BSSS

AUSTRALIAN CAPITAL TERRITORY

Electronics & Mechatronics

A/T/M

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The ACT Senior Secondary System

The ACT senior secondary system recognises a range of university, vocational or life skills pathways.

The system is based on the premise that teachers are experts in their area: they know their students and community and are thus best placed to develop curriculum and assess students according to their needs and interests. Students have ownership of their learning and are respected as young adults who have a voice.

A defining feature of the system is school-based curriculum and continuous assessment. School-based curriculum provides flexibility for teachers to address students' needs and interests. College teachers have an opportunity to develop courses for implementation across ACT schools. Based on the courses that have been accredited by the BSSS, college teachers are responsible for developing programs of learning. A program of learning is developed by individual colleges to implement the courses and units they are delivering.

Teachers must deliver all content descriptions; however, they do have flexibility to emphasise some content descriptions over others. It is at the discretion of the teacher to select the texts or materials to demonstrate the content descriptions. Teachers can choose to deliver course units in any order and teach additional (not listed) content provided it meets the specific unit goals.

School-based continuous assessment means that students are continually assessed throughout years 11 and 12, with both years contributing equally to senior secondary certification. Teachers and students are positioned to have ownership of senior secondary assessment. The system allows teachers to learn from each other and to refine their judgement and develop expertise.

Senior secondary teachers have the flexibility to assess students in a variety of ways. For example: multimedia presentation, inquiry-based project, test, essay, performance and/or practical demonstration may all have their place. College teachers are responsible for developing assessment instruments with task specific rubrics and providing feedback to students.

The integrity of the ACT Senior Secondary Certificate is upheld by a robust, collaborative and rigorous structured consensus-based peer reviewed moderation process. System moderation involves all year 11 and 12 teachers from public, non-government and international colleges delivering the ACT Senior Secondary Certificate.

Only students who desire a pathway to university are required to sit a general aptitude test, referred to as the ACT Scaling Test (AST), which moderates student scores across courses and colleges. Students are required to use critical and creative thinking skills across a range of disciplines to solve problems. They are also required to interpret a stimulus and write an extended response.

Senior secondary curriculum makes provision for student-centred teaching approaches, integrated and project-based learning inquiry, formative assessment and teacher autonomy. ACT Senior Secondary Curriculum makes provision for diverse learners and students with mild to moderate intellectual disabilities, so that all students can achieve an ACT Senior Secondary Certificate.

The ACT Board of Senior Secondary Studies (BSSS) leads senior secondary education. It is responsible for quality assurance in senior secondary curriculum, assessment and certification. The Board consists of nominees from colleges, professional bodies, universities, industry, parent/carer organisations and unions. The Office of the Board of Senior Secondary Studies (OBSSS) consists of professional and administrative staff who support the Board in achieving its objectives and functions.

ACT Senior Secondary Certificate

Courses of study for the ACT Senior Secondary Certificate:

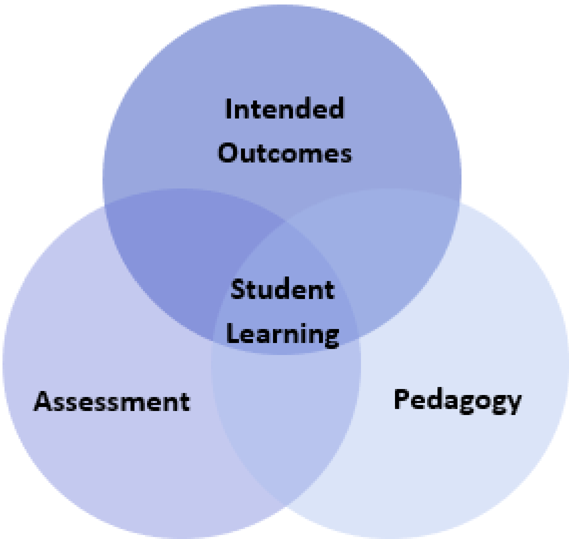
- provide a variety of pathways, to meet different learning needs and encourage students to complete their secondary education
- enable students to develop the essential capabilities for twenty-first century learners
- empower students as active participants in their own learning
- engage students in contemporary issues relevant to their lives
- foster students' intellectual, social and ethical development
- nurture students' wellbeing, and physical and spiritual development
- enable effective and respectful participation in a diverse society.

Each course of study:

- comprises an integrated and interconnected set of knowledge, skills, behaviours and dispositions that students develop and use in their learning across the curriculum
- is based on a model of learning that integrates intended student outcomes, pedagogy and assessment
- outlines teaching strategies which are grounded in learning principles and encompass quality teaching
- promotes intellectual quality, establish a rich learning environment and generate relevant connections between learning and life experiences
- provides formal assessment and certification of students' achievements.

