Electronics and Advanced Technologies

LEVEL 3	15 TCE CREDIT POINTS
COURSE CODE	EAT315124
COURSE SPAN	2024 — 2028
READING AND WRITING STANDARD	NO
MATHEMATICS STANDARD	NO
COMPUTERS AND INTERNET STANDARD	NO

This course is current for 2024.

Learners investigate how electronic components and devices are important parts of advancing technologies in a variety of industries including advanced manufacturing.

Course Description

Electronics and Advanced Technologies Level 3 extends learners' understanding of the broad field of electronics. Learners investigate how electronic components and devices are important parts of advancing technologies in a variety of industries including advanced manufacturing.

Learning in this course will focus on developing specialist knowledge in the field of electronics and the application of relevant theories, concepts and methodologies to develop skills in:

- prototyping and testing
- using computer applications for drawing circuits, simulation of circuits and printing circuit boards
- construction of electronic projects
- the application of mathematical knowledge to electronics contexts
- programming of microcontrollers as a key component of most modern electronics.

Learners undertake a variety of individual and collaborative projects to research, plan and develop electronic circuits and systems. The course culminates in an internally assessed project based on developing integrated circuits or a microcontroller and an externally assessed examination.

Focus Area

Discipline-based Study

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.

Electronics and Advanced Technologies 3 is a Discipline-based Study course.

Discipline-based study includes content, core concepts and big ideas; enabling deep knowledge and understanding of the content and the application of what is learned. Learners consider accepted key disciplinary knowledge, apply distinctive ways of thinking and become increasingly independent learners. They use methodologies specific to the discipline to explore and strengthen their understanding of key concepts and develop deep knowledge, skills and understanding.

Discipline-based study courses have three key features that guide teaching and learning:

- specialist knowledge
- theories and concepts
- methodology and terminology.

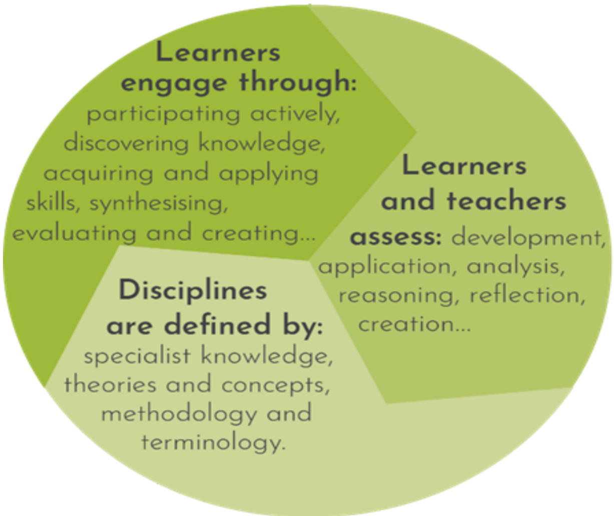


Figure 1: Discipline-based study diagram (developed by Years 9-12 Learning)

In this course learners will do this by:

- engaging with specialist knowledge, core concepts and principles relating to discrete circuits, integrated circuits and microcontrollers
- applying their knowledge and understanding through experimentation, practical tasks and project work following electronics processes and production practices
- analysing the critical role electronics plays in advanced technologies as the key enabler for many of the technologies that are shaping the world today.

Rationale

Technologies enrich and impact on the lives of people and societies globally. “Learning in Technologies is also important for a diverse and capable science, technology, engineering and mathematics (STEM) workforce. STEM learning involves explicit teaching of knowledge and skills in each learning area: Science, Technologies and Mathematics. A transdisciplinary approach can enhance the application of students’ scientific and mathematical literacy, design and computational thinking, problem-solving and collaboration skills. Developing STEM competencies enables students to develop, model, analyse and improve solutions to real-world problems. It supports students to access further study and a variety of careers and jobs.” (ACARA, 2021).

Advanced Technologies refers to those technologies at the ‘cutting edge’ or latest technological equipment available on the market at a point in time. The characteristics of current electronic systems have evolved to become part of the sophisticated systems that make advanced technology possible today. The evolution of the telephone is one example of such advanced technology. As electronic components have become smaller in scale, the telephone has become smaller and more advanced. The evolution of advanced technologies is inextricably reliant on the field of electronics and is transforming modern manufacturing within industry.

This course provides practical experience in how to design, prototype, and manufacture electronic circuits and devices, and experiment with new ideas and designs within a range of projects. Through Electronics and Advanced Technologies Level 3, learners are able to:

- prepare for 21st century careers
- understand the technology that shapes their lives and the world around them
- understand how the world is transforming and enable them to be informed citizens and discerning decision-makers
- design, build and troubleshoot electronic systems for a variety of purposes.

Electronics engineers, as a possible pathway, are responsible for developing and designing many of the products used in everyday life such as computers, cell phones, televisions, and home appliances. They also work on the development of new technologies such as artificial intelligence, robotics, and the Internet of Things (IoT). Electronic engineering has enabled new industries and created countless jobs contributing significantly to the world's economy.

Electronics and Advanced Technologies Level 3 is designed to equip learners with specialist knowledge and skills in the field of electronics. Learners will be able to connect the fundamental principles of mathematics, science and technology to the analysis, design and construction of electronic circuits. Studying electronics provides pathways to further study in fields such as electrical engineering. It also enables opportunities for hobbyists and enthusiasts to further their electronics knowledge.

