DEPARTMENT OF EDUCATION
learners first

Professional Studies

Technologies

Engineering Design 2

COURSE DOCUMENT

Catholic Education Tasmania

INDEPENDENT SCHOOLS TASMANIA

Years 9 to 12 Learning

Tasmanian Government

Table of Contents

Focus Area – Professional Studies

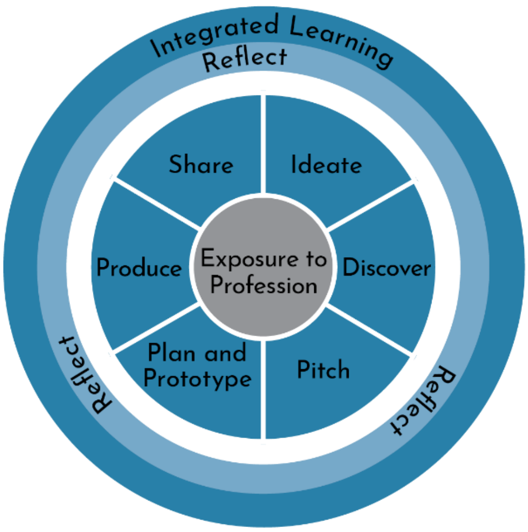
Courses aligned to the Years 9 to 12 Curriculum Framework belong to one of the five focus areas of Discipline-based Study, Transdisciplinary Projects, Professional Studies, Work-based Learning and Personal Futures.

Engineering Design Level 2 is a Professional Studies course.

Professional Studies bridges academic courses and career-related study to provide learners with a combination of academic and practical knowledge, skills and understanding to pursue a particular pathway of interest. Courses integrate exposure to professional environments, processes and practice through inquiry based learning. Professional Studies reflect professional processes and standards and provide learners with an equivalent experience to that of someone working within that profession Professional Studies enhances learners cognitive capacity, efficacy, creativity and craftsmanship in readiness for higher education, internships, apprenticeships, or work in a designated field of interest. Professional Studies courses connect with recognised professional study pathways and contextually align with key Tasmanian industry sectors.

Professional Studies courses have three key features that guide teaching and learning:

- exposure to professional practice
- ideation, research, discovery and integrated learning
- production and sharing replicating a professional paradigm.



In this course learners will engage in opportunities to research and appraise existing ideas, products, processes, and solutions to problems. They will learn to generate imaginative and creative solutions of their own and communicate their ideas within the parameters and requirements of engineering-based tasks while gaining and applying knowledge of industry standards of design, manufacture, and safety. Through practical experiences, learners will learn to use technology to design, test and appraise products, systems and solutions and have the opportunity to identify and articulate further improvements and developments.

Rationale

Technologies enrich and impact on the lives of people and societies globally. The practical nature of the Technologies learning area engages learners in critical and creative thinking, including understanding interrelationships in systems when solving complex problems. (ACARA, 2021).

The *Engineering Design* suite provides a flexible framework for learners to engage with engineering principles and systems through integrated Science, Technologies, Engineering and Mathematics (STEM) inquiry. Engineering is a broad term covering a wide range of skills and diverse disciplines but fundamentally, engineering is about improving people's lives through engineered solutions.

The *Engineering Design* suite encourages learners to become aware of factors that influence innovation and enterprise, and the subsequent success or failure of a product.

Learners will develop a specific skill set that will enable them to confidently explore a challenge or identify an existing problem and develop a solution in an engineering context. They will achieve this through using an engineering design process and gain valuable experience, in designing engineered components and in project management.

Learners will learn to generate imaginative and creative solutions of their own. They will communicate their ideas within the parameters and requirements of engineering-based tasks whilst gaining and applying knowledge of industry standards of design, manufacture, and safety. Through practical experiences, learners will learn to use technology to design, test and appraise products, systems and solutions and identify and articulate further improvements and developments.

The purpose of Years 9 to 12 Education is to enable all learners to achieve their potential through Years 9 to 12 and beyond in further study, training, or employment.

Years 9 to 12 Education enables Personal Empowerment, Cultural Transmission, Preparation for Citizenship and Preparation for Work.

This course is built on the principles of Access, Agency, Excellence, Balance, Support and Achievement as part of a range of programs that enables learners to access a diverse and flexible range of learning opportunities suited to their level of readiness, interests and aspirations.

Learning Outcomes

On successful completion of this module, learners will be able to:

1. use design thinking to generate creative ideas in response to an engineering design challenge
2. apply an engineering design process in the development of prototypes
3. use project management strategies when working independently and collaboratively with others
4. apply an engineering design process to test, review and refine engineered solutions against success criteria
5. communicate engineering design decisions and solutions
6. describe the impact of existing, new, and emerging technologies on people and engineering practice
7. describe the roles and responsibilities of engineers
8. explain how engineering solutions are utilised and their impact on society.

Integration of General Capabilities and Cross-Curriculum Priorities

The general capabilities addressed specifically in this course are:

- Critical and creative thinking
- Ethical understanding
- Information and communication technology capability
- Literacy
- Numeracy
- Personal and social capability

The cross-curriculum priorities enabled through this course are:

- Sustainability

Course Description

Engineering Design Level 2 enables learners to be creative problem solvers who explore how and why things work. Learners will be supported to work individually and collaboratively with others to explore the activity of engineers through practical problem-solving using engineering design processes.

Engineering Design Level 2 incorporates concepts from Maths, Science and subjects such as Design and Technology, Computing and Construction, within a project-based learning context to enable learners to solve problems and to design and improve products, services and environments.

Learners will have opportunities to shape their learning experience through their interests, questions they want to explore and the products they choose to create in response to authentic challenges.

Pathways

This course is designed for learners who are interested in studying the design life cycle as it relates to the engineering process. *Engineering Design* Level 2 builds on learners' prior learning in Years 9-10 *Australian Curriculum:* Technologies and Science.

Engineering Design Level 2 may provide background and support for vocational programs within training packages, where some engineering knowledge and experience is useful. It may also provide links with VET (Vocational Education and Training) programs, traineeships, and apprenticeships.

