about: | Students learn to: |
|---|---|
| **Scope of the profession**<br>• nature and scope of telecommunications engineering<br>• health and safety issues<br>• training for the profession<br>• career prospects<br>• relations with the community<br>• technologies unique to the profession<br>• legal and ethical implications<br>• engineers as managers<br>• current applications and innovations | • define the responsibilities of the telecommunications engineer<br>• describe the nature and range of work done in this profession<br>• examine projects and innovations in the telecommunications profession<br>• analyse the training and career prospects within telecommunications engineering |
| **Historical and societal influences**<br>• historical development within the telecommunications industry<br>• the effect of telecommunication engineering innovation on people's lives<br>• materials and techniques used over time | • research the history of technological change in the field of telecommunications<br>• describe the nature of engineering systems in the telecommunications field and the importance of this to society |
| **Engineering materials**<br>• specialised testing<br>– voltage, current, insulation<br>• copper and its alloys used in telecommunications<br>– structure/property relationships<br>• ceramics as insulation materials<br>• semiconductors<br>– types and uses in telecommunications<br>• polymers<br>– insulation materials<br>• fibre-optics<br>– types and applications | • analyse structure, properties, uses and appropriateness of materials in telecommunications engineering applications<br>• select and justify materials and processes used in telecommunications engineering |
| **Engineering electricity/electronics**<br>• telecommunications<br>– analogue and digital systems<br>– modulation, demodulation<br>– radio transmission (AM, FM)<br>– television transmission (B/W, colour)<br>– telephony – fixed and mobile<br>– transmission media – cable, microwave, fibre-optics | • describe the basic concepts and applications of modulation and transmission systems in telecommunications<br>• distinguish the communication bands in the electromagnetic spectrum<br>• contrast the differences in transmission media |

| | |
|---|---|
| • satellite communication systems, geostations | • describe the basic principles of satellite communication systems |
| **Communication** | |
| • freehand and technical drawing, pictorial and dimensioned orthogonal drawings | • produce orthogonal drawings applying appropriate Australian Standard (AS 1100) |
| • Australian Standard AS1100 | • apply dimensions to drawings to AS1100 standard |
| • computer graphics, computer assisted drawing (CAD)<br>– for use in the presentation of reports<br>– in the solution of problems | • justify graphics as a communication tool for telecommunications engineering |
| • collaborative work practices | • work with others and appreciate the value of collaborative working |
| • research methods including the Internet, CD-ROM and libraries | |
| • Engineering Report writing | • complete an Engineering Report on the telecommunications engineering profession with reference to the following aspects:<br>– nature and range of work done<br>– engineers as managers<br>– technologies unique to the profession<br>– career prospects<br>– training for the profession<br>– use of appropriate software and presentation techniques |

# 10 Course Requirements

The Engineering Studies Stage 6 syllabus includes a Preliminary course of 120 hours (indicative time) and a HSC course of 120 hours (indicative time).

There is no prerequisite study for the Preliminary course. Completion of the Preliminary course is a prerequisite for study of the HSC Course.

The Preliminary course consists of five modules including a school-based elective module. The school-based elective module may be studied as either an Engineering Application or Engineering Focus module. It may be studied at any time during the Preliminary course in order to revise or extend content of particular interest.

The HSC course consists of five modules comprising three Engineering Application modules and two Engineering Focus modules. Each module is compulsory.

An Engineering Report is required for each Preliminary and HSC course module.

# 11 Post-school Opportunities

The study of Engineering Studies Stage 6 provides students with knowledge, understanding and skills that form a valuable foundation for a range of courses at university and other tertiary institutions.

In addition, the study of Engineering Studies Stage 6 assists students to prepare for employment and full and active participation as citizens. In particular, there are opportunities for students to gain recognition in vocational education and training. Teachers and students should be aware of these opportunities.

### Recognition of Student Achievement in Vocational Education and Training (VET)

Wherever appropriate, the skills and knowledge acquired by students in their study of HSC courses should be recognised by industry and training organisations. Recognition of student achievement means that students who have satisfactorily completed HSC courses will not be required to repeat their learning in courses in TAFE NSW or other Registered Training Organisations (RTOs).

Registered Training Organisations, such as TAFE NSW, provide industry training and issue qualifications within the Australian Qualifications Framework.

The degree of recognition available to students in each subject is based on the similarity of outcomes between Higher School Certificate courses and industry training packages endorsed within the Australian Qualifications Framework (AQF). Training packages are documents that link an industry's competency standards to AQF qualifications. More information about industry training packages can be found on the National Training Information Service (NTIS) website (www.ntis.gov.au).

