Engineering Design

LEVEL 2	15 TCE CREDIT POINTS
COURSE CODE	EDN215118
COURSE SPAN	2018 — 2021
READING AND WRITING STANDARD	NO
MATHEMATICS STANDARD	NO
COMPUTERS AND INTERNET STANDARD	NO

This course was delivered in 2019. Use A-Z Courses to find the current version (if available).

Engineering Design introduces learners to engineering principles and systems through an integrated Science, Technologies, Engineering and Mathematics (STEM) inquiry

STEM education integrates concepts that are usually delivered as separate subjects in different classes and emphasises the application of knowledge to real-life situations. STEM learning is typically based around finding a solution to a real-world problem and tends to emphasise project based learning.

Course Description

For the content areas of *Engineering Design*, the three (3) interrelated strands –

1. Science Understanding
2. Science Inquiry Skills
3. Design and Technologies Knowledge and Understanding.

These three strands draw upon the specific skill sets of both disciplines that are directly related to the identification, analysis, understanding and problem solving techniques of a specific problem.

These three strands will be integrated into four (4) general areas of study based on the themes of Engineering and Design in the real world:

1. identify a problem area, or an area that could be improved upon with the application of new technologies or a different approach
2. investigate all aspects of the problem itself, including all directly related science apply the science and mathematics behind all aspects of the problem itself, including all directly related science and mechanical function
3. apply a conceived solution, record and draw conclusions regarding the effectiveness of the result
4. experiment with variations of the solution in the hope of correcting errors or improving on effectiveness.

The course consists of three interconnected content units plus a major project that relies on knowledge from those content areas.

UNIT 1: DESIGN THINKING
This content area includes the engineering design process known as design thinking, how it is applied to create solutions, and how it is documented and communicated.

UNIT 2: ENGINEERING FUNDAMENTALS
This content area includes core engineering concepts, as well as the science, technology, and mathematics that underpins the technical aspects of engineering.

UNIT 3: ENGINEERING AND SOCIETY
This content area includes social and ethical issues associated with the engineering solutions, as well as the engineering profession and career pathways.

UNIT 4: MAJOR PROJECT
In the major project, learners use a design thinking process to solve a problem they have identified. This can include development of engineering solution to meet a client need, or application of engineering tools and resources to solve a problem identified by the student.

Rationale

Engineering Design introduces learners to engineering principles and systems through an integrated Science, Technologies, Engineering and Mathematics (STEM) inquiry. STEM education integrates concepts that are usually delivered as separate subjects in different classes and emphasises the application of knowledge to real-life situations. STEM learning is typically based around finding a solution to a real-world problem and tends to emphasise project based learning.

As a discipline, engineering contributes significantly to society through the design, manufacture and maintenance of a diverse range of products and infrastructure integral to the functioning of commerce and the environment. *Engineering Design* affords an opportunity for learners to gain an understanding of our influence as users and consumers, and can equip students with the skills and knowledge to make positive contributions to the future of the societies and environments in which we live. In this regard, an engineer must be socially responsible and conscious of global community issues that may impact on the environment and sustainable management of resources.

Society's heavy reliance on the creativity and problem solving abilities of Engineers reinforces that *Engineering Design* students need to learn how to formulate ideas and strategies to solve problems by applying lateral thinking and engineering design principles.

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

Through the *Engineering Design* course, learners will have the opportunity to research and appraise existing ideas, products, processes and solutions to problems. 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 have the opportunity identify and articulate further improvements and developments.

Aims

"Engineering is an occupation with extremely wide reach. The term 'engineering' covers many fields and, by extension, many skills. Engineers are scientists, inventors, designers, builders and great thinkers. They improve the state of the world, amplify human capability and make people's lives safer and easier.

Engineering skills include:

- the scientific method
- social, cultural and economic awareness
- mathematics
- biology, chemistry, physics and other areas of science
- creativity
- teamwork.

Engineering disciplines cover:

- mechanics and the construction of tools and machines of all sizes, from the nano scale to entire manufacturing facilities
- the creation of cars, trains, ships, boats, aircraft and all other vehicles
- the design and production of chemical compounds
- operations of businesses and cities
- entertainment, industry, construction, transport, healthcare, defence and more."

https://www.engineersaustralia.org.au/For-Students-And-Educators/Engineering-Careers/What-Is-Engineering

Engineering Design will impart a specific skill set upon learners that will enable them to confidently identify a problem and develop a well-structured and well thought-out solution in an engineering context. This will be achieved through a rigorous design process. This means that learners will not only gain valuable experience in designing engineered components but also gain experience in project management.