This foundation course may also provide pathways to several Level 3 TASC-accredited courses including: *Agricultural Systems; Computer Science; Electronics; Housing and Design; Information Systems and Design Technologies*, and *Physical Sciences*.

Course Requirements

Access

Learners enrolled in this course are required to be able to work responsibly and safely in practical situations.

This course requires learners to collaborate with others. This could include peers, community members, and/or industry professionals.

Resource Requirements

Delivery of this course requires specialised workspace(s)† and associated facilities for prototypes to be created and tested safely and effectively. Learners need to be able to access a wide range of reliable sources of information about the uses and applications of engineering within the wider community.

† Specialised workspaces may include equipment such as 3D Printers, electronic components and tools, microprocessors, sensors, robotic equipment, CNC routers, laser cutters, vinyl cutters, VR headsets, drones, power and hand tools, construction materials and equipment, computers with appropriate systems requirements and software to enable computer aided design, operate additive manufacturing equipment and display high-end graphics.

Consumable Resources
Providers will make available a basic stock of consumable materials relevant to the engineering context. Additional consumable resources may be required for specific design briefs.

Course Structure and Delivery

Structure

This course consists of three 50-hour modules.

Module 1: Understanding the Engineering Design Process

Module 2: Engineering Solutions

Module 3: Negotiated Design Project(s)

Delivery

Modules 1 and 2 must be delivered before Module 3. There is no further prescribed order.

Scaffolding a Design Project Response in Engineering Design

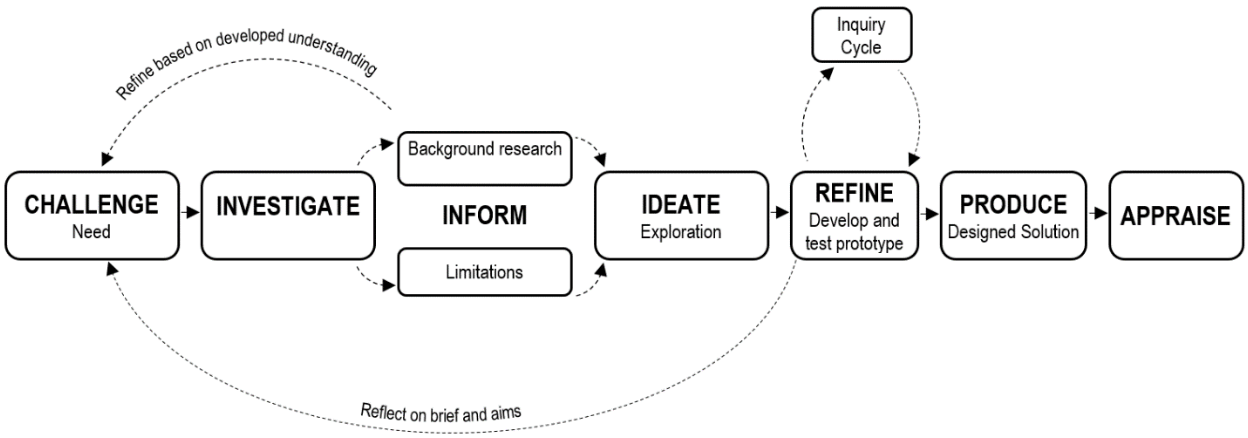
Teachers will scaffold initial design challenges more heavily and provide more significant support in sections for learners as they develop their knowledge and skills of working through the design process. Teachers may also combine sections or unpack and further expand sections in their delivery and expectations of the project response in order to meet the needs of their learners. Learners develop their skills in responding to a design brief throughout this course, working towards a more learner-initiated and managed approach in the Module 3 negotiated design project.

Course Content

Module 1 - Understanding the Engineering Design Process

Engineering design is a process. It is a way of thinking that is usually represented as a series of steps that guides the problem-solving process from problem identification to the development and improvement of solutions.

This module focuses on developing the learner's foundational knowledge and understanding about the processes used by engineers to develop a solution to a problem. Using a practical, problem/project-based approach, learners develop the core understanding, knowledge and skills that underpin design thinking (such as the five stage Stanford d.school methodology for creative problem solving) and engineering design processes, such as the one detailed below and expanded further in Appendix 6.



(diagram based on Design Thinking : a non-linear process, Teo Yu Siang, 2016)

Module 1 Learning Outcomes

The following Learning Outcomes are a focus of this module:

1. use design thinking to generate creative ideas in response to an engineering design challenge
2. apply an engineering design process in the development of prototypes
3. use project management strategies when working independently and collaboratively with others
4. apply an engineering design process to test, review and refine engineered solutions against success criteria
5. communicate engineering design decisions and solutions
6. describe the impact of existing, new, and emerging technologies on people and engineering practice.

Module 1 Content

Exposure to professional practice

- engineering design challenges
- managing projects
- investigating existing, new, and emerging technologies.

Ideation, research, discovery, and integrated learning

- design thinking and engineering design processes.

Production and sharing replicating professional paradigm

- communicate with purpose
- solve problems
- prototype
- collaborate
- use a design journal.

Learners will be immersed in the engineering design process and practices through a variety of engineering design challenges. They will unpack the elements of an engineering design cycle (Appendix

6) and develop an understanding of iterative problem solving. Learners will work with established safety protocols when using a variety of tools and equipment and will develop visual communication skills to communicate their ideas and understandings through the process of design development and the presentation of a final product. In this module learners will investigate the impact of existing, new and emerging technologies on people and engineering practice.

Key Knowledge

- think critically and creatively
- design thinking methodologies
- use techniques for recording and reflecting on decision making
- use research techniques
- use visual communication skills including sketching and graphic communication
- prototyping and product development frameworks, such as - rapid prototyping, lean product development, agile product development, design sprints
- use relevant prototype production techniques (such as soldering, cutting, coding)
- operate a range of tools, equipment, and processes to produce practical projects safely
- evaluate engineered solutions using success criteria
- manage projects.