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 course, learners will be able to:

1. communicate discipline-specific knowledge, concepts and methodology
2. plan, implement and monitor project management strategies
3. apply professional electronic engineering practices to safely construct, test and evaluate electronic systems
4. explain how the discipline of electronics and advanced technologies have transformed society
5. explain and apply mathematical concepts and scientific inquiry relating to circuit theory and analysis
6. analyse and apply concepts and principles relating to discrete components and analogue circuits
7. analyse and apply concepts and principles relating to integrated circuits
8. analyse and apply concepts and principles relating to programmable circuits

Pathways

- Electronics and Advanced Technologies Level 3 builds on Australian Curriculum: Technologies F–8, and is a potential pathway from senior secondary accredited Technologies and Science courses and Vocational courses including Certificates in Electrotechnology and Sustainable Energy.
- Electronics and Advanced Technologies Level 3 builds on the knowledge and skills of Electronics and Advanced Technologies Level 2. It is not mandatory to undertake the Level 2 course prior to study of the Level 3 course.
- Electronics and Advanced Technologies Level 3 may lead to further studies at tertiary level, including courses in engineering, sciences or related technical studies.

Integration of General Capabilities and Cross-curriculum Priorities

The general capabilities addressed specifically in this course are:

- Critical and creative thinking
- Digital literacy
- Numeracy
- Personal and social capability.

The cross-curriculum priorities enabled through this course are:

- Sustainability.

Course Size And Complexity

This course has a complexity level of 3.

For a full description of courses at a complexity level of 3, please refer to the Levels of Complexity - Tasmanian Senior Secondary Education document.

This course has a size value of 15. Upon successful completion of this course (i.e., a Preliminary Achievement (PA) award or higher), a learner will gain 15 credit points at Level 3 towards the Participation Standard of the Tasmanian Certificate of Education (TCE).

Course Structure

This course consists of three 50-hour modules.

Module 1: Processes and production practices

Module 2: Discrete electronic circuits

Module 3: Integrated circuits and microcontrollers

Course Delivery

Module 1 must be delivered concurrently with modules 2 and 3. There is no further order to delivery required.

Course Requirements

Access

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

There is a requirement that learners enrolled in this course will meet the level of mathematical skills as outlined in Appendix 7.

Previously submitted work cannot be used in meeting the requirements of Electronics and Advanced Technologies Level 3. Therefore, a learner cannot use work including, but not limited to, an independent study, folio, project or assignment that has already been presented for assessment for a previously or concurrently studied TASC accredited or recognised formal learning qualification.

Resource requirements

Providers offering this course will need equipment, materials and associated facilities for electronic prototypes to be created and tested safely and effectively. For example, a science lab or workshop facilities may be suitable to the safe working needs of this course. Learners need to be able to access a wide range of reliable sources of information about the uses and applications of electronics within industry and the wider community.

Learners require access to equipment such as:

- multimeters, oscilloscopes, breadboards, direct current (DC) power supplies, and equipment for circuit board manufacturing
- computers with simulation and circuit design software appropriate to support delivery of course content and student cohort as determined by provider
- a microcontroller system for this course (type of system not prescribed). When selecting a microcontroller or microcontrollers, providers will ensure they are resourced to meet the needs of the course and learner.

Course Content: Module 1

Module 1: Processes and production practices

Electronic devices and systems are ubiquitous in our modern world. Through theoretical concepts and practical applications, learners will:

- define process and production skills
- demonstrate an understanding of what is required to design, prototype, and test electronic components and circuits
- explore a range of analogue and digital circuits and systems.

Module 1 learning outcomes

The following learning outcomes are a focus of this module:

1. communicate discipline-specific knowledge, concepts and methodology
2. plan, implement and monitor project management strategies
3. apply professional electronic engineering practices to safely construct, test and evaluate electronic systems
4. explain how the discipline of electronics and advanced technologies have transformed society.

Module 1 content

Learners will understand and apply a systematic engineering design process to experimentation, problem-solving, prototyping and evaluation in the creation of electronic circuits.
Learners will conduct and record a range of experiments to understand the behaviours of system components such as resistors, sensors, transistors and capacitors. They will:

- have the opportunity to work individually and collaboratively to develop solutions through experimentation
- plan and review processes to safely conduct experiments on system components
- prototype electronic circuits using breadboards and Printed Circuit Board (PCB) design software
- construct simple and complex circuits
    - 'simple' circuits form the building blocks, that when combined create 'complex' circuits.
- understand and apply methods for testing circuits
- review the processes and results of the experiments to develop solutions
- apply an engineering design process to projects.

See Appendix 8: Engineering design process

Key knowledge and skills:

- understand and apply appropriate work health and safety practices
- understand and apply the engineering design process
- understand and select project management strategies such as:
    - setting personal and group goals
    - establishing timelines and milestones
    - monitoring progress.
- understand, interpret and use specifications, safety data sheets and technical data manuals including:
    - component ratings and tolerance, and their suitability to application
    - resistor colour code charts
    - capacitor values and picopico-Farads (pF) code
    - component current, voltage and power limits
- understand that electronic systems are made up of inputs, processes, outputs and feedback
- use a range of diagnostic equipment, physically and virtually, including multimeters and oscilloscopes
- measure, test and evaluate electronic systems using appropriate measuring and testing equipment and interpret the results
- use standard logic-circuit methods to communicate the behaviour of logic systems
- use the International System of Units (SI units) to quantify measurements and calculations
- interpret and communicate technical information including:
    - circuit diagrams
    - schematics
    - block diagrams
- identify and represent electronic systems in diagrammatic and symbolic forms
- prototype solutions using breadboards and circuit simulation software
- use a scientific process to experiment with circuits
- use design and systems thinking to problem solve and prototype possible solutions
- use appropriate terminology to describe the operation of electronic components, circuits and systems
- communicate electronic and advanced technology ideas and insights in a range of mediums to a variety of audiences using appropriate evidence, technical terminology and accurate referencing.

Module 1 work requirements summary

This module includes the following work requirements:

- an investigation and project logbook to document a series of 4–5 skill building circuit experiments

- learners use the engineering design process to respond to a teacher-directed scenario related to safely constructing, testing and evaluating electronic systems.