Learning Outcomes

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

1. describe and apply engineering concepts involved in the design and testing of engineering solutions [Criterion 1]
2. use prototypes to assess the effectiveness of proposed solutions [Criterion 2]
3. respond appropriately to the imperative nature of failure when testing prototypes [Criterion 2]
4. apply design thinking to real world engineering scenarios [Criterion 3]
5. produce appropriate prototypes [Criterion 4]
6. select the appropriate resources to use for a project based on a set of relevant criteria such as durability, strength and cost effectiveness [Criterion 4]
7. skilfully use techniques and equipment relating to engineering and design [Criteria 3 & 4]
8. describe how engineering solutions are utilised and their impact on society [Criterion 5]
9. collate, represent and interpret data from experimentation [Criterion 6]
10. plan and model engineering solutions using graphic, algebraic and symbolic communication techniques [Criterion 7]
11. Plan and organise - organise and complete activities including practical tasks [Criterion 8]
12. Communicate for work - collect, process, communicate and organise detailed research about a specific problem [Criterion 8]
13. Connect and work with others - work cooperatively with others [Criterion 8].

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* builds on students' learning in Years 9-10 Australian curriculum: Science and Technologies. Engineering Design, may be studied as a standalone course. It 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 programs, traineeships and apprenticeships. This foundation course may also provide pathways to a number of Level 3 courses including: *Agricultural Systems; Computer Science; Electronics; Housing and Design; Information Systems and Design Technologies*; and *Physical Sciences*.

Resource Requirements

Delivery of this course requires specialised workspace(s) and associated facilities in order 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.

Course Size And Complexity

This course has a complexity level of 2.

At Level 2, the learner is expected to carry out tasks and activities that involve a range of knowledge and skills, including some basic theoretical and/or technical knowledge and skills. Limited judgment is required, such as making an appropriate selection from a range of given rules, guidelines or procedures. VET competencies at this level are often those characteristic of an AQF Certificate II.

This course has a size value of 15.

Relationship To Other TASC Accredited And Recognised Senior Secondary Course

Engineering Design Level 2 is underpinned by design thinking which appears in other TASC Design and Technology courses. Although learners who are studying more than one Design and Technology course (either sequentially or concurrently) may have some advantages in dealing with familiar terms and integrating broad concepts, the depth, contextualisation of content and application all vary significantly between courses.

Course Delivery

Learners must complete the work requirements as listed in the Course Content section of this document.

Content from Units 1 and 2 may be integrated in their delivery and must be completed before undertaking Unit 3 then Unit 4, as each unit builds upon skills gained from the previous unit.

Initial design challenges will be scaffolded by providers, giving support for learners as they develop their knowledge and skills of working through the design process. To facilitate this, course providers may choose to focus on particular stages of the engineering design process at different times, depending on the needs of students. Learners will develop their skills in responding to design challenges throughout this course, working towards a more learner-initiated and managed approach in the major project.

While each general area of study is compulsory, the method of delivery is not prescribed. The course may be delivered in a number of ways, for example:

- using a theme-based approach
- on the basis of individual project work
- unitised into topics
- a combination of these and other strategies.

Course Requirements

Work submitted for assessment must be:

- produced over the duration of one calendar year
- be unique to this course

and not be work submitted for assessment in any other course.

Literacy

Literacy is of fundamental importance in the study of the *Engineering Design*, Level 2 course. Learners access engineering and technological content through a variety of print, oral, visual, spatial and electronic forms, including data books, texts, computer software, images, and written technical materials. They learn to investigate, interpret, and apply engineering principles from a variety of sources to design solutions for engineering tasks. They analyse and evaluate information for authority, reliability, relevance and accuracy. They learn to monitor their own language use for accuracy in the use of design principles and technological terms, for clarity of ideas, processes and explanations of engineering activities, and for development and evaluation of functioning prototypes.

Numeracy

Numeracy is fundamental in calculating and evaluating engineering processes. Learners develop their understanding and skills of numeracy while undertaking tasks to produce, test and evaluate engineered products. Core and specialist area theory continues to be studied to forge greater understanding of the scientific, mathematical and technical concepts that explain and investigate how engineered products function.

Information and communication technology capability

Information and communication technology (ICT) capability is important in all stages of the design process. Learners use digital tools and strategies to locate, access, process and analyse information. They use ICT skills and understandings to investigate, devise and test design ideas. Learners access information from websites and software programs to develop design solutions. Learners use computer-aided drawing software to assist in the design and production engineered products.

Critical and creative thinking

Critical and creative thinking is integral to the design process. Design thinking methodologies are fundamental to the *Engineering Design*, Level 2 course. Learners develop understandings and skills in critical and creative thinking during periods of evaluation at various stages of the design process. They devise plausible solutions to problems, and then through interrogation, critically assess the performance of the most efficient solution. Learners identify possible weaknesses in their design solutions, and analyse, evaluate and modify the developing solution to construct a functioning prototype.