Key Skills

- critical and creative thinking
- techniques for recording and reflecting on decision making
- research techniques
- visual communication skills including sketching and graphic communication
- prototyping and product development
- relevant prototype production skills (soldering, cutting, coding etc)
- operate a range of tools, equipment, and processes to produce practical projects safely
- analysis using success criteria
- collaboration
- project management skills including time management and self-imposed deadlines.

Module 1 Work Requirements Summary

This module includes the following work requirements:

- one project presentation and an accompanying production diary or equivalent (eg folio or blog)
- one extended response - research task

See Appendix 3 for the specifications of the work requirements of this course.

Module 1 Assessment

This module has a focus on criteria 1, 2, 3, 4, 5 and 6.

Module 2 - Engineering Solutions

In Module 2 learners build upon their understanding of engineering design processes and develop and apply their core understanding and skills using theory related to their specialist area in order to better understand the scientific, mathematical, and technical concepts that explain how engineered products function. They study the interrelationships between engineering products and society and investigate the varied roles and professional responsibilities of engineers.

Module 2 Learning Outcomes

The following Learning Outcomes are a focus of this module:

1. use design thinking to generate creative ideas in response to an engineering design challenge
2. apply an engineering design process in the development of prototypes
3. use project management strategies when working independently and collaboratively with others
4. apply an engineering design process to test, review and refine engineered solutions against success criteria
5. communicate engineering design decisions and solutions
7. describe the roles and responsibilities of engineers.

Module 2 Content

Exposure to professional practice

- respond to and create engineering design briefs
- manage projects (including identifying objectives, setting targets and timescales, managing resources and carrying out risk assessment)
- understand and apply professional standards such as ethical conduct, safe work practices and fundamental principles of intellectual property rights and protection
- investigate roles and responsibilities of engineers.

Ideation, research, discovery and integrated learning

- design thinking and engineering design processes.

Production and sharing replicating professional paradigm

- communicate with purpose
- assess and develop engineered solutions
- collaborate
- use a design journal
- produce engineering reports.

Learners will explore the varied roles and responsibilities of engineers and opportunities for enterprise. They will investigate the role played by engineers in supporting communities and improving peoples' lives. They will respond to engineering design briefs focussing on a personal, local or global problem. Learners will communicate using engineering drawing and technical information and identify the science, technology, and mathematics that is used to explain the key function of their engineering solutions.

Key Knowledge

- interpret and respond to a design brief
- identify and represent the operation of components and systems in diagrammatic and symbolic form, referring to the applicable science, technology, and mathematics principles
- know how engineering solutions are used by people and communities, the impacts they have and how the impacts are managed.

Key Skills

- collect data and perform appropriate manipulations
- apply materials, technique, and technologies to achieve solutions
- apply suitable communication techniques in the development, planning, production and presentation of ideas and projects
- use initiative and organisational skills to work both independently and collaboratively
- use project management skills including time management and self-imposed deadlines.

Module 2 Work Requirements Summary

This module includes the following work requirements:

- a poster/infographic
- a design process and solution.

See Appendix 3 for the specifications of the work requirements of this course.

Module 2 Assessment

This module has a focus on criteria 1, 2, 3, 4, 5 and 7.

Module 3 - Negotiated Design Project(s)

This culminating module provides learners with the opportunity to apply the practical skills and knowledge developed in the previous modules to the study of an area of special interest. This can be undertaken as a class, in groups or individually in consultation with their teacher.

Module 3 Learning Outcomes

The following Learning Outcomes are a focus of this module:

1. use design thinking to generate creative ideas in response to an engineering design challenge
2. apply an engineering design process in the development of prototypes
3. use project management strategies when working independently and collaboratively with others
4. apply a process to test, review and refine engineered solutions against success criteria
5. communicate engineering design decisions and solutions
8. explain how engineering solutions are utilised and their impact on society.

Module 3 Content

Exposure to professional practice

- develop an engineering design brief
- manage projects
- consider the needs of the present with the needs of future generations.

Ideation, research, discovery and integrated learning

- design thinking and engineering design processes.

Production and sharing replicating professional paradigm

- communicate with purpose
- appraise, design and create engineered solutions
- collaborate
- produce an engineering design report.

Learners design and produce an engineered solution to a specified design problem/challenge/situation/opportunity.

Learners will develop a design brief, conduct their own research, design, and construct a prototype and then perform an evaluation of their final product (Appendix 6). Learners must consider within their project, ethical, economic, environmental, and sustainability factors that may influence design decisions.

Key Knowledge

- components of a design brief
- strategies to achieve an objective
- factors that impact upon engineering design decisions
- role of innovation and the impact of engineered solutions on society
- iterative engineering design processes
- modes and contexts to articulate the design process in an engineering context.

Key Skills

- collect, assess and interpret data
- apply iterative engineering design processes
- use production processes
- test, review, refine engineered solutions
- reflect on actions and processes
- manage projects (including identifying objectives, setting targets and timescales, managing resources and carrying out risk assessment)
- collaborate with others.

Module 3 Work Requirements Summary

This module includes a folio incorporating a negotiated design project as a work requirement.

See Appendix 3 for the full specifications of the Work Requirements of this course.

Module 3 Assessment

This module has a focus on criteria 1, 2, 3, 4, 5 and 8

Assessment

Criterion-based assessment is a form of outcomes assessment that identifies the extent of learner achievement at an appropriate end-point of study. Although assessment – as part of the learning program – is continuous, much of it is formative, and is done to help learners identify what they need to do to attain the maximum benefit from their study of the course. Therefore, assessment for summative reporting to TASC will focus on what both teacher and learner understand to reflect end-point achievement.

The standard of achievement each learner attains on each criterion is recorded as a rating 'A', 'B', or 'C', according to the outcomes specified in the standards section of the course.

A 't' notation must be used where a learner demonstrates any achievement against a criterion less than the standard specified for the 'C' rating.