Underpinning beliefs

- All students are able to learn.
- Learning is a partnership between students and teachers.
- Teachers are responsible for advancing student learning.



Learning Principles

- Learning builds on existing knowledge, understandings and skills.
  (Prior knowledge)
- When learning is organised around major concepts, principles and significant real world issues, within and across disciplines, it helps students make connections and build knowledge structures.
  (Deep knowledge and connectedness)
- Learning is facilitated when students actively monitor their own learning and consciously develop ways of organising and applying knowledge within and across contexts.
  (Metacognition)
- Learners' sense of self and motivation to learn affects learning.
  (Self-concept)
- Learning needs to take place in a context of high expectations.
  (High expectations)
- Learners learn in different ways and at different rates.
  (Individual differences)
- Different cultural environments, including the use of language, shape learners' understandings and the way they learn.
  (Socio-cultural effects)
- Learning is a social and collaborative function as well as an individual one.
  (Collaborative learning)
- Learning is strengthened when learning outcomes and criteria for judging learning are made explicit and when students receive frequent feedback on their progress.
  (Explicit expectations and feedback)

General Capabilities

All courses of study for the ACT Senior Secondary Certificate should enable students to develop essential capabilities for twenty-first century learners. These ‘capabilities’ comprise an integrated and interconnected set of knowledge, skills, behaviours and dispositions that students develop and use in their learning across the curriculum.

The capabilities include:

- literacy
- numeracy
- information and communication technology (ICT)
- critical and creative thinking
- personal and social
- ethical understanding
- intercultural understanding

Courses of study for the ACT Senior Secondary Certificate should be both relevant to the lives of students and incorporate the contemporary issues they face. Hence, courses address the following three priorities. These priorities are:

- Aboriginal and Torres Strait Islander histories and cultures
- Asia and Australia’s engagement with Asia
- Sustainability

Elaboration of these General Capabilities and priorities is available on the ACARA website at www.australiancurriculum.edu.au.

Literacy

Literacy is important in students’ development of *Science Inquiry Skills* and their understanding of content presented through the *Science Understanding* and *Science as a Human Endeavour* strands. Students gather, interpret, synthesise and critically analyse information presented in a wide range of genres, modes and representations (including text, flow diagrams, symbols, graphs and tables). They evaluate information sources and compare and contrast ideas, information and opinions presented within and between texts. They communicate processes and ideas logically and fluently and structure evidence-based arguments, selecting genres and employing appropriate structures and features to communicate for specific purposes and audiences.

Numeracy

Numeracy is key to students’ ability to apply a wide range of *Science Inquiry Skills*, including making and recording observations; ordering, representing and analysing data; and interpreting trends and relationships. They employ numeracy skills to interpret complex spatial and graphic representations, and to appreciate the ways in which Earth systems are structured, interact and change across spatial and temporal scales. They engage in analysis of data, including issues relating to reliability and probability, and they interpret and manipulate mathematical relationships to calculate and predict values.

Information and Communication Technology (ICT) Capability

ICT capability is a key part of *Science Inquiry Skills*. Students use a range of strategies to locate, access and evaluate information from multiple digital sources; to collect, analyse and represent data; to model and interpret concepts and relationships; and to communicate and share science ideas, processes and information. Through exploration of *Science as a Human Endeavour* concepts, students assess the impact of ICT on the development of science and the application of science in society, particularly with regard to collating, storing, managing and analysing large data sets.

Critical and Creative Thinking

Critical and creative thinking is particularly important in the science inquiry process. Science inquiry requires the ability to construct, review and revise questions and hypotheses about increasingly complex and abstract scenarios and to design related investigation methods. Students interpret and evaluate data; interrogate, select and cross-reference evidence; and analyse processes, interpretations, conclusions and claims for validity and reliability, including reflecting on their own processes and conclusions. Science is a creative endeavour and students devise innovative solutions to problems, predict possibilities, envisage consequences and speculate on possible outcomes as they develop *Science Understanding* and *Science Inquiry Skills.* They also appreciate the role of critical and creative individuals and the central importance of critique and review in the development and innovative application of science.

Personal and Social Capability

Personal and social capability is integral to a wide range of activities in, as students develop and practise skills of communication, teamwork, decision-making, initiative-taking and self-discipline with increasing confidence and sophistication. In particular, students develop skills in both independent and collaborative investigation; they employ self-management skills to plan effectively, follow procedures efficiently and work safely; and they use collaboration skills to conduct investigations, share research and discuss ideas. In considering aspects of *Science as a Human Endeavour,* students also recognise the role of their own beliefs and attitudes in their response to science issues and applications, consider the perspectives of others, and gauge how science can affect people’s lives.