Personal and social capability

Personal and social capability skills are developed and practiced in the *Engineering Design*, Level 2 course by learners enhancing their communication skills and participating in teamwork. Learners have opportunities to work collaboratively during stages of investigation and when producing engineering products. Learners develop increasing social awareness through the study of the impact of engineering in society and on the environment.

Ethical understanding

Learners have opportunities to explore and understand the diverse perspectives and circumstances that shaped engineering technology, the actions and possible motivations of people in the past compared with those of today. Learners have opportunities, both independently and collaboratively, to explore the values, beliefs and principles that have influenced engineering achievements and global engineering activities of today.

Intercultural understanding

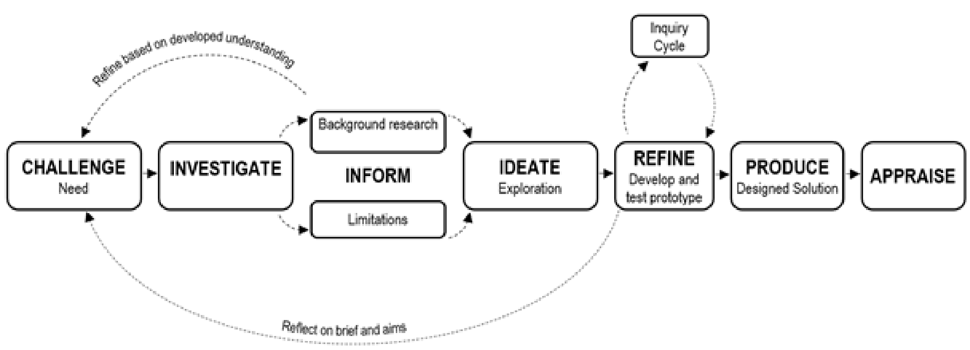
Learners have opportunities to explore the different beliefs and values of a range of cultural groups and develop an appreciation of cultural diversity. Learners have opportunities to develop an understanding of different contemporary perspectives with regard to contexts such as: building materials, styles of structures, energy supply and use, automation and control, and engineering and technological influences on different groups within society, and how they contribute to individual and group actions in the contemporary world.

Course Content

Unit 1 – Design Thinking 25 hours	
Unit Outline	Design underpins all engineering solutions. In this Unit learners develop an understanding of design thinking and how this is applied to develop design solutions. The importance of working to a design brief within this process is pivotal. Learners will develop visual communication skills to communicate their ideas and understandings through the process of design development and the presentation of a final product.
Key Knowledge and skills	• design thinking processes (brief, research and prototype, production and appraisal) • design elements and principles • visual communication skills including sketching and graphic communication • techniques for recording and reflecting on decision making • ergonomics and function in design • the role of visual communication in design • relevant prototype production skills (soldering, cutting, coding etc.) • the role of failure in the engineering design process • project management skills including time management and self-imposed deadlines.
Work requirements	Design and production of an engineered solution (examples can be found below) to a specified project brief as provided by the course provider. The size, complexity and scale of the engineering solution will be appropriate to a guided figure of 25 hours for this Unit. Through this area of study, learners will also develop skills in documentation and communication. In particular, they will learn how to record the creation of an engineering solution through a production diary or equivalent (e.g. a folio or blog), that includes: • the original brief • projected timeline • the initial research • initial designs and thoughts on a solution • prototyping and appropriate testing • final analysis of product for effectiveness. This is to be presented in an appropriate format including evidence of design development though sketching and annotated photos of production process and documentation of testing processes. The learning from this unit is also embedded and assessed in the projects produced using the skills developed and work requirements specified in Unit 3 and 4.

The Engineering Design Process

Learners will respond to engineering design challenges by applying a design process, such as the one detailed below. This process is an iterative process that uses a design brief, is informed by research and impacting factors and documents the development and presentation of an engineered solution.



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

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 to the major design project.

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.

Unit 2 – Engineering Fundamentals 25 hours	
Unit Outline	Now that learners are familiar with the fundamentals of engineering and the impact of engineering on society. The second unit focuses on their skills around applying science, technology and mathematics to explain, test and refine an engineering solution. Learners will be allowed to choose from a variety of solutions (including their solution from Unit 1). They must provide detailed summary of: the application of the key science, technology and mathematics principles associated with the engineering solution, the data and information gathered and investigate its use and impact on society.
Key Knowledge and skills	• describe and explain how basic systems function, using appropriate engineering terms for the components and operational processes that make up these systems and subsystems • identify and represent the operation of components and systems in diagrammatic and symbolic form, referring to the applicable science, technology and mathematics principles • identify appropriate components and subsystems that will form operational systems • measure system parameters using appropriate measuring/testing equipment, and interpret results • collect data and perform appropriate manipulations • develop criteria to appraise the operational system • describe where the engineering solution is used in society, what impacts it has and how these are managed.
Work requirements	Learners are required to keep a diary of the process of explanation, planning, testing, and interpretation of the engineering process when examining their chosen engineering solution (examples can be found below), including: • a detailed 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 system, including: why the data will improve the system and the expected results • data collected and represented to enable interpretation and the creation of useful information • reasoned conclusions made from the testing process using scientific, technological and mathematical theory and the data collected • where the engineering solution is used in society, the impacts it has, and how those impacts are managed. It is expected that this process will form an inquiry cycle where application of science, technology and mathematics to explain, data collected and conclusions are refined 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 of engineering systems to behave as expected. The learning from this unit is also embedded and assessed in the projects produced using the skills developed and work requirements specified in Units 3 and 4.