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

Module 1 assessment

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

Course Content: Module 2

Module 2: Discrete electronic circuits

Learners will develop an understanding of circuit theory and analysis. They will explore the function and operation of electronic components including individual transistors, diodes, resistors, and capacitors. Learners will:

- use electronic components to construct circuits or systems that produce a desired output based on input.
- apply theory and laws to analyse circuit behaviour by calculating the expected values of voltage, current and resistance at any point in the circuit
- identify, select and use components with appropriate values and ratings.

Module 2 learning outcomes

The following learning outcomes are a focus of this module:

1. communicate discipline-specific knowledge, concepts and methodology
2. plan, implement and monitor project management strategies
5. explain and apply mathematical concepts and scientific inquiry relating to circuit theory and analysis
6. analyse and apply concepts and principles relating to discrete components and analogue circuits.

Module 2 content

Learners will review fundamental circuits and develop an understanding of common transistor topologies. Learners apply theory and concepts to practical experiments, prototyping and projects. In preparation for module 3, learners will consider the advantages and disadvantages of discrete circuits in relation to integrated circuits (ICs).

Key knowledge and skills

Learners will:

- measure and analyse:
  - resistor networks in both parallel and series
  - diode networks in steady state analysis
  - commonly used transistor topologies
- select appropriate formula and apply calculations to predict behaviour of circuits
- identify simple electronic components and circuits including:
  - active and inactive semiconductors in a circuit
  - transistor topologies
  - decoupling and filtering
  - capacitors
  - positive and negative feedback
- demonstrate an understanding of and apply circuit theory and analysis including:
  - Ohm's and Watt's Laws
  - Kirchhoff's Voltage Law and Current Law
  - calculations relating to power, current, voltage, a voltage divider, resistance, resistors (in series and parallel) and capacitors (in series and parallel)
  - calculation of Ohm's and Kirchhoffs's Laws in circuits with non-Ohmic components under steady state
  - Thevenin theorem and calculation of the Thevenin equivalent of a voltage divider
  - alternating current (AC) and direct current (DC) power supplies and their use
  - impedance and resistance (calculations not required)
- use digital technologies to:
  - simulate and demonstrate electronic principles
  - support planning and communication

Module 2 work requirements summary

This module includes the following work requirements:

- a discrete electronic circuit project undertaken and documented through an engineering design process
- a series of short responses related to electronic components, circuits and systems.

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

Module 2 assessment

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

Course Content: Module 3

Module 3: Integrated circuits and microcontrollers

Learners apply and extend knowledge and skills from the study of discrete circuits to developing an understanding of integrated circuits and programable systems. Learners will demonstrate an understanding of that most modern electronic circuits have programmable chips. They will study the fundamentals of microcontrollers and their interactions with physical systems including input/output (I/O) devices, programming and communications. This study will enable learners to develop the skills and knowledge that underpin the innovation of advanced technologies, including the IoT.

Module 3 learning outcomes

The following learning outcomes are a focus for this module:

1. communicate discipline-specific knowledge, concepts and methodology
2. plan, implement and monitor project management strategies
4. explain how the discipline of electronics and advanced technologies have transformed society
7. analyse and apply concepts and principles relating to integrated circuits
8. analyse and apply concepts and principles relating to programmable circuits.

Module 3 content

Learners have opportunities to experiment with microcontrollers and various physical devices. They develop the skills to design and implement programs using simple language constructs. Learners will investigate advanced technologies, particularly, operations and applications of new and emerging electronic components and products. Learners consider the impacts and the potential of the new and emerging technological developments in relation to social, economic and environmental factors.

Key knowledge and skills:

- describe IC, their functions and elements
- understand IC design:
  - logic methods and circuit layouts
  - categories of IC design: analogue, digital and mixed signal design
- understand IC features and construction
- understand microcontroller communications protocols and their relationship to advanced technologies
- identify core elements of a microcontroller - processor, memory and I/O peripherals
- analyse and design programs to code microcontrollers for different purposes
- compare discrete and integrated circuits
- investigate, design and program microcontroller-based circuits using simple constructs of a procedural programming language
- select appropriate electronic subsystems and electronic components that will form operational systems and subsystems.
- identify the function, typical operation and implementation of common electronic components
- identify and differentiate between digital and analogue signals and circuits
- use standard methods to communicate the behaviour of digital and sequential logic systems
- design and analyse sequential logic systems

Module 3 work requirements summary

This module includes the following work requirements:

- IC or microcontroller based project
- a case study communicating how technology has changed over time.

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, 4, 7 and 8.

Assessment

Criterion-based assessment is a form of outcomes assessment that identifies the extent of learner achievement at an appropriate endpoint 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 the Office of TASC will focus on what both teacher and learner understand to reflect endpoint 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 the Office of TASC.

The Office of TASC will supervise the external assessment of designated criteria which will be indicated by an asterisk (*). The ratings obtained from the external assessments will be used in addition to internal ratings from the provider to determine the final award.

Quality Assurance Process

The following processes will be facilitated by the Office of 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

The Office of TASC gives course providers feedback about any systematic differences in the relationship of their internal and external assessments and, where appropriate, seeks further evidence through audit and requires corrective action in the future.

Additionally, the Office of TASC may select to undertake scheduled audits of this course (Provider Standards 1, 2, 3, & 4) and work requirements.

External Assessment Requirements

The external assessment for this course will comprise:

- one written examination assessing criteria 3, 5, 6, 7 and 8.

For further information, see the current external assessment specifications and guidelines for this course available in the Supporting documents below.