Ethical Understanding

Ethical understanding is a vital part of science inquiry. Students evaluate the ethics of experimental science, codes of practice, and the use of scientific information and science applications. They explore what integrity means in science, and they understand, critically analyse and apply ethical guidelines in their investigations. They consider the implications of their investigations on others, the environment and living organisms. They use scientific information to evaluate the claims and actions of others and to inform ethical decisions about a range of social, environmental and personal issues and applications of science.

Intercultural Understanding

Intercultural understanding is fundamental to understanding aspects of *Science as a Human Endeavour*, as students appreciate the contributions of diverse cultures to developing science understanding and the challenges of working in culturally diverse collaborations. They develop awareness that raising some debates within culturally diverse groups requires cultural sensitivity, and they demonstrate open-mindedness to the positions of others. Students also develop an understanding that cultural factors affect the ways in which science influences and is influenced by society.

Cross Curriculum Priorities

While the significance of the cross curriculum priorities for varies, there are opportunities for teachers to select contexts that incorporate the key concepts from each priority.

Aboriginal and Torres Strait Islander

The curriculum may provide an opportunity for students to engage with Aboriginal and Torres Strait Islander histories and cultures. It acknowledges that Aboriginal and Torres Strait Islander people have longstanding scientific knowledge traditions that inform understanding of the Australian environment and the ways in which it has changed over time.

Asia and Australia's Engagement with Asia

Students investigate a range of contexts that draw on Asia and Australia's engagement with Asia. Students could explore the technological environment within the Asia region and develop an appreciation that technology developed in one area has significant impacts across the world. Students could appreciate that the Asia region plays an important role in scientific research and development, including through collaboration with Australian scientists.

Sustainability

Students appreciate the importance of using science to predict possible effects of human and other activity, and to develop management plans or alternative technologies that minimise these effects and provide for a more sustainable future.

Electronics & Mechatronics

A/T/M

Rationale

This course combines elements of electronics and the engineering discipline of mechatronics. The course has two streams: electronics and mechatronics. In the electronics stream, students learn about the fundamental principles of electrical and electronic circuits. In the mechatronics stream, students learn about the use of microcontrollers to control an electrical circuit and the mechanical system that it operates. In both electronic and mechatronic streams, students apply their knowledge to the design and construction of real systems.

The electronics stream provides a pathway for students interested in electrotechnology trades. The mechatronics stream aims to build theoretical and practical knowledge to prepare students for technical pathways such as engineering.

Goals

Electronics & Mechatronics aims to develop students':

- understanding of electronics/ mechatronics and the significant contribution electronics & mechatronics has made to contemporary society
- understanding that electronics/mechatronics may be explained, analysed and predicted using concepts, models and theories that provide a reliable basis for action
- understanding of how electronics/ mechatronics knowledge is used in a wide range of contexts
- investigative skills, including the design and evaluation of prototypes to solve problems, the collection and analysis of data, and the interpretation of evidence
- ability to use accurate and precise measurement, valid and reliable evidence, and scepticism and intellectual rigour to evaluate claims
- ability to communicate electronics/ mechatronics understanding, findings, arguments and conclusions using appropriate representations, modes and genres.

Mathematical skills expected of students studying

The curriculum requires students 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, students are required to gather, represent and analyse numerical data to identify the evidence that forms the basis of their scientific arguments, claims or conclusions. In gathering and recording numerical data, students are required to make measurements with an appropriate degree of accuracy and to represent measurements using appropriate units.

Students may need to be taught to recognise 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.

Unit Titles

- Safety, Circuits & Solenoids
- Semiconductors & Systems
- Digital and Analog Interactions
- AC & Advanced Applications
- Independent Study

Organisation of Content

Safety, Circuits & Solenoids

In this unit the science understanding strand comprises of two alternate electives. For a standard 1.0 unit, students must study either the electronic or mechatronic strand. In both electives of this unit, students will identify electrical hazards and implement various safety measures. They will measure electrical quantities and apply basic principles to electronic or mechatronic components and circuits. Students will be introduced to electromagnetism and will use various tools and techniques in construction and analysis activities. Finally they will gain a historical and societal perspective on the development and application of electronics or mechatronics.

Semiconductors & System

In this unit the science understanding strand comprises of two alternate electives. For a standard 1.0 unit, students must study either the electronic or mechatronic strand. In the electronics elective, students will study the structures, operations and applications of a range of semiconductor devices in analog circuits. In the mechatronics elective, students will study the application of mechatronics to pilot and unpiloted vehicles, becoming familiar with their systems, sensors and other aspects of control.

Digital and Analog Interaction

In this unit the science understanding strand comprises of two alternate electives. For a standard 1.0 unit, students must study either the electronic or mechatronic strand. In the electronics elective, students will study the theory and application of digital electronics through a range of individual components and their uses in computer systems and analog interfaces. In the mechatronics elective, students will study the fundamentals of microcontrollers and their interactions with physical systems including I/O devices, programming and communications.