Unit 3 – Engineering Solutions 50 hours	
Unit Outline	Once learners are familiar with the design process and the fundamentals of engineering, the third unit focuses on their skills around engineering an appropriate solution to a set problem. Learners will be allowed to choose from a variety of design challenges and will be required to design and produce an appropriate solution. They must then conduct a full review and appraisal of their final solution.
Key Knowledge and skills	• identify human needs • develop and produce working prototypes • identify, develop, produce and appraise design solutions, including recommendations for improvement • select appropriate resources for a product • communicate and discuss alternative resources based on suitability and availability • compare and consider the effectiveness of different strategies to achieve an objective. • data collection and scientific interpretation of data.

Work requirements	Design and production of an engineered solution (examples can be found below) to a specified project brief as provided by the course instructor. The size, complexity and scale of the engineering solution should be appropriate to a guided figure of 50 hours for this Unit.
	
	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
	    ○ clear statement identifying the problem
	    ○ in depth analysis of the problem including:
	        ▪ identification of stake holders
	        ▪ identification of existing solutions
	        ▪ limitations of existing solutions.
	• Iterative testing plans and implementation
	    ○ documenting each step of each cycle of the Engineering Inquiry Cycle.
	
	• Project plan – including:
	    ○ projected timeline
	    ○ initial designs and thoughts on a new solution
	    ○ prototype and appropriate documentation
	    ○ analysis of chosen design
	    ○ identification of flaws in design
	    ○ suggested improvements given ideal circumstances.
	
	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
	
	The learning from this unit is also embedded and assessed in the projects produced using the skills developed and work requirements specified in Unit 4.

Unit 4 – Learner Project 50 hours	
Unit Outline	Having completed the previous three units learners will now be responsible for proposing a third and final design engineering project. As with the previous two units they will have to conduct their own research, design and construct a prototype and then perform an evaluation of their final product.
Key Knowledge and skills	• identify and appraise important information to be included in a design brief • compare and consider effectiveness of different strategies to achieve an objective • project management skills including time management and self-imposed deadlines • application of data collection.Representing and comparing data, including graphs.

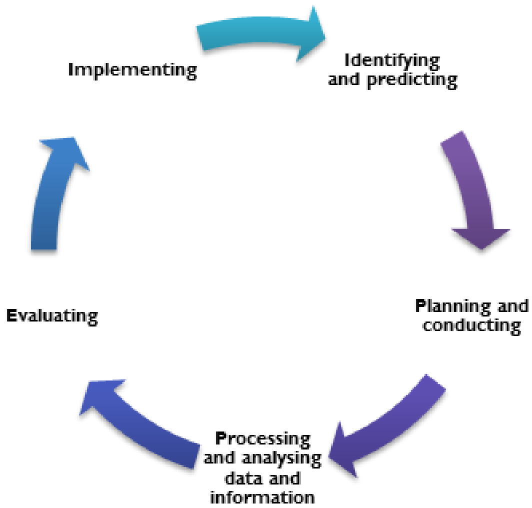
Work requirements	Design and production of an engineered solution (examples can be found below) to a specified project brief as provided by the course instructor. The size, complexity and scale of the engineering solution should be appropriate to a guided figure of 50 hours for this Unit.
	
	The process 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
	    ○ clear statement identifying the problem
	    ○ in depth analysis of the problem including:
	        ▪ identification of stake holders
	        ▪ identification of existing solutions
	        ▪ limitations of existing solutions.
	
	• Project plan – including:
	    ○ projected timeline
	    ○ initial designs and thoughts on a new solution
	    ○ prototype and appropriate documentation
	    ○ analysis of chosen design
	    ○ identification of flaws in design
	    ○ suggested improvements given ideal circumstances.
	
	• Iterative testing plans and implementation
	    ○ documenting each step of each cycle of the Engineering Inquiry Cycle.
	
	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.