### Recognition by TAFE NSW

TAFE NSW conducts courses in a wide range of industry areas, as outlined each year in the TAFE NSW Handbook. Under current arrangements, the recognition available to students of Engineering Studies in relevant courses conducted by TAFE is described in the HSC/TAFE Credit Transfer Guide. This guide is produced by the Board of Studies and TAFE NSW and is distributed annually to all schools and colleges. Teachers should refer to this guide and be aware of the recognition available to their students through the study of Engineering Studies Stage 6. This information can be found on the TAFE NSW website (www.tafensw.edu.au/mchoice).

### Recognition by other Registered Training Organisations

Students may also negotiate recognition into a training package qualification with another Registered Training Organisation. Each student will need to provide the RTO with evidence of satisfactory achievement in Engineering Studies Stage 6 so that the degree of recognition available can be determined.

# 12 Assessment and Reporting

**PLEASE NOTE**

The assessment and HSC examination requirements detailed in this syllabus refer to the 2009 HSC. New *Assessment and Reporting* information will apply to this syllabus for the 2010 HSC and beyond.

## 12.1 Requirements and Advice

The information in this section of the syllabus relates to the Board of Studies requirements for assessing and reporting achievement in the Preliminary and HSC courses for the Higher School Certificate.

Assessment is the process of gathering information and making judgements about student achievement for a variety of purposes.

In the Preliminary and HSC courses those purposes include:

- assisting student learning
- evaluating and improving teaching and learning programs
- providing evidence of satisfactory achievement and completion in the Preliminary course
- providing the Higher School Certificate results.

Reporting refers to the Higher School Certificate documents received by students that are used by the Board to report both the internal and external measures of achievement.

NSW Higher School Certificate results will be based on:

- **an assessment mark** submitted by the school and produced in accordance with the Board's requirements for the internal assessment program

- **an examination mark** derived from the HSC external examinations.

Results will be reported using a course report containing a performance scale with bands describing standards of achievement in the course.

The use of both internal assessment and external examinations of student achievement allows measures and observations to be made at several points and in different ways throughout the HSC course. Taken together, the external examinations and internal assessment marks provide a valid and reliable assessment of the achievement of the knowledge, understanding and skills described for each course.

### Standards Referencing and the HSC Examination

The Board of Studies will adopt a standards-referenced approach to assessing and reporting student achievement in the Higher School Certificate examination.

The standards in the HSC are:

- the knowledge, skills and understanding expected to be learned by students – the *syllabus standards*
- the levels of achievement of the knowledge, skills and understanding – the *performance standards.*

Both *syllabus standards* and *performance standards* are based on the aims, objectives, outcomes and content of a course. Together they specify what is to be learned and how well it is to be achieved.

Teacher understanding of standards comes from the set of aims, objectives, outcomes and content in each syllabus together with:

- the performance descriptions that summarise the different levels of performance of the course outcomes
- HSC examination papers and marking guidelines
- samples of students' achievement on assessment and examination tasks.

## 12.2 Internal Assessment

The internal assessment mark submitted by the school will provide a summation of each student's achievements measured at points throughout the course. It should reflect the rank order of students and relative differences between students' achievements.

Internal assessment provides a measure of a student's achievement based on a wider range of syllabus content and outcomes than may be covered by the external examination alone.

The assessment components, weightings and task requirements to be applied to internal assessment are identified on page 51. They ensure a common focus for internal assessment in the course across schools, while allowing for flexibility in the design of tasks. A variety of tasks should be used to give students the opportunity to demonstrate outcomes in different ways and to improve the validity and reliability of the assessment.

## 12.3 External Examination

In Engineering Studies Stage 6 the external examination is a written paper. The specifications for the examination in Engineering Studies Stage 6 are on page 52.

The external examination provides a measure of student achievement in a range of syllabus outcomes that can be reliably measured in an examination setting.

The external examination and its marking and reporting will relate to syllabus standards by

- providing clear links to syllabus outcomes
- enabling students to demonstrate the levels of achievement outlined in the course performance scale
- applying marking guidelines based on established criteria.

## 12.4 Board Requirements for the Internal Assessment Mark in Board Developed Courses

For each course the Board requires schools to submit an assessment mark for each candidate.

The collection of information for the HSC internal assessment mark must not begin prior to the completion of the Preliminary course.

The Board requires that the assessment tasks used to determine the internal assessment mark must comply with the components, weightings and types of tasks specified in the table on page 51.

Schools are required to develop an internal assessment program which:

- specifies the various assessment tasks and the weightings allocated to each task
- provides a schedule of the tasks designed for the whole course.