AC & Advanced Applications

In this unit the science understanding strand comprises of two alternate electives. For a standard 1.0 unit, students must study either the electronic or mechatronic strand. In the electronic elective, students will study electromagnetism in its application to a range of devices and in the generation and use of alternating current. In the mechatronics elective, students will study advanced microcontroller systems, programming and techniques.

Independent Study

An Independent Study unit has an important place in senior secondary courses. It is a valuable pedagogical approach that empowers students to make decisions about their own learning. An Independent Study unit can be proposed by an individual student for their own independent study and negotiated with their teacher. The program of learning for an Independent Study unit must meet the unit goals and content descriptions as they appear in the course. Students must have studied a minimum of <u>three</u> standard 1.0 units from this course.

Each unit includes:

- Unit descriptions – short descriptions of the purpose of and rationale for each unit.
- Learning outcomes – statements describing the learning expected as a result of studying the unit.
- Content descriptions – descriptions of the core content to be taught and learned, organised into three strands:
  - Science Inquiry Skills
  - Science as a Human Endeavour
  - Science Understanding (organised as two electives; students study either mechatronic or electronics within each unit).

Science Strand Descriptions

The Australian Curriculum: Science has three interrelated strands: Science Inquiry Skills, Science as a Human Endeavour and Science Understanding. These strands are used to organise the Science learning area from Foundation to Year 12. In the senior secondary Science subjects, the three strands build on students' learning in the F-10 Australian Curriculum: Science.

In the practice of science, the three strands are closely integrated: the work of scientists reflects the nature and development of science, is built around scientific inquiry, and seeks to respond to and influence society. Students' experiences of school science should mirror this multifaceted view of science. To achieve this, the three strands of the Australian Curriculum: Science should be taught in an integrated way. The content descriptions for Science Inquiry Skills, Science as a Human Endeavour and Science Understanding have been written so that this integration is possible in each unit.

Science Inquiry Skills

- Science inquiry involves identifying and posing questions; planning, conducting and reflecting on investigations; processing, analysing and interpreting data; and communicating findings. This strand is concerned with evaluating claims, investigating ideas, solving problems, reasoning, drawing valid conclusions, and developing evidence-based arguments.
- Science investigations are activities in which ideas, predictions or hypotheses are tested and conclusions are drawn in response to a question or problem. Investigations can involve a range of activities, including experimental testing, field work, locating and using information sources, conducting surveys, and using modelling and simulations. The investigation design will depend on the context and subject of the investigation.
- In science investigations, the collection and analysis of data to provide evidence plays a major role. This can involve collecting or extracting information and reorganising data in the form of tables, graphs, flow charts, diagrams, prose, keys, spreadsheets and databases. The analysis of data to identify and select evidence, and the communication of findings, involve the selection, construction and use of specific representations, including mathematical relationships, symbols and diagrams.
- Through the senior secondary Science subjects, students will continue to develop generic science inquiry skills, building on the skills acquired in the F-10 Australian Curriculum: Science. These generic skills are described below and will be explicitly taught and assessed in each unit. In addition, each unit provides more specific skills to be taught within the generic science inquiry skills; these specific skills align with the Science Understanding and Science as a Human Endeavour content of the unit.

The generic science inquiry skills are:

- Identifying, researching and constructing questions for investigation; proposing hypotheses; and predicting possible outcomes
- Designing investigations, including the procedure/s to be followed, the materials required and the type and amount of primary and/or secondary data to be collected; conducting risk assessments; and considering ethical research
- Conducting investigations, including using equipment and techniques safely, competently and methodically for the collection of valid and reliable data
- Representing data in meaningful and useful ways; organising and analysing data to identify trends, patterns and relationships; recognising error, uncertainty and limitations in data; and selecting, synthesising and using evidence to construct and justify conclusions
- Interpreting scientific and media texts and evaluating processes, claims and conclusions by considering the quality of available evidence; and using reasoning to construct scientific arguments
- Selecting, constructing and using appropriate representations to communicate understanding, solve problems and make predictions
- Communicating to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes
- The senior secondary Science subjects have been designed to accommodate, if appropriate, an extended scientific investigation within each pair of units.