Example Problems and Solutions (providing guidance around size and scale of problems and solutions)

Type of Problem	**Practical Example of Problem to solve**	**Possible Engineering Solution**
How close can we be to energy independence?	Energy independence at our school or in my home	A plan to adapt a building that generates more energy than it consumes
Building a machine that can learn and remember	If I showed a toaster my perfect piece of toast could I have consistently perfect toast forever?	A toaster that can see and interpret colour
Providing solutions for multistep mundane tasks	Needing sufficient quantities of usable pencils for a primary school at the start of every day	A robotic pencil sharpener

Solving a problem I have specific knowledge about	Get me to class on time - it knows my timetable, it knows where I am - how long can I hang before hot-footing it?	A app that connects the calendar and GPS features of a mobile device
Challenging the limitations of a design through extreme conditions	My model boat is not fast enough to break the world speed record	Redesign the model boat to improve speed through considering the impact of shape, materials and balance
Using shared experience to make our lives better	How do I stop my screen from smashing when I drop my phone?	A way to use my phone so I don't drop it
Looking at environmental issues as a possible resource	How do I capture and reuse or recycle plastic microbeads	Reusable egg cartons made from captured plastic microbeads
Imagining how a common problem could be solved	How do I feed my pets while I'm away from home?	A way of determining which pet is feeding when and what it needs to eat
Producing solutions that could be used around the world	How do I produce clean drinking water at low cost?	An easy to clean, gravity fed filter

Engineering Inquiry Cycle



Adapted from Australian Curriculum – Science Inquiry Skills (https://www.australiancurriculum.edu.au/f-10-curriculum/science/structure/)

Identifying and predicting

Identifying what is going to be tested and suggesting possible outcomes.

Planning and conducting

Making decisions about how to test an engineering solution and carrying out an investigation; including the collection of data.

Processing and analysing data and information

Representing data in meaningful and useful ways; identifying trends, patterns and relationships in data, and using this evidence to justify conclusions.

Evaluating

Considering and communicating the quality and nature of available evidence, what was being tested, and improvements to an engineering solution with reference to that evidence.

Implementing

Making changes to an engineering solution to optimise performance.

Science Technology and mathematics as a basis for engineering

Science, Technology, and Mathematics, especially through formula and symbolic representation, underpin the technical aspects of Engineering. Learners are expected to apply appropriate scientific, technological and mathematical concepts to each engineering solution they encounter. These will differ widely between each system and include but are not restricted to:

- Mechanics and Dynamics utilising elements such as:
  - Accuracy in measurement and SI units
  - Displacement, Velocity and Acceleration (magnitude, direction and limited graphing)
  - Mass, Force and Gravity (including Newtons three laws)
  - Work, Energy and Power
  - Problems, Calculations (and limited Scalar and Vector analysis) involving the above.

- Statics and Machines utilising elements such as:
  - Beams and frameworks (including internal forces and non-current forces in beam(s))
  - Types of supports an basic reactions at supports
  - Types of members and joints (including Trusses, struts and ties) and forces acting on these
  - Types, Function and Mechanical advantage (including ratio calculations) for the following:
    - Levers (1st, 2nd and 3rd class)
    - Gearing
    - Pulley systems.

- Programmable technologies utilising elements such as:
  - Data types and structures
  - Conditional Logic, probability and discrete mathematics
  - Input mechanisms and sensors: characteristics and limitations
  - Interface principles: layout of control systems and information display
  - Feedback mechanisms: audio, visual and kinaesthetic
  - User experience principles: affordance, transmissibility and accessibility
  - Automation: intelligent algorithms, artificial intelligence and machine learning.

Work Requirements

This course will be delivered on a project basis. The format will be one teacher directed project, one learner selected project and one learner initiated project. The projects that learners select will be from a list of teacher approved briefs. The learner initiated projects will be from a teacher approved area of inquiry. Learners will be required to produce a folio of work for each project as detailed in the course content section.

Unit	Work Requirement
Unit 1 Design Foundation	1. One teacher directed design project
Unit 2 Engineering Fundamentals	1. Inquiry Cycle documentation
Unit 3 Engineering Solutions	1. One learner selected design project
Unit 4 Learner Project	1. One learner initiated design project

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.
Providers offering this course must participate in quality assurance processes specified by TASC to ensure provider validity and comparability of standards across all awards. Further information on quality assurance processes, as well as on assessment, is on the TASC website: http://www.tasc.tas.gov.au

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

Quality Assurance Process

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 learners
- community confidence in the integrity and meaning of the qualification.

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

- student attendance records; and
- course delivery plans (the sequence of course delivery/tasks and when assessments take place):
- assessment instruments and rubrics (the 'rules' or marking guide used to judge achievement)
- class records of assessment
- examples of student work that demonstrate the use of the marking guide
- samples of current student's work, including that related to any work requirements articulated in the course document.

This process may also include interviews with past and present students. It will be scheduled by TASC using a risk-based approach.