Criteria

The assessment for Electronics and Advanced Technologies Level 3 will be based on the degree to which the learner can:

1. communicate discipline-specific knowledge, concepts and methodology
2. plan, monitor and manage collaborative and own learning to problem solve and design solutions
3. apply professional electronic engineering practices to safely construct, test and evaluate electronic systems*
4. explain how the discipline of electronics has contributed to advanced technologies
5. explain and apply mathematical concepts and scientific inquiry in relation to electronics*
6. analyse and apply concepts and principles relating to discrete components and analogue circuits*
7. analyse and apply concepts and principles relating to integrated circuits*
8. analyse and apply concepts and principles relating to programmable circuits*.

*Denotes criteria that are both internally and externally assessed.

	Module 1	**Module 2**	**Module 3**
Criteria focus	1, 2, 3, 4	1, 2, 5, 6	1, 2, 4, 7, 8

Standards

Criterion 1: communicate discipline-specific knowledge, concepts and methodology

This criterion is only internally assessed.

Standard Element	Rating A	Rating B	Rating C
E01 - Conceptual communication	clearly and effectively communicates electronics concepts, using appropriate and targeted drawings, schematics, specialised terminology and technical information to meet the needs and context of the audience	clearly communicates electronics concepts, using appropriate drawings, schematics, specialised terminology and technical information to meet the needs and context of the audience	communicates electronics concepts, using drawings, schematics, specialised terminology and technical information to meet the needs and context of the audience
E02 - Project development process	applies and evaluates a project development process by analysing opportunities, constraints and implications for proposing solutions	applies and analyses a project development process and explains opportunities, constraints and implications for proposing solutions	applies and explains a project development process and describes opportunities, constraints and implications for proposing solutions
E03 - Specialist knowledge	produces coherent and well-structured discipline-specific documentation across a wide range of appropriate mediums† for the identified purpose and audience	produces logical and structured discipline-specific documentation using a range of appropriate mediums† for the identified purpose and audience	produces appropriate discipline-specific documentation for an identified purpose and audience
E04 - Differentiating the work of others and referencing	clearly differentiates the work of others from the learner's own†. Referencing conventions and methodologies are followed including a high degree of accuracy in individual entries‡ and well-structured reference lists and bibliographies◊.	clearly differentiates the work of others from the learner's own†. Referencing conventions and methodologies are followed accurately‡, including appropriate, structured reference lists and bibliographies◊.	differentiates the work of others from the learner's own†. Referencing conventions and methodologies are followed‡, including the use of reference lists and bibliographies◊.

†This includes, but is not limited to, ideas, images, information, data or words
‡This includes, but is not limited to, alphabetising the surnames of authors, and use of an abbreviation key for journal titles
◊This includes but is not limited to, grouping by publication dates, source types (books, internet, personal communications).

Criterion 2: plan, monitor and manage collaborative and own learning to problem solve and design solutions

This criterion is only internally assessed.

Standard Element	Rating A	Rating B	Rating C
E01 - Project management	selects and applies appropriate project management† approaches to monitor progress and makes adjustments when and where necessary to achieve goals	applies appropriate project management† approaches to monitor progress and makes adjustments to achieve goals	applies appropriate project management† approaches to monitor progress towards goals
E02 - Self-management strategies	uses a range of planning and self-management strategies to ensure the effective completion of tasks within agreed time frames	uses planning strategies to ensure successful completion of tasks within agreed time frames	uses planning strategies to ensure completion of key elements of tasks within agreed time frames
E03 - Collaboration	initiates, performs, monitors and evaluates tasks to complete individual activities and guides others to ensure the completion of collaborative activities	initiates, performs, monitors and analyses tasks to ensure the completion of individual and collaborative activities	initiates, performs, monitors and examines tasks to ensure the completion of individual and collaborative activities
E04 - Reflection	evaluates own performance in achieving engineered solutions, analysing learner's own strengths and weaknesses.	analyses own performance in achieving engineered solutions, explaining learner's own strengths and weaknesses.	explains own performance in achieving engineered solutions, giving a limited explanation of learner's own strengths and weaknesses.

† Project management approaches may include time scheduling, resource scheduling and tracking documents.

Criterion 3: apply professional electronic engineering practices to safely construct, test and evaluate electronic systems

This criterion is both internally and externally assessed.

Standard Element	Rating A	Rating B	Rating C
E01 - Risk management	applies appropriate work health and safety principles to select and use relevant safety procedures to minimise risks to self and others, including effective use of personal protective equipment	selects and uses established safety procedures for equipment and facilities, including appropriate use of personal protective equipment	uses established safety procedures for equipment and facilities, including using appropriate personal protective equipment, as directed
E02 - Equipment and technologies	selects and uses appropriate equipment and technologies safely to build, test and measure complex circuits and perform experiments on these circuits in familiar and some unfamiliar contexts	selects and uses appropriate equipment and technologies safely to build, test and measure simple circuits with limited experimentation in familiar contexts	identifies and uses equipment and technologies safely to build and test simple circuits in familiar contexts
E03 - Simulation and circuit design software	selects and uses software features and modules to effectively design simple circuits	selects and uses software features and modules to appropriately design simple circuits	uses software as instructed to design simple circuits
E04 - Conceptual design	produces comprehensive, logical and detailed concept and schematic drawings to model an electronic system and accurately predict its behaviour.	produces logical concept and schematic drawings to model an electronic system and predict with some accuracy its behaviour	produces concept and schematic drawings to model an electronic system
E05 - Performance of electronic systems	evaluates performance of electronic components and systems against design specifications, making recommendations for further improvement.	analyses performance of electronic components and systems against design specifications, making recommendations for further improvement.	assesses performance of electronic components and systems against design specifications, making recommendations for further improvement.

Criterion 4: explain how the discipline of electronics has contributed to advanced technologies

This criterion is only internally assessed.