Science as a Human Endeavour

- Through science, we seek to improve our understanding and explanations of the natural world. The Science as a Human Endeavour strand highlights the development of science as a unique way of knowing and doing, and explores the use and influence of science in society.
- As science involves the construction of explanations based on evidence, the development of science concepts, models and theories is dynamic and involves critique and uncertainty. Science concepts, models and theories are reviewed as their predictions and explanations are continually re-assessed through new evidence, often through the application of new technologies. This review process involves a diverse range of scientists working within an increasingly global community of practice and can involve the use of international conventions and activities such as peer review.
- The use and influence of science are shaped by interactions between science and a wide range of social, economic, ethical and cultural factors. The application of science may provide great benefits to individuals, the community and the environment, but may also pose risks and have unintended consequences. As a result, decision making about socio-scientific issues often involves consideration of multiple lines of evidence and a range of stakeholder needs and values. As an ever-evolving body of knowledge, science frequently informs public debate, but is not always able to provide definitive answers.

Science Understanding

- Science understanding is evident when a person selects and integrates appropriate science concepts, models and theories to explain and predict phenomena, and applies those concepts, models and theories to new situations. Models in science can include diagrams, physical replicas, mathematical representations, word-based analogies (including laws and principles) and computer simulations. Development of models involves selection of the aspects of the system/s to be included in the model, and thus models have inherent approximations, assumptions and limitations.
- The Science Understanding content in each unit develops students' understanding of the key concepts, models and theories that underpin the subject, and of the strengths and limitations of different models and theories for explaining and predicting complex phenomena.
- Science understanding can be developed through the selection of contexts that have relevance to and are engaging for students.

Safety

Science learning experiences may involve the use of potentially hazardous substances and/or hazardous equipment. It is the responsibility of the school to ensure that duty of care is exercised in relation to the health and safety of all students and that school practices meet the requirements of the Work Health and Safety Act 2011, in addition to relevant state or territory health and safety guidelines.

Assessment

The identification of criteria within the achievement standards and assessment tasks types and weightings provide a common and agreed basis for the collection of evidence of student achievement.

Assessment Criteria (the dimensions of quality that teachers look for in evaluating student work) provide a common and agreed basis for judgement of performance against unit and course goals, within and across colleges. Over a course, teachers must use all these criteria to assess students' performance but are not required to use all criteria on each task. Assessment criteria are to be used holistically on a given task and in determining the unit grade.

Assessment Tasks elicit responses that demonstrate the degree to which students have achieved the goals of a unit based on the assessment criteria. The Common Curriculum Elements (CCE) is a guide to developing assessment tasks that promote a range of thinking skills (see Appendix B). It is highly desirable that assessment tasks engage students in demonstrating higher order thinking.

Rubrics are constructed for individual tasks, informing the assessment criteria relevant for a particular task and can be used to assess a continuum that indicates levels of student performance against each criterion.

Assessment Criteria

Students will be assessed on the degree to which they demonstrate an understanding of:

- concepts, models and application
- contexts
- inquiry skills.

Assessment Task Types

Suggested tasks

Individual tasks may incorporate one or more of the following:

- models
- commentary
- debate
- portfolio/journal
- field work
- investigation
- document/source analysis
- practical report
- role play
- research report
- test/quiz
- seminar/workshop/lecture
- poster
- response to stimulus
- essay
- multimedia presentation
- creative response
- interview
- discussion forum
- rationale/validation
- practical skills

It is recommended that a student conceived investigation be undertaken at least once during a minor and twice during a major. This investigation may either be theoretical or practical, or a combination of both.

Weightings in A/T/M 1.0 and 0.5 Units:

No task to be weighted more than 45% for a standard 1.0 unit.

Additional Assessment Information

Requirements

- For a standard unit (1.0), students must complete a minimum of three assessment tasks and a maximum of five.
- For a half standard unit (0.5), students must complete a minimum of two and a maximum of three assessment tasks.
- Students must experience a variety of task types and different modes of communication to demonstrate the Achievement Standards in both theoretical and practical tasks.
- All Achievement Standards must be demonstrated in standard (1.0) or half-standard (0.5) units.
- Task types need to be selected to address all Achievement Standards within the Concepts, Models & Applications, Contexts and Inquiry Skills strands across a standard (1.0) or half-standard (0.5) unit.
- For tasks completed in unsupervised conditions, schools need to have mechanisms to uphold academic integrity, for example: student declaration, plagiarism software, oral defence, interview, or other validation tasks.

Achievement Standards

Years 11 and 12 Achievement Standards are written for A/T courses. A single achievement standard is written for M courses.

A Year 12 student in any unit is assessed using the Year 12 achievement standards. A Year 11 student in any unit is assessed using the Year 11 achievement standards. Year 12 achievement standards reflect higher expectations of student achievement compared to the Year 11 achievement standards. Years 11 and 12 achievement standards are differentiated by cognitive demand, the number of dimensions and the depth of inquiry.

An achievement standard cannot be used as a rubric for an individual assessment task. Assessment is the responsibility of the college. Student tasks may be assessed using rubrics or marking schemes devised by the college. A teacher may use the achievement standards to inform development of rubrics. The verbs used in achievement standards may be reflected in the rubric. In the context of combined Years 11 and 12 classes, it is best practice to have a distinct rubric for Years 11 and 12. These rubrics should be available for students prior to completion of an assessment task so that success criteria are clear.