Additionally:

TASC will undertake on-site visits of selected providers in order to collect specific evidence regarding the complexity and scope of major project products, and this evidence informs consideration of continued accreditation of the course.

Criteria

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

1. describe and apply engineering concepts
2. plan, interpret and review prototype testing
3. apply design thinking to generate engineering solutions
4. use materials, techniques and processes to create engineering solutions
5. describe the application and impact of engineering on society
6. collect, represent and interpret data
7. utilise and apply scales, plans and models
8. apply skills to organise and complete activities and communicate information

Standards

Criterion 1: describe and apply engineering concepts

Rating A	Rating B	Rating C
explains scientific and technological concepts* related to observations and theories	describes scientific and technological concepts* related to observations and theories	recognises and identifies scientific and technological concepts* related to observations and theories
explains engineering concepts related to own observations	describes engineering concepts related to own observations	recognises and identifies engineering concepts related to own observations
explains and utilises appropriate engineering applications when solving problems	describes and utilises appropriate engineering applications when solving problems	identifies appropriate basic engineering applications when solving problems
explains relationships between components of an engineering system and utilises them to solve engineering problems.	describes simple relationships between components of an engineering system and utilises them to solve engineering problems.	identifies simple relationships between components of an engineering system.

Criterion 2: plan, interpret and review prototype testing

The learner:

Rating A	Rating B	Rating C
explains the purpose and process of testing	describes the purpose and process of testing	identifies the purpose and process of testing
explains safety considerations and possible outcomes of testing	describes safety considerations and possible outcomes of testing including	identifies safety considerations and possible outcomes of testing
draws valid and reasoned conclusions, based on evidence and correct engineering concepts	draws valid conclusions based on evidence and appropriate engineering concepts	draws valid conclusions based on evidence
comments on the validity of conclusions, identifies sources of uncertainty and describes ways to improve the prototype and further evidence required.	identifies sources of uncertainty and describes ways to improve the prototype and further evidence required.	makes limited suggestions for improvement to the prototype and further testing required.

Criterion 3: apply design thinking to generate engineering solutions

The learner:

Rating A	Rating B	Rating C
documents a wide range of ideas and appraises these ideas by reflecting on a design brief, aims and other related design principles to produce an effective engineering solution	documents a range of ideas and appraises these ideas with reference to a design brief and related design principles to produce an engineering solution	documents a limited range of ideas in response to a design brief to produce an engineering solution
adjusts and modifies initial design ideas to develop design solutions that meet the requirements of a brief	adjusts and modifies initial design ideas to develop design solutions that meet most of the requirements of a brief	makes modifications, as directed, when developing design solutions

sequences and clearly presents graphics and detailed annotations to clearly show problem solving processes and identify pivotal points in design decisions	sequences and presents graphics and annotations to clearly show problem solving processes and identify pivotal points in design decisions	sequences and presents graphics and annotations to show problem solving processes
explains engineering solutions with supportive evidence in familiar and unfamiliar contexts	describes engineering solutions, with supportive evidence, to problems within familiar contexts	describes engineering solutions to problems within familiar contexts
appraises the suitability and appropriateness of solution(s) in meeting the success indicators for a brief, and identifies competing design factors.	appraises the suitability and appropriateness of solution(s) in meeting the success indicators for a brief.	makes some realistic conclusions about suitability and appropriateness of solution(s) in meeting success indicators for a brief.

Criterion 4: use materials, techniques and processes to create engineering solutions

The learner:

Rating A	Rating B	Rating C
selects appropriate resources and initiates actions to effectively and efficiently solve problems	selects appropriate resources and uses them to effectively solve engineering problems	identifies and selects resources to solve basic engineering problems
selects appropriate techniques and processes, and initiates actions to effectively and efficiently solve problems	selects appropriate techniques and processes, and uses them to effectively solve problems	identifies and selects techniques and processes to solve problems
acts with a level of awareness of the safety of self and others to apply health and safety procedures, including using appropriate personal protective equipment (PPE)	selects and uses established safety procedures for the use of equipment and facilities, including using appropriate personal protective equipment (PPE)	follows established safety procedures for the use of equipment and facilities including using appropriate personal protective equipment (PPE), as directed
produces prototypes appropriate to the brief and provides detailed supporting evidence of testing	produces prototypes appropriate to the brief and provides limited supporting evidence of testing	produces prototypes appropriate to the brief
plans and sequences the construction process, making appropriate adjustments as required	plans and sequences the construction process	lists, orally and in writing, the sequence of a construction process
explains the purpose and actions intended by plans, and monitors and assesses progress towards meeting goals and timelines in order to complete tasks.	describes the purpose and actions intended by plans, and monitors progress towards meeting goals and timelines in order to complete tasks.	identifies purpose and actions intended by plans, and monitors progress towards meeting goals and timelines in order to complete tasks.