Standard Element	Rating A	Rating B	Rating C
E01 - Historical factors	analyses and evaluates a range of historical factors† that have influenced contemporary electronics and advanced technologies	explains a range of factors† that have influenced electronics and advanced technologies	communicates a range of factors† that have influenced electronics and advanced technologies
E02 - Design solutions	evaluates existing, new and emerging tools, technologies and systems to determine suitability for design solutions	analyses existing, new and emerging tools, technologies and systems that could be suitable for design solutions	identifies existing, new and emerging tools, technologies and systems that could be suitable for design solutions
E03 - Systems and computational thinking	applies and documents a range of effective problem-solving strategies to resolve problems and create solutions.	applies and documents a range of appropriate problem-solving strategies to resolve problems and create solutions.	applies and documents problem-solving strategies to resolve problems and create solutions.

†Factors include function-related, environmental, economic, social, aesthetic and technological.

Criterion 5: explain and apply mathematical concepts and scientific inquiry in relation to electronics

This criterion is both internally and externally assessed.

Standard Element	Rating A	Rating B	Rating C
E01 - Scientific inquiry	plans and conducts experiments to generate data and analyses relationships to draw reasoned and valid conclusions	plans and conducts experiments to generate data and explains relationships to draw logical conclusions	plans and conducts experiments to generate data and describes relationships to draw conclusions
E02 - Electronics concepts	analyses concepts involved in the role, function and operation of systems, circuits and components	explains concepts involved in the role, function and operation of systems, circuits and components	describes concepts involved in the role and function of circuits and components in given contexts

E03 - Model and predict	interprets and accurately applies mathematical concepts and techniques and models, predicts or analyses the behaviour of circuits	applies mathematical concepts and techniques and models, predicts or analyses the behaviour of circuits	applies mathematical concepts and techniques and models or predicts the behaviour of circuits
E04 - Mathematical calculations	calculates component values or physical quantities using appropriate mathematical formulae, using correct units and explaining if the results are reasonable.	calculates component values or physical quantities using identified mathematical formulae and correct units.	uses given mathematical formulae and calculates component values or physical quantities.

Criterion 6: analyse and apply concepts and principles relating to discrete components and analogue circuits

This criterion is both internally and externally assessed.

Standard Element	Rating A	Rating B	Rating C
E01 - Component understanding	identifies discrete components by name, symbol and function and evaluates their behaviour, effects and limitations in dynamic circuits when combined with active components	identifies discrete components by name, symbol and function and analyses their purpose and behaviour in static circuits when combined with active components	identifies discrete components by name and symbol and describes their uses and purpose in static circuits when combined with passive components
E02 - Discrete circuit design	identifies relevant circuit components to select and design circuits from evaluation of block and circuit diagrams	identifies relevant circuit components to select and design circuits from analysis of block and circuit diagrams	identifies circuit components to select and design circuits from block and circuit diagrams
E03 - Discrete circuit analysis	calculates or predicts and explains changes and outcomes made through experiments on circuits made with discrete components	describes the effects of changes made through experiments on circuits made with discrete components	identifies the effects of changes made through experiments on circuits made with discrete components
E04 - Standard transistor circuits	analyses the operation of single and double transistor circuits when combined into compound circuits and explains the function of the compound circuit.	analyses the operation of standard single transistor circuit and explains the operation of two-transistor circuits in isolation.	describes the function and purpose of standard single transistor circuits and identifies some standard two-transistor circuits.

Criterion 7: analyse and apply concepts and principles relating to integrated circuits

This criterion is both internally and externally assessed.

Standard Element	Rating A	Rating B	Rating C
E01 - Designing with integrated circuits	evaluates a combined sensing, processing and output requirement and selects and uses appropriate integrated circuits to design and implement a solution	analyses a given sensing, processing, and/or output requirement and selects and uses an integrated circuit to design and implement a solution	explains a given sensing, processing, and/or output task and uses a provided integrated circuit to implement a relevant circuit
E02 - Digital integrated circuits	analyses the constraints and limitations and analyses the operation of asynchronous and synchronous digital circuits	explains the constraints and limitations and analyses the operation of asynchronous and synchronous digital circuits	describes the function of asynchronous and synchronous digital logic components
E03 - Mixed signal circuits	uses a combination of discrete and integrated circuits to design a solution to a mixed signal interfacing problem	selects an appropriate discrete or integrated circuit to solve a given mixed signal interfacing problem	identifies the purpose and function of mixed signal integrated circuits
E04 - Comparing integrated circuits	analyses the advantages and disadvantages of a discrete versus integrated circuit in a specific scenario.	explains the advantages and disadvantages of a discrete versus integrated circuit in a specific scenario.	describes the advantages and disadvantages of discrete versus integrated circuits.

Criterion 8: analyse and apply concepts and principles relating to programmable circuits

This criterion is both internally and externally assessed.

Standard Element	Rating A	Rating B	Rating C

E01 - Application of microcontrollers	evaluates the use and application of microcontrollers and analyses reasons for their adoption as standard technology in a range of industries	analyses the use and application of microcontrollers and explains reasons for their adoption as standard technology in a range of industries	explains the use and application of microcontrollers and describes reasons for their adoption as standard technology in a range of industries
E02 - Programs	analyses and designs programs and uses a range of control structures to program microcontrollers	designs programs and uses control structures to program microcontrollers	adjusts programs for microcontrollers by following a given flowchart program
E03 - Microcontroller peripherals	designs, constructs, and microcontroller peripheral interfaces by observing, recording, interpreting and comparing their operation	designs, constructs and explains microcontroller peripheral interfaces by observing, recording and interpreting their operation	constructs and describes microcontroller peripheral interfaces as directed, by observing and recording their operation
E04 - Communication protocols	evaluates and applies a range of appropriate communication protocols.	analyses and applies a range of appropriate communication protocols.	explains and applies a limited range of appropriate communication protocols.