A 'z' notation is to be used where a learner provides no evidence of achievement at all.

Internal assessment of all criteria will be made by the provider. Providers will report the learner's rating for each criterion to TASC.

Criteria

	Module 1	Module 2	Module 3
Criteria Focus	1, 2, 3, 4, 5, and 6	1, 2, 3, 4, 5 and 7	1, 2, 3, 4, 5 and 8

The assessment for *Engineering Design* Level 2 will be based on the degree to which the learner can:

1. apply critical and creative thinking to the design of a solution
2. apply an iterative design cycle to prototype engineering design solutions
3. apply self and project management skills
4. test, refine and appraise engineered solutions
5. communicate to different audiences using a range of methods
6. describe the impact of existing, new, and emerging technologies on people and engineering practice
7. describe the roles and responsibilities of engineers
8. explain how engineering solutions are utilised and their impact on society.

Standards

Criterion 1: apply critical and creative thinking to the design of a solution

Standard Element	Rating C	Rating B	Rating A
E1 - Problem identification	investigates and identifies a limited range of needs and opportunities in response to a problem or challenge	investigates and identifies a range of needs and opportunities in response to a problem or challenge	investigates and identifies a wide range of needs and opportunities in response to a problem or challenge
E2 - Problem solving	applies critical and creative thinking to ideate an engineering solution that meets most of the requirements of a brief	applies critical and creative thinking to ideate a range of engineering solutions that meet most of the requirements of a brief	applies critical and creative thinking to ideate engineered solutions that effectively satisfy the requirements of a brief
E3 - Design considerations	selects (from a given range) appropriate criteria for success to assess design ideas, processes, and solutions	selects (from a given range) criteria for success that include consideration of key design factors†, to assess design ideas, processes, and solutions	identifies suitable criteria for success that include consideration of key design factors†, to assess design ideas, processes, and solutions
E4 - Engineering design proposal	modifies a given engineering production proposal to meet an identified need or opportunity.	creates a basic engineering production proposal to meet an identified need or opportunity.	creates a detailed engineering production proposal to meet an identified need or opportunity.

† design factors may include but are not limited to efficiency, function, manufacturing processes, sustainability, aesthetics, social impact, cost, safety

Criterion 2: apply an iterative design cycle to prototype engineering design solutions

Standard Element	Rating C	Rating B	Rating A
E1 - Knowledge and application of STEM concepts	uses and records familiar technological, scientific, and mathematical concepts related to observations and theories relevant to the engineering context	explains, applies and records familiar and some unfamiliar technological, scientific, and mathematical concepts related to observations and theories relevant to the engineering context	synthesises, applies and records familiar and unfamiliar technological, scientific, and mathematical concepts related to observations and theories relevant to the engineering context

E2 - Safety protocols	follows established safety procedures for the use of equipment and facilities, including using appropriate personal protective equipment (PPE), as directed	selects and uses established safety procedures for the use of equipment and facilities, including using appropriate personal protective equipment (PPE)	applies principles of occupational health and safety to minimise risks to self and others, including using appropriate personal protective equipment (PPE)
E3 - Use of specialist tools and equipment	uses a limited range of appropriate materials, components, tools, equipment and techniques to produce engineered solutions	selects and uses a range of appropriate materials, components, tools, equipment and techniques to produce engineered solutions	selects and manipulates a wide range of appropriate materials, components, tools, equipment and techniques to produce engineered solutions
E4 - Prototype production	produces a prototype that could solve a relevant problem.	produces a prototype that could solve a relevant problem and meets most of the requirements of a brief.	produces a prototype that could solve a relevant problem and meets the requirements of a brief.

Criterion 3: apply self- and project management skills

Standard Element	Rating C	Rating B	Rating A
E1 - Organisational skills	uses limited planning strategies to facilitate completion of key elements of tasks within agreed time frames	uses planning strategies to facilitate successful completion of tasks within agreed time frames	uses a range of planning and self-management strategies to enable the effective completion of tasks within agreed time frames
E2 - Reflective skills	reflects, orally and in writing, on learning and performance including planning and time management, and makes minor modifications as directed	reflects, orally and in writing, on learning and performance, including planning and time management; suggests and makes minor modifications for improvement	reflects, orally and in writing, on learning and performance, including planning and time management; suggests and makes modifications for improvement
E3 - Roles and Responsibilities	identifies own contribution to the successful completion of collaborative activities.	describes own contribution to the successful completion of collaborative activities.	explains own and others' contributions to the successful completion of collaborative activities.

Criterion 4: test, refine and appraise engineered solutions

Standard Element	Rating C	Rating B	Rating A
E1 - Process	identifies the purpose and process of testing	describes the purpose and process of testing	explains the purpose and process of testing
E2 -Testing of engineered solution	collects, records, and interprets data and information accurately in given formats	collects, records, and interprets data and information accurately	collects, records, and assesses data accurately and systematically
E3 - Reviewing the engineered solution	identifies design choices and actions taken in response to feedback from others	describes and provides some justification for design choices and actions taken in response to feedback from others	explains and provides clear justification for design choices and actions taken in response to feedback from others
E4 - Refining the engineered solution	makes modifications, as directed, when developing design solutions	adjusts and modifies initial prototype to develop a design solution	adjusts and modifies initial prototype to develop and iteratively improve a design solution
E5 - Appraise the final engineered solution	identifies the suitability and appropriateness of a solution using success criteria.	describes the suitability and appropriateness of a solution using success criteria.	assesses the suitability and appropriateness of a solution using success criteria and describes suggestions for future improvement.