Criterion 5: describe the application and impact of engineering on society

The learner:

Rating A	Rating B	Rating C
discusses how engineering solutions meet needs in society	describes ways in which an engineering solutions meet needs in society	identifies ways in which engineering solutions meet needs in society
explains social, economic, cultural and	describes social, economic, cultural	identifies social, economic, cultural and

ethical issues related to engineering solutions	and ethical issues related to engineering solutions	ethical issues related to engineering solutions
describes in detail components of issues and presents balanced discussions	identifies key components of issues and presents balanced discussions	identifies components of issues and lists points in favour, and against
argues reasoned, valid conclusions using relevant evidence.	presents valid conclusions using relevant evidence.	presents valid conclusions using limited evidence.

Criterion 6: collect, represent and interpret data

The learner:

Rating A	Rating B	Rating C
collects and records data accurately and systematically	collects and records data accurately	collects and records data accurately in given formats
correctly identifies, utilises and appropriately converts units of measure when solving problems	correctly identifies and utilises appropriate units of measure when solving problems	identifies appropriate units of measure when solving problems
interprets mathematical information and data when selecting and applying mathematical techniques to solve problems	interprets mathematical information and data when applying basic mathematical techniques to solve problems	uses mathematical information and data to solve simple problems
selects and constructs appropriate graphs or tables from data	selects from a range of given formats and constructs graphs and tables from data	following given instructions, constructs graphs and tables from data
accurately reads and interprets multiple representations of data to explain trends and relationships.	accurately reads and interprets representations of data to describe trends and relationships.	accurately reads representations of data to identify trends and relationships.

Criterion 7: utilise and apply scales, plans and models

The learner:

Rating A	Rating B	Rating C
selects and correctly applies drawing conventions in the process of constructing accurate scale drawings	correctly applies key drawing conventions when constructing accurate scale drawings	applies appropriate drawing conventions when constructing accurate scale drawings, as directed
accurately estimates and calculates resources using measurements from scale drawings	accurately estimates quantities of resources using measurements from scale drawings	estimates quantities of resources using measurements from scale drawings
correctly transposes linear mathematical equations, or selects appropriate transpositions from non-linear equations, to calculate answers	correctly selects appropriate transpositions of mathematical equations to calculate answers	substitutes correctly into given mathematical equations to calculate answers
accurately interprets diagrams and symbols,	accurately and appropriately interprets	accurately uses diagrams and

and uses them to correctly model and explain behaviour when solving problems.	diagrams and symbols to model and describe behaviour when solving problems.	symbols to model and explore behaviour when solving problems.

Criterion 8: apply skills to organise and complete activities and communicate information

The learner:

Rating A	Rating B	Rating C
uses a range of planning and self-management strategies to enable the effective completion of tasks within agreed time frames	uses planning strategies to facilitate successful completion of tasks within agreed time frames	uses limited planning strategies to facilitate completion of key elements of tasks within agreed time frames
reflects, orally and in writing, upon planning timelines; suggesting and making modifications for improvement	reflects, orally and in writing, upon planning timelines; suggesting and making minor modifications intended for improvement	reflects, orally and in writing, upon planning timelines, and makes minor modifications as directed
collects and discusses the reliability of information using a variety of relevant resources	collects information using a variety of relevant resources	collects information using a limited range of relevant resources
explains own and other learners' contributions to the successful completion of group activities	describes own contribution to the successful completion of group activities	identifies own contribution to the successful completion of group activities
selects and correctly uses accurate terminology to clearly communicate key concepts and ideas from engineering	uses key terminology to clearly communicate key concepts and ideas from engineering	uses given terminology to clearly communicate key concepts and ideas from engineering
selects and uses appropriate conventions for communication of information	from a range, selects and uses appropriate conventions for communication of information	uses appropriate conventions for communication of information, as directed
accurately records sources of information.	records sources of information.	records sources of information as directed.

Qualifications Available

Engineering Design Level 2 (with the award of):

EXCEPTIONAL ACHIEVEMENT
HIGH ACHIEVEMENT
COMMENDABLE ACHIEVEMENT
SATISFACTORY ACHIEVEMENT
PRELIMINARY ACHIEVEMENT

Award Requirements

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

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

EXCEPTIONAL ACHIEVEMENT (EA)
7 ‘A’ ratings, 1 ‘B’ rating

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 ratings 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

The Department of Education’s Curriculum Services will develop and regularly revise the curriculum. This evaluation will be informed by the experience of the course’s implementation, delivery and assessment. In addition, stakeholders may request Curriculum Services to review a particular aspect of an accredited course.

Requests for amendments to an accredited course will be forward by Curriculum Services to the Office of TASC for formal consideration.

Such requests for amendment will be considered in terms of the likely improvements to the outcomes for learners, possible consequences for delivery and assessment of the course, and alignment with Australian Curriculum materials.