Qualifications Available

Electronics and Advanced Technologies Level 3 (with the award of):

EXCEPTIONAL ACHIEVEMENT

HIGH ACHIEVEMENT

COMMENDABLE ACHIEVEMENT

SATISFACTORY ACHIEVMENT

PRELIMINARY ACHIEVEMENT

Award Requirements

The final award will be determined by the Office of TASC from 13 ratings (8 from the internal assessment, 5 from external assessment).
The minimum requirements for an award are as follows:

EXCEPTIONAL ACHIEVEMENT (EA)
10 ‘A’ ratings, 3 ‘B’ ratings (3 ‘A’ ratings, 2 ‘B’ rating from external assessment)

HIGH ACHIEVEMENT (HA)
5 ‘A’ ratings, 5 ‘B’ ratings, 3 ‘C’ ratings (1 ‘A’ ratings, 3 ‘B’ ratings, 1 ‘C’ rating from external assessment)

COMMENDABLE ACHIEVEMENT (CA)
6 ‘B’ ratings, 6 ‘C’ ratings (2 ‘B’ ratings, 3 ‘C’ ratings from external assessment)

SATISFACTORY ACHIEVEMENT (SA)
11 ‘C’ ratings (3 ‘C’ ratings from external assessment)

PRELIMINARY ACHIEVEMENT (PA)
6 ‘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

Years 9-12 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 9-12 website.

Course Developer

This course has been developed by the Department for Education, Children and Young People’s Years 9-12 Learning Unit in collaboration with Catholic Education Tasmania and Independent Schools Tasmania.

Accreditation

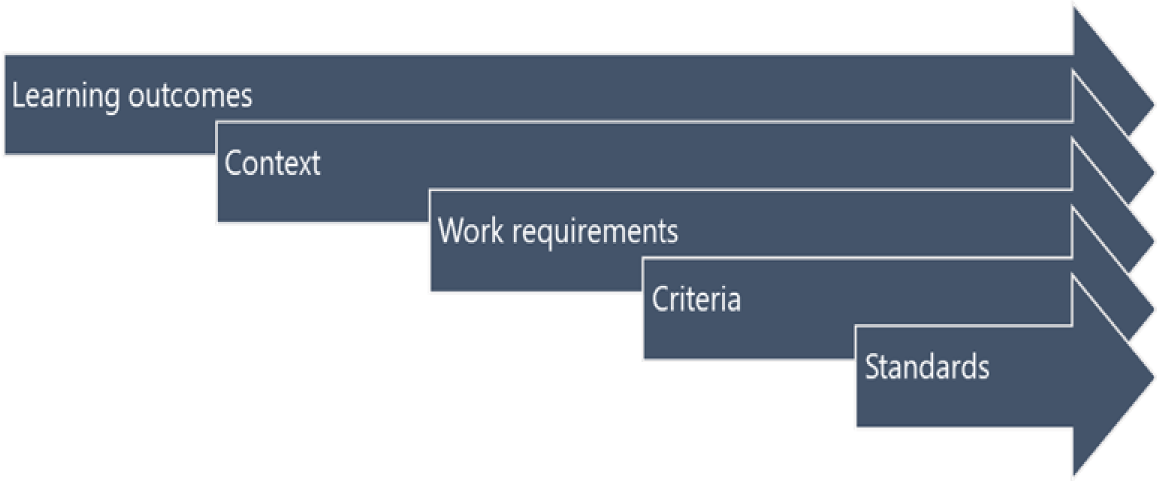
Accredited on 27 March 2023 for use from 1 January 2024 to 31 December 2028.

Version History

Version 1

Accredited on 27 March 2023 for use from 1 January 2024 to 31 December 2028. This course replaces Electronics Level 3 (ELT315114) which expires on 31 December 2023.

Appendix 1 – Line of sight



Learning outcomes	Course content: module	Work requirements: module	Criterion	Criterion element	General capabilities
1. **communicate discipline-specific knowledge, concepts and methodology**	1, 2, 3	1, 2, 3	1	1, 2, 3, 4	Critical and creative thinking; Digital literacy; Personal and social capability
2. **plan, implement and monitor project management strategies**	1, 2, 3	1, 2, 3	2	1, 2, 3, 4	Critical and creative thinking; Digital literacy; Personal and social capability
3. **apply professional electronic engineering practices to safely construct, test and evaluate electronic systems**	1	1	3	1, 2, 3, 4, 5	Critical and creative thinking; Digital literacy; Personal and social capability
4. **explain how the discipline of electronics and advanced technologies have transformed society**	1, 3	1, 3	4	1, 2, 3	Critical and creative thinking; Digital literacy
5. **explain and apply mathematical concepts and scientific inquiry relating to circuit theory and analysis**	2	2	5	1, 2, 3, 4	Critical and creative thinking; Numeracy; Digital literacy
6. **analyse and apply concepts and principles relating to discrete components and analogue circuits**	2	2	6	1, 2, 3, 4	Critical and creative thinking; Digital literacy
7. **analyse and apply concepts and principles relating to integrated circuits**	3	3	7	1, 2, 3, 4	Critical and creative thinking; Digital literacy
8. **analyse and apply concepts and principles relating to programmable circuits**	3	3	8	1, 2, 3, 4	Critical and creative thinking; Digital literacy

Appendix 2 – Alignment to curriculum frameworks

Electronics and Advanced Technologies Level 3 aligns with the ACSF Level 4 Learning core skills in the following ways:

- Support: works independently, initiates and uses support from a range of established resources.
- Context: range of contexts; including some that are unfamiliar and/or unpredictable; some specialisation in less familiar/known contexts.
- Text complexity: complex texts; embedded information; includes specialised vocabulary; includes abstraction and symbolism.
- Task complexity: complex task organisation and analysis involving the application of a number of steps; processes include extracting, extrapolating, inferencing, reflecting and abstracting.