Criterion 5: communicate to different audiences using a range of methods

Standard Element	Rating C	Rating B	Rating A
E1 - Use of terminology	uses given terminology to communicate key concepts and ideas within an engineering context	uses a range of terminology to clearly communicate key concepts and ideas within an engineering context	accurately uses a wide range of appropriate terminology to clearly communicate key concepts and ideas within an engineering context
E2 - Technical and graphic communication	interprets and uses a limited range of engineering drawings and technical information and applies graphics – with limited detail and accuracy – as a communication tool	effectively interprets and uses engineering drawings and technical information and applies graphics – with increasing detail and accuracy – as a communication tool	uses informed and accurate interpretations of engineering drawings and technical information and effectively applies graphics as a communication tool

E3 - Communicating as an engineer	records the process of solving design problems with limited explanation of the choices made in response to a design brief	describes the process of solving design problems and justifies the choices made in response to a design brief using some appropriate evidence	explains the process of solving design problems and justifies the choices made in response to a design brief using appropriate evidence
E4 - Communication mode	uses nominated communication formats in meaningful, targeted communication	uses a range of nominated communication formats to clarify meaning	appropriately selects from and uses a range of communication formats to suit purpose
E5 - Academic integrity	uses referencing/citation methods, as directed.	uses some appropriate referencing/citation methods.	uses appropriate referencing/citation methods.

Criterion 6: investigate the impact of existing, new, and emerging technologies on people and engineering practice

Standard Element	Rating C	Rating B	Rating A
E1 - Technological transformation	describes the influence of technological change on engineering, and its effect on people	explains the influence of technological change on engineering, and its effect on people	assesses the influence of technological change on engineering, and its effect on people
E2 - Evolution of technologies	investigates and describes an aspect of an existing, new and emerging tool, technology, or system	investigates and describes several aspects of an existing, new and emerging tool, technology, or systems	investigates and describes – with supporting detail – existing, new, and emerging tools, technologies, and systems, and their evolution
E3 – The role of innovation	identifies the role of innovation in an engineering context.	describes the role of innovation in an engineering context.	assesses the role of innovation in an engineering context.

Criterion 7: describe the roles and responsibilities of engineers

Standard Element	Rating C	Rating B	Rating A
E1 - Applies professional standards	identifies and applies relevant professional standards†	describes and applies relevant professional standards†	explains and applies relevant professional standards†

E2 - Professional pathways	identifies the roles and responsibilities of engineers in an engineering context	describes the roles and responsibilities of engineers in multiple engineering contexts	explains the roles and responsibilities of engineers in multiple engineering contexts
E3 - Enterprise	identifies current and future opportunities for enterprise in an engineering field.	explains current and future opportunities for enterprise in an engineering field.	assesses current and future opportunities for enterprise in an engineering field.

† Professional standards may include but are not limited to fundamental principles of intellectual property rights and protection, ethical conduct, safe work practices

Criterion 8: explain how engineering solutions are utilised and their impact on society

Standard Element	Rating C	Rating B	Rating A
E1 - Creating preferred futures	identifies ethical, cultural and economic considerations in engineered solutions	describes ethical, cultural and economic considerations in engineered solutions	explains ethical, cultural and economic considerations in engineered solutions
E2 - Sustainable engineering	identifies environmental and sustainability considerations in engineered solutions	describes environmental and sustainability considerations in engineered solutions	explains environmental and sustainability considerations in engineered solutions
E3 - Impact of technology choices	identifies impacts, including unintended negative consequences, of choices made about technology use	describes impacts, including unintended negative consequences, of choices made about technology use	discusses impacts, including unintended negative consequences, of choices made about technology use
E4 - Technologies and society	identifies the role played by engineering in supporting communities and improving peoples' lives.	describes the role played by engineering in supporting communities and improving peoples' lives.	assesses the role played by engineering in supporting communities and improving peoples' lives.

Quality Assurance Processes

The following processes will be facilitated by TASC to ensure there is:

- a match between the standards of achievement specified in the course and the skills and knowledge demonstrated by individual learners
- community confidence in the integrity and meaning of the qualification.

Process

TASC will verify that the provider's course-delivery and assessment meet the course requirements and community expectations for fairness, integrity and validity of qualifications TASC issues. This will involve checking:

- scope and sequence documentation (Provider Standard 1):
  - course delivery plan
  - course assessment plan (assessment matrix)
- student attendance records (Provider Standard 2)
- examples of assessments tools / instruments, and associated rubrics / marking guides (Provider Standard 3)
- examples of student work, including that related to any work requirements articulated in the course document (Provider Standard 1 & 3)
- class records of assessment (Provider Standard 4).

This process will be scheduled by TASC using a risk-based approach.

Qualifications and Award Requirements

The final award will be determined by the Office of Tasmanian Assessment, Standards and Certification from 8 ratings.

The minimum requirements for an award in Engineering Design Level 2 are as follows:

EXCEPTIONAL ACHIEVEMENT (EA)
6 'A' ratings, 2 'B' ratings

HIGH ACHIEVEMENT (HA)
3 'A' ratings, 4 'B' ratings, 1 'C' rating

COMMENDABLE ACHIEVEMENT (CA)
4 'B' ratings, 3 'C' ratings

SATISFACTORY ACHIEVEMENT (SA)
6 'C' ratings

PRELIMINARY ACHIEVEMENT (PA)
4 'C' ratings

A learner who otherwise achieves the rating for a CA (Commendable Achievement) or SA (Satisfactory Achievement) award but who fails to show any evidence of achievement in one or more criteria ('z' notation) will be issued with a PA (Preliminary Achievement) award.

Course Evaluation

Years 9 to 12 Learning will develop and regularly review and revise the curriculum. Course evaluation is informed by the experience of the course's implementation, delivery and assessment. More information about course evaluation can be found on the Years 11 and 12 website.