A course is formally analysed prior to the expiry of its accreditation as part of the process to develop specifications to guide the development of any replacement course.

Course Developer

The Department of Education acknowledges the significant leadership of Chris Denton, Jacob Willard, Peter Wright and Melinda Williams in the development of this course.

Expectations Defined By National Standards In Content Statements Developed by ACARA

There are no statements of national standards relevant to this course.

Accreditation

The accreditation period for this course has been renewed from 1 January 2019 until 31 December 2021.

During the accreditation period required amendments can be considered via established processes.

Should outcomes of the Years 9-12 Review process find this course unsuitable for inclusion in the Tasmanian senior secondary curriculum, its accreditation may be cancelled. Any such cancellation would not occur during an academic year.

Version History

Version 1 - Accredited on 5 March 2018, effective from 1 January 2018.

Accreditation renewed on 22 November 2018 for the period 1 January 2019 until 31 December 2021.

Line Of Sight

Line of Sight - Engineering Design - Level 2

Learning Outcome	Criteria	Criteria Element/s	Content areas / Work requirements
Science			
* describe and apply engineering concepts involved in the design and testing of engineering solutions [Criterion 1]	1. describe and apply engineering concepts	all	Unit 2 – Engineering Fundamentals Unit 3 – Engineering Solutions Unit 4 – Learner Project
* use prototypes to assess the effectiveness of proposed solutions. [Criterion 2]	2. plan, interpret and review prototype testing	Elements 2 and 3	Unit 2 – Engineering Fundamentals Unit 3 – Engineering Solutions Unit 4 – Learner Project
*respond appropriately to the imperative nature of failure when testing prototypes [Criterion 2]	2. plan, interpret and review prototype testing	Elements 1 and 4	Unit 2 – Engineering Fundamentals Unit 3 – Engineering Solutions Unit 4 – Learner Project
Technology			
*apply design thinking to real world engineering scenarios [Criterion 3]	3. apply design thinking to generate engineering solutions	Elements 2, 4 and 5	Unit 1 – Design Foundation Unit 3 – Engineering Solutions Unit 4 – Learner Project
*produce appropriate prototypes. [Criterion 4]	4. use materials, techniques and processes to create engineering solutions	Elements 2, 4, 5 and 6	Unit 1 – Design Foundation Unit 3 – Engineering Solutions Unit 4 – Learner Project
*select the appropriate resources to use for a project based on a set of criteria such as durability, strength and cost effectiveness [Criterion 4]	4. use materials, techniques and processes to create engineering solutions	Element 1	Unit 1 – Design Foundation Unit 3 – Engineering Solutions Unit 4 – Learner Project
Engineering			
*skilfully use techniques and equipment relating to engineering and design [Criteria 3/4]	3. apply design thinking to generate engineering solutions 4. use materials, techniques and processes to create engineering solutions	3. Elements 1 and 3 4. Element 3	Unit 1 – Design Foundation Unit 3 – Engineering Solutions Unit 4 – Learner Project
*describe how engineering solutions are utilised and their impact on society [Criterion 5]	5. describe the application and impact of engineering on society	all	Unit 2 – Engineering Fundamentals Unit 3 – Engineering Solutions Unit 4 – Learner Project
Mathematics			
*collate, represent and interpret data from experimentation [Criterion 6]	6. collect, represent and interpret data	all	Unit 2 – Engineering Fundamentals Unit 3 – Engineering Solutions Unit 4 – Learner Project
*plan and model engineering solutions using graphic, algebraic and symbolic communication techniques [Criterion 7]	7. utilise and apply scales, plans and models	all	Unit 1 – Design Foundation Unit 2 – Engineering Fundamentals Unit 3 – Engineering Solutions Unit 4 – Learner Project
Core Skills for work			
*organise and complete activities including practical tasks [Criterion 8]	8. apply skills to organise and complete activities and communicate information	Elements 1 and 2	Unit 1 – Design Foundation Unit 2 – Engineering Fundamentals Unit 3 – Engineering Solutions Unit 4 – Learner Project
*collect, process, communicate and organise detailed research about a specific problem [Criterion 8]	8. apply skills to organise and complete activities and communicate information	Elements 3, 5, 6 and 7	Unit 1 – Design Foundation Unit 2 – Engineering Fundamentals Unit 3 – Engineering Solutions Unit 4 – Learner Project
*work cooperatively with others [Criterion 8]	8. apply skills to organise and complete activities and communicate information	Element 4	Unit 1 – Design Foundation Unit 2 – Engineering Fundamentals Unit 3 – Engineering Solutions Unit 4 – Learner Project

Supporting documents including external assessment material

- EngineeringDesign_Communications Summary_Accreditation.pdf (2018-03-21 12:21pm AEDT)