Electronics and Advanced Technologies Level 3 is also a progression from the F-10 Australian Curriculum: Technologies.

This course continues to develop learner understanding and skills across the two strands of the F-10 Australian Curriculum: Technologies drawing from the Design and Technologies and Digital Technologies subjects:

- knowledge and understanding
- process and production.

Note: The F-10 Australian Curriculum: Technologies is written on the basis that all learners will study Digital Technologies from Foundation to the end of Year 8, but not necessarily beyond Year 8.

This course requires learners to use the mathematical skills they developed through the F-10 Australian Curriculum: Mathematics.

Digital Literacy Skills Framework (Department of Education, Skills and Employment).

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: Investigating circuits and systems

Mode or format: investigation and project logbook

Description: Learners will document a series of 4 - 5 circuit experiments or investigations. Across the investigations, learners must have the opportunity to document:

- work health and safety practices
- use of specifications, data sheets, safety data sheets and technical data manuals
- use of equipment for testing and measuring
- fault finding skills: diagnosing and repairing or modifying
- production processes, such as soldering and PCB manufacturing
- use of simulation software
- planning and problem-solving skills.

Note: Learners will have the opportunity to conduct multiple investigations throughout the delivery of the module. The 4 – 5 investigations in this work requirement are a part of these ongoing opportunities. Investigations that enable learners to be assessed against the relevant criteria need to be formally documented for this work requirement.

Size: approximately 6 - 8 hours in total

Timing: throughout module 1 and 2

Relevant criteria: 1, 2 and 3

Relationship to external assessment: no relationship

Work requirement 2 of 2

Title of work requirement: Application of concepts and processes

Mode or format: short response

Description: Learners will be presented with a teacher-directed scenario to respond to. Through a written and diagrammatic response, learners will demonstrate their understanding of concepts and processes related to safely constructing, testing and evaluating electronic systems. This may be used to prepare learners for the external examination.

Size: approximately 1 – 2 hours on task

Timing: throughout module 1

Relevant criteria: 1, 3 and 4

Relationship to external assessment: no direct relationship

Module 2 work requirements specifications

Work requirement 1 of 2

Title of work requirement: Discrete electronic circuit project

Mode or format: product

Description: Learners respond to a teacher-provided or negotiated brief with the outcome resulting in an analogue electronic circuit. The project must be documented by the learner, demonstrating an iterative design process including collaboration, planning and analysis.

Projects might include:

- simple USB lamp
- water level indicator
- metal detector circuit
- simple panic alarm.

Size: approximately 6 – 8 hours of dedicated class time

Timing: throughout module 2

Relevant criteria: 1, 2, 5 and 6

Relationship to external assessment: no relationship

Work requirement 2 of 2

Title of work requirement: Knowing electronic components

Mode or format: short response

Description: Learners will demonstrate knowledge in a series of short responses to show understanding of:

- how to identify, select and use electronic components
- relationships between electronic components, circuits and systems
- theory and laws to analyse circuit behaviour.

This work requirement may be used to prepare learners for the external examination.

Size: approximately 1 – 2 hours on task

Timing: throughout module 2

Relevant criteria: 1, 3, 5 and 6

Relationship to external assessment: no direct relationship

Module 3 work requirements specifications

Work requirement 1 of 2

Title of work requirement: IC or microcontroller based project

Mode or format: Product

Description: Learners respond to a teacher-provided or negotiated brief. The brief must enable learners to showcase skills related to integrated circuits and microcontrollers.

Size: approximately 15 – 20 hours

Timing: throughout module 3

Relevant criteria: 1, 2, 7 and 8

Relationship to external assessment: key knowledge and skills developed through this work requirement may be included in the external examination

Work requirement 2 of 2

Title of work requirement: Case study

Mode or format: extended response

Description: Learners respond to a real world or hypothetical case study or studies relating to the impact that advanced technologies have made on societies. Learners are required to describe how their chosen technology has changed in terms of electronic components, circuits and systems.

Examples for a case study include analysis of the impact created by:

- the evolution from the telephone to the mobile phone
- stereoscopes to virtual reality
- wired headphones to wireless earbuds

Size: approximately 2 – 4 hours

Timing: Any time during the module provided students have had the opportunity to engage with the necessary knowledge and skills

Relevant criteria: 1, 2 and 4

Relationship to external assessment: no relationship

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
- Digital literacy
- 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

Refer to the current Australian Curriculum Technologies glossary.

Appendix 6 - Content specifications

Given the broad scope of the field of electronics the following content specifications provide direction as to the knowledge required for, or developed during, construction projects in module 2 and 3.

Module 2 content specifications

Discrete Components

Input sensors:

- electronic signals: a signal is an electrical current or voltage representing information
- types: analogue and digital
- may include but are not limited to microphone, thermistor, light dependent resistor (ldr), variable resistor.

Passive components:

- voltage sources
- resistors
- potentiometers
- capacitors
- explanation of how capacitors can be used to form the basis of timing circuits
- use of capacitors:
    - timing, resistor-capacitor (RC) time constant
    - decoupling (high pass)
    - integration (low pass)
    - DC smoothing (bypass).

Semiconductor components:

- diodes (regular, LED, Schottky, Zener)
- transistors, idealised switching bipolar junction transistors (BJT's):
    - n-type (NPN) and p-type (PNP)
    - open collector
    - inverter
    - high-side and low-side switching
    - driving high power outputs
    - commonly used transistor topologies, e.g. emitter-follower, Darlington, totem pole.

Systems processors:

- timing
- amplifying
- comparators.

Feedback:

- positive feedback:
    - threshold comparison of sensor inputs
    - hysteresis of sensor inputs
    - Schmitt inverter, signal conditioning.
- negative feedback:
    - amplifiers
- multivibrators including astable, monostable and bistable.

Output devices:

- may include but are not limited to buzzer, speaker, lamp, light emitting diode (LED) and motor.