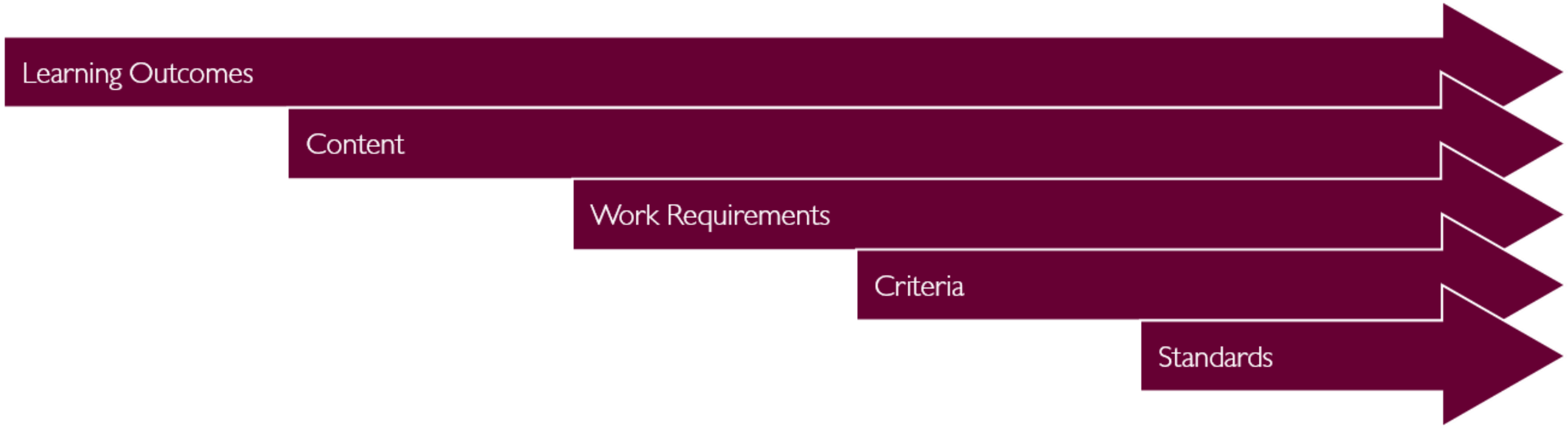
Course Developer

This course has been developed by the Department of Education's Years 9 to 12 Learning Unit in collaboration with Catholic Education Tasmania and Independent Schools Tasmania.

Accreditation and Version History

Version 1. Accredited on 23 September 2021 for use from January 2022 to 31 December 2026.

Appendix 1 - Line of Sight



Learning Outcomes	Course Content	Work Requirements	Criteria	Standards	General Capabilities (GC)
1. use design thinking to generate creative ideas in response to an engineering design challenge	Module 1, 2, 3	Module 1, 2, 3	C 1	E 1, 2, 3, 4	
2. apply an engineering design process in the development of prototypes	Module 1, 2, 3	Module 1, 2, 3	C 2	E 1, 2, 3, 4	
3. use project management strategies when working independently and collaboratively with others	Module 1, 2, 3	Module 1, 2, 3	C3	E 1, 2, 3	
4. apply an engineering design process to test, review and refine engineered solutions against success criteria	Module 1, 2, 3	Module 1, 2, 3	C 4	E 1, 2, 3, 4, 5	
5. communicate engineering design decisions and solutions	Module 1, 2, 3	Module 1, 2, 3	C 5	E 1, 2, 3, 4, 5	
6. describe the impact of existing, new and emerging technologies on people and engineering practice	Module 1	Module 1	C 6	E 1, 2, 3	
7. describe the roles and responsibilities of engineers	Module 2	Module 2	C 7	E 1, 2, 3	
8. explain how engineering solutions are utilised and their impact on society	Module 3	Module 3	C8	E1, 2, 3, 4	

Appendix 2 - Alignment to Curriculum Frameworks

No relevant Curriculum Frameworks apply to this course

Appendix 3 - Work Requirements

The work requirements of a course are processes, products or performances that provide a significant demonstration of achievement that is measurable against the course's standards. Work requirements need not be the sole form of assessment for a module.

Module 1 Work Requirements Specifications

Work requirement 1 of 2

Title of Work Requirement: Research task – existing, new, and emerging technologies

Mode /Format: Extended response

Description: Investigation of the impacts of existing, new, and emerging technologies, for example, the development of the mobile phone.

Size: Recommended maximum - 500 words or 3 minutes of recorded oral communication, or equivalent in multimodal form.

Timing: No specified timing

External agencies: Not required

Relevant Criteria:

- Criterion 3: element 1
- Criterion 5: elements 1, 4, 5
- Criterion 6: all standard elements

Work requirement 2 of 2

Title of Work Requirement: Engineering Design Challenge

Mode /Format: Project presentation and production diary – design process and engineering challenge solution.

Description: Learners experience the design process by responding to engineering design challenges.

Through this area of study, learners develop an understanding of effective collaboration and how they as individuals, contribute to project success. They develop skills in prototyping, product development and project management within specific constraints such as resource, time and relative complexity of the project.

Size: Recommended maximum - 750 words or 5 minutes of recorded oral communication, or equivalent in multimodal form.

Timing: No specified timing – learners may have the opportunity to undertake multiple mini design challenges throughout Module 1.

External agencies: Not required

Relevant Criteria: 1, 2, 3, 4 and 5. (All standard elements)

Module 2 Work Requirements Specifications

Work requirement 1 of 2

Title of Work Requirement: Roles and Responsibilities of Engineers

Mode /Format: Poster or infographic

Description: Identify the key characteristics of engineers, describe how these characteristics apply to the engineer's role in a particular engineering context, ie civil engineering, software engineering.

Size: 1 single-sided A3 page (digital/non-digital)

Timing: No specified timing

External agencies: Not required

Relevant Criteria:

- Criterion 3: element 1
- Criterion 5: elements 1, 4, 5
- Criterion 7: all standard elements

Work requirement 2 of 2

Title of Work Requirement: Learner selected engineering design project

Mode /Format: Project and accompanying design journal

Description: Learners are required to keep a journal to document the elements of the engineering design process as they develop their chosen engineering solution including:

- a description of the science, technology, and mathematics (using scientific symbols, diagrams, and formula where appropriate) that is used to explain the key function of the engineering solution
- a plan to collect data to assess the solution
- data collected and represented to enable interpretation
- reasoned conclusions made from the testing process using scientific, technological, and mathematical theory and the data collected
- identification of relevant professional standards and the role of enterprise

It is expected that this process will form an inquiry cycle where the application of science, technology and mathematics is used to inform choices including data collection, and refinements are made through an iterative process. The completed diary entries should reflect this process and document the learner's evolution of knowledge and exploration, including the role and value of failure when engineering systems do not behave as expected.