The school must also develop and implement procedures to:

- inform students in writing of the assessment requirements for each course before the commencement of the HSC course
- ensure that students are given adequate written notice of the nature and timing of assessment tasks
- provide meaningful feedback on students' performance in all assessment tasks.
- maintain records of marks awarded to each student for all assessment tasks
- address issues relating to illness, misadventure and malpractice in assessment tasks
- address issues relating to late submission and non-completion of assessment tasks
- advise students in writing if they are not meeting the assessment requirements in a course and indicate what is necessary to enable the students to satisfy the requirements
- inform students about their entitlements to school reviews and appeals to the Board
- conduct school reviews of assessments when requested by students
- ensure that students are aware that they can collect their Rank Order Advice at the end of the external examinations at their school.

## 12.5 Assessment Components, Weightings and Tasks

### Preliminary Course

The components, suggested weightings and tasks for the Preliminary course are set out below.

| Components | Weighting | Suggested Tasks |
|---|---|---|
| Scope of the profession | 10 | • **Assessment tasks might include**<br><br>class tests<br>examinations<br>engineering reports<br>site visit reports<br>interview reports<br>experimental work<br>practical applications |
| Knowledge of engineering principles | 40 | |
| Communication skills | 20 | |
| Understanding the impacts of engineering | 10 | |
| Management and problem-solving | 10 | |
| The application of engineering methodology | 10 | |
| Total | 100 | |

**Engineering Reports must be allocated 25% of the total school assessment based on the range of assessment components.**

## HSC Course

The components, weightings and suggested tasks for the HSC course are set out below.

| Components | Weighting | Suggested Tasks |
|---|---|---|
| Scope of the profession | 20 | • **Assessment tasks might include**<br><br>class tests<br>examinations<br>engineering reports<br>site visit reports<br>interview reports<br>experimental work<br>practical applications |
| Knowledge of engineering principles | 40 | |
| Communication skills | 10 | |
| Understanding the impacts of engineering | 10 | |
| Management and problem-solving | 10 | |
| The application of engineering methodology | 10 | |
| Total | 100 | |

**Engineering Reports must be allocated 35% of the total school assessment based on the range of assessment components.**

The internal assessment mark for Engineering Studies Stage 6 is to be based on the HSC course only. Final assessment should be based on a range and balance of assessment instruments.

One task may be used to assess several components. It is suggested that 3–5 tasks are sufficient to assess the HSC course outcomes.

## 12.6 HSC External Examination Specifications

**The written examination in Engineering Studies will consist of an examination paper of 3 hours duration (plus 5 minutes reading time).**

The written paper is divided into THREE sections.

### Section I (10 marks)

- All questions are compulsory
- There will be TEN multiple-choice questions
- These questions will be based on application modules

### Section II (70 marks)

- All questions are compulsory
- There will be SIX questions
- Each question will consist of a number of parts requiring short structured responses
- There will be one question, worth 10 marks, based on historical and societal influence and the scope of the profession
- There will be THREE questions, worth 10 marks each, based on application modules
- There will be TWO questions, worth 15 marks each, based on focus modules

### Section III (20 marks)

- All questions are compulsory
- Each question will consist of a number of parts requiring short structured responses
- There will be TWO questions, worth 10 marks each, based on all modules and Engineering Reports.

## 12.7 Summary of External and Internal Assessment

| External Assessment | Weighting | Internal Assessment | Weighting Prelim | Weighting HSC |
|---|---|---|---|---|
| A written examination consisting of THREE parts<br>All questions are compulsory<br><br>Section I<br>– Multiple choice. There will be ten questions relating to application modules<br><br>Section II<br>– There will be six short structured response questions<br>– There will be one question worth *10 marks*, based on historical and societal influences and the scope of the profession<br>– There will be three questions worth *10 marks* each based on application modules<br>– There will be two questions worth *15 marks* each based on focus modules<br><br>Section III<br>– There will be two short structured response questions worth *10 marks* each. Both questions are based on all modules and the Engineering Report | 10<br><br>70<br><br>100 | Tasks relating to module content exclusive of the Engineering Report<br><br>Engineering Reports are integral to this course and contribute to student communication skills. They are also an effective vehicle for assessing many course objectives | 75<br><br>25<br><br>100 | 65<br><br>35<br><br>100 |

## 12.8 Reporting Student Performance Against Standards

Student performance in an HSC course will be reported against standards on a course report. The course report includes a performance scale for the course describing levels (bands) of achievement, an HSC examination mark and the internal assessment mark. It will also show, graphically, the statewide distribution of examination marks of all students in the course.

Each band on the performance scale (except for band 1) includes descriptions that summarise the attainments typically demonstrated in that band.

The distribution of marks will be determined by students' performances against the standards and not scaled to a predetermined pattern of marks.