Module 3 content specifications

Integrated Circuits

Logic systems

- logic circuits:
    - types of logic circuits – sequential and combinational
    - identify and use NOT; 2 and 3-input AND, NAND, OR, NOR, XNOR and XOR logic gates
- use standard methods to communicate the behaviour of logic systems construct, recognise and use truth tables for these gates and simple combinations of them
- design and construct circuits containing logic gates – simulation of logical circuits
- introduction to number systems, including binary, hexadecimal decimal
- basic logic blocks:

    - decoders - 7 segment decoder
    - multiplexers (mux)
    - demultiplexers (demux)
- introduction to digital circuits:
    - identify how a digital circuit works
    - digital vs analogue
    - advantages of digital circuits
    - reading digital datasheets – voltage and current limits
    - floating points: pull up, pull down
    - protection diodes
    - latch up
    - logic signal voltage levels
    - synchronous and asynchronous circuits
    - techniques for debouncing and decoupling
    - sequential logic:
        - flip-flop
        - counters
- analogue to digital and digital to analogue
- Schmitt trigger
- R2R digital to analogue convertors (DAC)
- filtered pulse width modulation (PWM) DAC
- memorising signals: flip flops and latches
- operational amplifiers (Op-amps), characteristics of an ideal op-amp vs typical op-amp.

Microcontrollers

- overview:
    - core elements of a microcontroller - processor, memory, input/output peripherals
    - use and application of microcontrollers- including in the home and enterprise, building automation, manufacturing, robotics, automotive, lighting, smart energy, industrial automation, communications and internet of things (IoT) deployments
    - social and economic implications.
- coding:
    - flowcharts
    - simple event
    - conditional
- basic pin functions:
    - analogue/digital 1/0 pins
    - internal pull ups
- sensors and control behaviours
- introduction to communication protocols including UART/SPI/I2C
- introduction to shields and modules.

Appendix 7 - Mathematical requirements

Mathematical skills required of students studying Electronics and Advanced Technologies Level 3

This course requires learners to use the mathematical skills they have developed through the F-10 Australian Curriculum: Mathematics, in addition to the numeracy skills they have developed through the Science Inquiry Skills strand of the Australian Curriculum: Science.

Within the science inquiry skills strand, learners are required to gather, represent and analyse numerical data to identify the evidence that forms the basis of scientific arguments, claims or conclusions. In gathering and recording numerical data, learners are required to make measurements using appropriate units to an appropriate degree of accuracy.

Learners may need to be taught when it is appropriate to join points on a graph and when it is appropriate to use a line of best fit. They may also need to be taught how to construct a straight line that will serve as the line of best fit for a set of data presented graphically.

It is assumed that learners will be able to competently:

- perform calculations involving addition, subtraction, multiplication and division of quantities
- perform approximate evaluations of numerical expressions
- express fractions as percentages, and percentages as fractions
- calculate percentages
- recognise and use ratios
- transform decimal notation to power of ten notation
- use square root and square or power functions
- change the subject of a simple equation
- substitute physical quantities into an equation using consistent units so as to calculate one quantity and check the dimensional consistency of such calculations
- solve simple algebraic equations
- comprehend and use the symbols and notations $<$, $>$, $\approx$, $\leq$, $\geq$,
- translate information between graphical, numerical and algebraic forms
- distinguish between discrete and continuous data and then select appropriate forms, variables and scales for constructing graphs
- interpret the slope of a linear graph.

Appendix 8 - Engineering design process

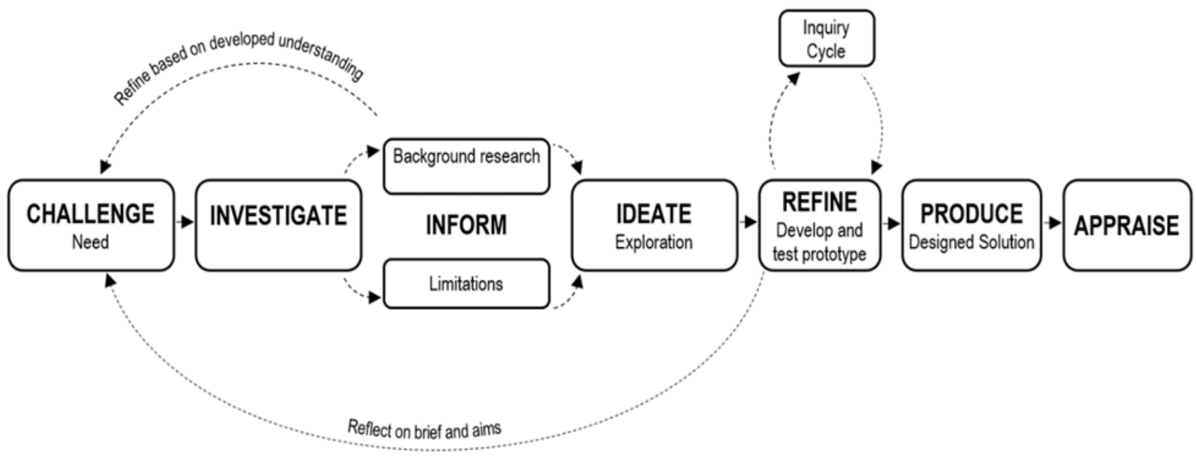
Engineering design process

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 developed by Years 9-12 Learning 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 accurately 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.

Supporting documents including external assessment material

- EAT315124 Electronics and Advanced Technologies External Assessment Specifications.pdf (2024-01-29 03:25pm AEDT)
- EAT315124 Electronics and Advanced Technologies Exemplar Exam Paper.pdf (2024-03-27 11:26am AEDT)
- Electronics and Advanced Technologies Information Sheet.pdf (2024-04-04 02:47pm AEDT)