Size: Recommended maximum - 750 words or 5 minutes of recorded oral communication, or equivalent in multimodal form.

Timing: No specified timing

External agencies: Not required

Relevant Criteria: 1, 2, 3, 4, 5 (all standard elements) and 7 (elements 1 and 3)

Module 3 Work Requirements Specifications
Work requirement 1 of 1

Title of Work Requirement: Negotiated engineering design project

Mode /Format: Folio – design and production

Description: Design and production of an engineered solution to a specified project brief as provided by the course instructor.

The process that learners have followed must be documented in a production diary. The production diary must be presented as a design folio, including:

- problem identification and analysis
- project plan
- iterative testing plans and implementation
- a discussion of where the engineering solution could be used in society, the impacts it has, and how those impacts are managed.

This is to be presented in an appropriate format including evidence of design development sketching and annotated photos of production process and documentation of testing processes.

Size: Recommended 40 hours

Timing This is the major task for this module

External agencies: Not required

Relevant Criteria: 1, 2, 3, 4, 5 and 8. (All standard elements)

Appendix 4 – General Capabilities and Cross-Curriculum Priorities

Learning across the curriculum content, including the cross-curriculum priorities and general capabilities, assists students to achieve the broad learning outcomes defined in the *Alice Springs (Mparntwe) Education Declaration (December 2019).*

General Capabilities

The general capabilities play a significant role in the Australian Curriculum in equipping young Australians to live and work successfully in the twenty-first century.

In the Australian Curriculum, capability encompasses knowledge, skills, behaviours and dispositions. Students develop capability when they apply knowledge and skills confidently, effectively and appropriately in complex and changing circumstances, in their learning at school and in their lives outside school.

The general capabilities include:

- Critical and creative thinking
- Ethical understanding
- Information and communication technology capability
- Intercultural understanding
- Literacy
- Numeracy
- Personal and social capability

Cross-Curriculum Priorities

Cross-curriculum priorities enable students to develop understanding about and address the contemporary issues they face, for their own benefit and for the benefit of Australia as a whole. The priorities provide national, regional and global dimensions which will enrich the curriculum through development of considered and focused content that fits naturally within learning areas. Incorporation of the priorities will encourage conversations between students, teachers and the wider community.

The cross-curriculum priorities include:

- Aboriginal and Torres Strait Islander Histories and Cultures
- Asia and Australia's Engagement with Asia
- Sustainability

Appendix 5 – Glossary

Term	Definition	Source Acknowledgement	Course Context
collaboration	working with others towards a shared goal.	OCR https://ocr.org.uk/Images/400187-terminology-guide.pdf	
define (as a component of the design thinking)	mode of the design process about bringing clarity and focus to the design space. In a word, the Define mode is sensemaking.	Stanford	
design brief	a concise statement clarifying a *project* task and defining a need or opportunity to be resolved after some analysis, investigation and research. It usually identifies users, *criteria for success*, constraints, available *resources* and timeframe for a *project* and may include possible consequences and impacts.	ACARA	
design challenge	an integral part of educational content where students have the opportunity to work on real-world challenges in a collaborative, team-based environment, applying the lessons learned to the technical problems of the workplace.	nasa.gov	
design thinking	use of strategies for understanding design problems and opportunities, visualising and generating creative and innovative ideas, and analysing and evaluating those ideas that best meet the criteria for success and planning.	ACARA	
designed solution	a product, service or environment that has been created for a specific purpose or intention as a result of design thinking, design processes and production processes.	ACARA	

Term	Definition	Source Acknowledgement	Course Context
designing	a process that typically involves investigating and defining; generating; producing and implementing; evaluating; and collaborating and managing to create a designed solution.	ACARA	
empathy/empathise (as a component of the design thinking)	is the centrepiece of a human-centered design process. The Empathize mode is the work you do to understand people, within the context of your design challenge. It is your effort to understand the way they do things and why, their physical and emotional needs, how they think about world, and what is meaningful to them.	Stanford	
engineering	a practical application of scientific and mathematical understanding and principles as a part of the process of developing and maintaining solutions for an identified need or opportunity.	ACARA	
engineering design process	a series of steps used by engineering teams to guide them as they develop new solutions, products or systems. The process is cyclical and iterative. Also called the engineering design cycle.	Solving Everyday Problems Using the Engineering Design Cycle - Activity - TeachEngineering	
engineering drawing	technical drawings used to fully and clearly define requirements for engineered items; their purpose is to capture all the geometric features of a product or a component and required for a manufacturer to produce that component,	QCAA – General Senior Syllabus – Engineering 2019	
enterprise	a *project* or activity that may be challenging, requires effort and initiative and may have risks.	ACARA	

Term	Definition	Source Acknowledgement	Course Context
evaluating	measuring performance against established criteria. Estimating nature, quality, ability, extent or significance to make a judgement determining a value. In this course: evaluation establishes whether the need(s) of the user(s) and stakeholder(s) have been met and informs the next iteration.	ACARA	
ideate	to form an idea of a particular thing.	Cambridge Dictionary	
ideate (as a component of design thinking)	the mode of the design process in which you concentrate on idea generation.	Stanford	
innovation	(the use of) a new idea or method.	https://dictionary.cambridge.org/dictionary/english/innovation	
iterative	engineers do not always follow the engineering design process steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to make a modification or change to your design. This way of working is called iteration.	https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-process-steps	
product	one of the outputs of design and production processes. Products are the tangible end results of natural, human, mechanical, manufacturing, electronic or digital processes to meet a need or want.	VCAA	

Term	Definition	Source Acknowledgement	Course Context
production process	a technologies context-specific process used to transform technologies into a product, service or environment, for example the steps used for producing a product.	NESA	
professional standards	professional standards are a set of practices, ethics, and behaviours that members of a particular professional group must adhere to. These sets of standards are frequently agreed to by a governing body that represents the interests of the group.	https://corporatefinanceinstitute.com/resources/knowledge/other/professional/	
project	an individual or collaborative problem-solving activity undertaken by students that is planned to achieve an articulated aim.	NESA	
project management	a responsibility for planning, organising, controlling resources, monitoring timelines and activities, and completing a project to achieve a goal that meets identified criteria for judging success.	ACARA	
prototype	a trial product or model built to test an idea or process to inform further design development. A prototype can be developed in the fields of service, design, electronics or software programming. Its purpose is to see if and how well the design works and is tested by users and systems analysts. It can be used to provide specifications for a real, working product or system rather than a virtual or theoretical one. Prototype is derived from Greek terms that, when translated, mean 'primitive form', 'first' and 'impression'.	ACARA	
Stanford d.school model	the five stages of Design Thinking, according to d.school, are as follows: Empathise, Define, Ideate, Prototype, and Test.	https://dschool.stanford.edu/resources/get-started-with-design	

Term	Definition	Source Acknowledgement	Course Context
success criteria	a descriptive list of essential features against which success can be measured. The compilation of criteria involves literacy skills to select and use appropriate terminology.	ACARA	
sustainable	supporting the needs of the present without compromising the ability of future generations to support their needs.	ACARA	
systems thinking	a holistic approach to the identification and solving of problems, where parts and components of a system, their interactions and interrelationships are analysed individually to see how they influence the functioning of the whole system. This approach enables learners to understand systems and work with complexity, uncertainty and risk.	ACARA	
technologies	materials, data, systems, components, tools and equipment used to create solutions for identified needs and opportunities, and the knowledge, understanding and skills used by people involved in the selection and use of these.	ACARA	
preferred futures	a selected future identified by a student, used to inform the creation and evaluation of solutions.	NESA	

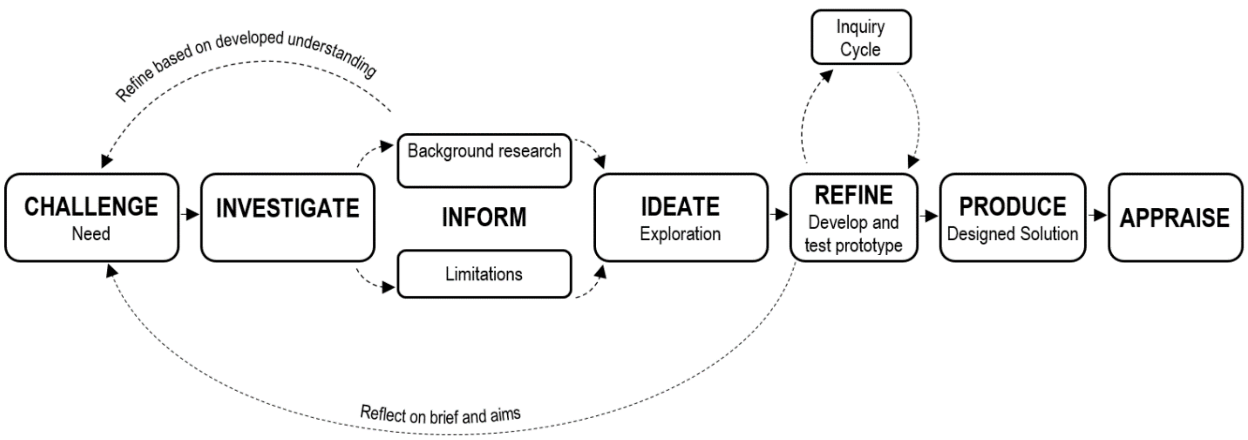
Appendix 6 Engineering Design Process

Engineering design is a process. It is a way of thinking that is usually represented as a series of steps that guides the problem-solving process from problem identification to the development and improvement of solutions.

Engineering Design is iterative. The steps of the engineering process are not always followed in sequence, and will vary depending on the project itself, allowing for steps to be repeated enabling lessons to be learnt from failures and improvements to be made to develop the best possible solution.

Engineers use a design process to define the problem and brainstorm ideas before creating a prototype to test that is then modified and improved until the solution meets the needs of the project.

The process allows for the application of science, mathematics and engineering concepts to be used to achieve a high level of optimisation to meet the requirements of an objective. There are numerous versions of an engineering design process. Typical steps include problem solving processes such as those identified below.



(diagram based on Design Thinking : a non-linear process, Teo Yu Siang, 2016)

Design Brief

The brief is usually the starting point of a design and is a statement of the project's purpose and the need it is being designed to fulfil. This details the requirements of the project or can be an explanation of a design problem to unpack and work from. The brief forms part of the criteria by which the final design solution is appraised. Learners will begin by having design briefs given to them to work from and work up to developing their own design brief for their final project.

Research

Research involves the collection of information, including data and background information to assist in the understanding of the brief and development of the design solution. This can include research to:

- further understand the intended design scenario or audience
- consider existing similar products, problems or solutions
- develop understanding of technologies that might be used in the product development phase.

Generation, development and refinement of ideas

This includes preliminary sketch designs and concept designs drawn as sketches with annotations which relate back to the brief and needs. Following on from sketches this can also include photographs of prototypes. This documents the learner's design progression, reflection and refinement of ideas. This is part of the iterative approach which can cycle back through further research to inform concept development and testing of product development which may then go back to the development stage to further refine concepts.

Production

This shows the development of the designed solution. There needs to be evidence of decision making that gives reasoning for final design decisions. This section should include well annotated drawings or photos of the development of the final solution.

Appraisal

An appraisal reflecting on how well the brief and aims have been met by the final design, identifying any aims that have not been fully resolved.

References

Learners must reference all images information, ideas and words which they use that are not their own creation. Images include, but are not limited to, pictures, tables, graphs, charts and graphics. This includes creations that are based on the works of others that learners manipulate, edit or otherwise transform.