Achievement Standards for Science A Course – Year 11

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Concepts, Models &	• analyses the fundamental properties and functions of system components, processes and interactions, and how they are affected by factors across a range of temporal and spatial scales	• explains the fundamental properties and functions of system components, processes and interactions, and how they are affected by factors across a range of temporal and spatial scales	• describes the fundamental properties and functions of system components, processes and interactions, and how they are affected by factors across a range of temporal and spatial scales	• identifies the fundamental properties and functions with some identification of system components and factors that affect processes across a range of temporal and spatial scales	• identifies the fundamental properties and functions with little or no identification of system components, processes, interactions and contextual scales
	• analyses the nature, functions, limitations and applications of theories and models using evidence, in unfamiliar contexts	• explains the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts	• describes the nature, functions, limitations and applications of theories and models with supporting evidence	• identifies the nature, functions, applications, and some possible limitations of theories and models, with some evidence	• identifies the nature, function of theories and models, with an assertion of a few possible limitations
	• assesses processes and claims, provides a critique based on evidence, and discusses alternatives	• explains processes and claims, provides a critique with reference to evidence, and identifies alternatives	• describes processes and claims, and identifies alternatives with some reference to evidence	• identifies processes and claims, and identifies the need for improvements with some reference to evidence	• identifies processes and the need for some improvements, with little or no reference to evidence
Contexts	• analyses how the practice and applications of science meet needs, make decisions; and is influenced by social, economic, technological, and ethical factors	• explains how the practice and applications of science meet needs, make decisions, and is influenced by social, economic, technological, and ethical factors	• describes how the applications of science meet needs, make decisions, and is influenced by social, economic, technological, and ethical factors	• identifies ways in the applications of science meet needs, and is influenced by some factors	• identifies ways in which the application of science has been used in society to meet needs
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that efficiently collect valid and reliable data in response to a complex question	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid data in response to a complex question	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a question	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a question with varying success	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question
	• analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and analyses errors	• explains causal and correlational relationships, anomalies, reliability and validity of data and representations, and explains errors	• describes relationships in data sets, reliability and validity of data and representations, and describes common errors	• identifies trends and anomalies in data and representations, with general comments about errors	• identifies trends in data and representations, with little or no reference to anomalies and errors
	• reflects with insight on their own thinking and learning and evaluates planning, time management and use of appropriate strategies to work independently and collaboratively	• reflects on their own thinking and analyses planning, time management, use of appropriate strategies to work independently and collaboratively	• reflects on their own thinking and explains planning, time management, use of appropriate strategies to work independently and collaboratively	• reflects on their own thinking with some reference to planning, time management, use of appropriate strategies to work independently and collaboratively	• reflects on their own thinking with little or no reference to planning, time management, use of appropriate strategies to work independently and collaboratively
	• communicates concisely, effectively and accurately, demonstrating scientific literacy in a range of modes, styles, representations, and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• communicates clearly and accurately, demonstrating scientific literacy in a range of modes, styles, representations and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• communicates accurately demonstrating scientific literacy, in a range of modes, styles, representations, and genres for specific purposes, with appropriate evidence and mostly consistent referencing	• communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing

Achievement Standards for Science T Course – Year 11

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Concepts, Models & Applications	• critically analyses the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales • evaluates the nature, functions, limitations and applications of theories and models using evidence, in unfamiliar contexts • analyses evidence with reference to models and/or theories, and develops evidence-based conclusions and evaluates limitations	• analyses the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales • analyses the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts • assesses evidence with reference to models and/or theories, and develops evidence-based conclusions and discusses limitations	• explains the fundamental properties and functions of system components, processes and interactions and the effects of factors across a range of scales • explains the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts • explains evidence with reference to models and/or theories, and develops evidence-based conclusions and identifies limitations	• describes the fundamental properties and functions, and with some description of system components, processes and interactions, and the effects of factors across a range of scales • describes the nature, functions, limitations and applications of theories and models with supporting evidence • describes evidence, and develops conclusions with some reference to models and/or theories	• identifies the fundamental properties and functions of system and identifies components, processes and interactions, and the effects of factors across a range of scales • identifies the nature, functions, applications, and some possible limitations of theories and models, with some evidence • identifies evidence, and asserts conclusions with little or no reference to models and/or theories
Contexts	• critically analyses epistemology, role of peer review, collaboration and technology in developing knowledge • critically analyses the influence of social, economic, ethical and cultural factors on Science	• analyses epistemology, role of peer review and technology in developing knowledge • analyses the influence of social, economic, ethical and cultural factors on Science	• explain epistemology, role of peer review and technology in developing knowledge • explains the influence of social, economic, ethical and cultural factors on Science	• describes the role of peer review in developing knowledge • describes the influence of social, economic, ethical and cultural factors on Science	• identifies that scientific knowledge has changed over time • identifies the influence of social, economic, ethical and cultural factors on Science
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that collect valid, reliable data in response to a complex question • analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and analyses errors • analyses processes and claims, and provides a critique based on evidence, and critically analyses alternatives • reflects with insight on own thinking and that of others, and evaluates planning, time management, and use of appropriate work strategies to work independently and collaboratively • communicates concisely, effectively and accurately, demonstrating scientific literacy in a range of modes, styles, representations, and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid, reliable data in response to a question • analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and discusses errors • assesses processes and claims, and provides a critique with reference to evidence, and analyses alternatives • reflects on their own thinking and analyses planning, time management, use of appropriate work strategies to work independently and collaboratively • communicates clearly and accurately, demonstrating scientific literacy in a range of modes, styles, representations and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a familiar question • explains causal and correlational relationships, anomalies, reliability and validity of data and representations, and cites common errors • explains processes and claims, and identifies alternatives with reference to reliable evidence • reflects on their own thinking and explains planning, time management, use of appropriate work strategies to work independently and collaboratively • communicates accurately demonstrating scientific literacy, in a range of modes, styles, representations, and genres for specific purposes, with appropriate evidence and mostly consistent referencing	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a simple question with varying success • describes trends, relationships and anomalies in data, identifies anomalies, and some possible sources of error • describes processes and claims, and identifies the need for improvements with some reference to evidence • reflects on their own thinking, with reference to planning and the use of appropriate work strategies to work independently and collaboratively • communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question • identifies trends and relationships in data, with little or no reference to sources of error • identifies processes and the need for some improvements, with little or no reference to evidence • reflects on their own thinking with little or no reference to planning, time management, and use of work strategies to work independently and collaboratively • communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing

Achievement Standards for Science A Course – Year 12

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Concepts, Models & Applications	• analyses the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales • analyse the nature, functions, limitations and applications of theories and models using evidence, in unfamiliar contexts • assesses evidence with reference to models and/or theories, and develops evidence-based conclusions and evaluates limitations	• explains the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales • explains the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts • explains evidence with reference to models and/or theories, and develops evidence-based conclusions and discusses limitations	• describes the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales • describes the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts • describes evidence with reference to models and/or theories, and develops evidence-based conclusions and identifies limitations	• describes the fundamental properties and functions of system components, processes and interactions, and the effects of one or more factors • describes the nature, functions, limitations and applications of theories and models with supporting evidence • describes evidence, and develops conclusions with some reference to models and/or theories	• identifies the fundamental properties and functions of system components, processes and interactions, and the effects of factors • identifies the nature, functions, applications, and some limitations of theories and models with some evidence • identifies evidence, and asserts conclusions with little or no reference to models and/or theories
Contexts	• analyses epistemology, role of peer review, collaboration and technology in developing knowledge • analyses the influence of social, economic, ethical and cultural factors on Science	• explains epistemology, role of peer review and technology in developing knowledge • explains the influence of social, economic, ethical and cultural factors on Science	• describes epistemology, role of peer review and technology in developing knowledge • describes the influence of social, economic, ethical and cultural factors on Science	• describes role of peer review and technology in developing knowledge • describes the influence of social, economic, ethical and cultural factors on Science	• identifies that scientific knowledge has changed over time • identifies the influence of social, economic, ethical and cultural factors on Science
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that collect valid, reliable data in response to a complex question • analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and analyses errors • analyses processes and claims, and provides a critique based on evidence, and analyses alternatives • reflects with insight on own thinking and that of others and, evaluates planning, time management and use of appropriate independent and collaborative work strategies • communicates concisely, effectively and accurately, demonstrating scientific literacy in a range of modes, styles, representations, and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid, reliable data in response to a question • analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and discusses errors • explains processes and claims, and provides a critique with reference to evidence, and proposes alternatives • reflects on their own thinking and analyses planning, time management, and use of appropriate independent and collaborative work strategies • communicates clearly and accurately, demonstrating scientific literacy in a range of modes, styles, representations and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a familiar question • describes causal and correlational relationships, anomalies, reliability and validity of data and representations, and cites common errors • describes processes and claims, and identifies alternatives with reference to reliable evidence • reflects on their own thinking and explains planning, time management, and use of appropriate independent and collaborative work strategies • communicates accurately demonstrating scientific literacy, in a range of modes, styles, representations, and genres for specific purposes, with appropriate evidence and mostly consistent referencing	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a simple question with varying success • describes trends, relationships and anomalies in data, identifies anomalies, and some possible sources of error • describes processes and claims, and identifies the need for improvements with some reference to evidence • reflects on their own thinking, with reference to planning and the use of appropriate independent and collaborative work strategies • communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question • identifies trends and relationships in data, with little or no reference to sources of error • identifies processes and the need for some improvements, with little or no reference to evidence • reflects on their own thinking with little or no reference to planning, time management, and use of appropriate independent and collaborative work strategies • communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing

Achievement Standards for Science T Course – Year 12

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Concepts, Models & Applications	• critically analyses the properties and functions of system components, processes and interactions, and the interplay and effects of factors across a range of scales • evaluates applications, limitations, and predictions of theories and models to explain systems and create solutions, with evidence, in unfamiliar contexts • evaluates evidence with reference to critical analysis of models and/or theories, and develops evidence-based conclusions and evaluates limitations	• analyses the properties and functions of system components, processes and interactions, and the interplay and effects of factors across a range of scales • analyses applications, limitations, and predictions of theories and models to explain systems and create plausible solutions, with evidence in familiar contexts • analyses evidence with reference to models and/or theories, and develops evidence-based conclusions and discusses limitations	• explains the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales • explains applications, limitations, and predictions of theories and models to explain systems and create plausible solutions in familiar contexts • describes evidence with reference to models and/or theories, and develops evidence-based conclusions and identifies limitations	• describes the fundamental properties and functions of system components, processes and interactions, and the effects of one or more factors • describes the nature, functions, limitations and applications of theories and models to create solutions to problems with supporting evidence • describes evidence, and develops conclusions with some reference to models and/or theories	• identifies the fundamental properties and functions of system components, processes and interactions, and some affective factors • identifies the nature, functions, limitations and applications of theories and models, and suggest solutions to problems with supporting evidence • identifies evidence, and asserts conclusions with little or no reference to models and/or theories
Contexts	• critically analyses epistemology, role of peer review, collaboration, and technology in developing knowledge • critically analyses the influence of social, economic, ethical and cultural factors on Science	• analyses epistemology, role of peer review and technology in developing knowledge • analyses the influence of social, economic, ethical and cultural factors on Science	• explains epistemology, role of peer review and technology in developing knowledge • explains the influence of social, economic, ethical and cultural factors on Science	• describes role of peer review and technology in developing knowledge • describes the influence of social, economic, ethical and cultural factors on Science	• identifies that scientific knowledge has changed over time • identifies the influence of social, economic, ethical and cultural factors on Science
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that collect valid, reliable data in response to a complex question • critically analyses cause and correlation, anomalies, reliability and validity of data and representations, and critically analyses errors • evaluates processes and claims, and provides a critique based on evidence, and critically analyses alternatives • reflects with insight on own thinking and that of others, evaluates planning, time management, and use of appropriate independent and collaborative work strategies • communicates concisely, effectively and accurately, with scientific literacy in a range of modes, representations, and genres for specific audiences and purposes, and accurate referencing	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid, reliable data in response to a question • analyses cause and correlation, anomalies, reliability and validity of data and representations, and analyses errors • explains processes and claims, and provides a critique with reference to evidence, and analyses alternatives • reflects on their own thinking and analyses planning, time management, and use of appropriate independent and collaborative work strategies • communicates clearly and accurately, with scientific literacy in a range of modes, representations and genres for specific audiences and purposes, and accurate referencing	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a familiar question • describes causal and correlational relationships, anomalies, reliability and validity of data and representations, and discusses common errors • describes processes and claims, and identifies alternatives with reference to reliable evidence • reflects on their own thinking and explains planning, time management, and use of appropriate independent and collaborative work strategies • communicates accurately demonstrating scientific literacy, in a range of modes, representations, and genres for specific purposes, and mostly consistent referencing	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a simple question with varying success • describes trends, relationships and anomalies in data, identifies anomalies, and cites sources of error • describes processes and claims, and identifies the need for improvements with some reference to evidence • reflects on their own thinking, with reference to planning and the use of appropriate independent and collaborative work strategies • communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question • identifies trends and relationships in data with reference to sources of error • identifies processes and the need for some improvements, with little or no reference to evidence • reflects on their own thinking with little or no reference to planning, time management, and use of appropriate independent and collaborative work strategies • communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing

Achievement Standards for Science M Course – Years 11 and 12

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Concepts, Models & Applications	• describes the properties and functions of system components and processes with independence • describes system components and processes with some reference to how they are affected by factors with independence	• describes the properties and functions of system components, processes and interactions with assistance • describes system components, processes and interactions with some reference to how they are affected by factors with assistance	• identifies the properties and functions of system components, processes and interactions with independence • identifies system components, processes and interactions with independence	• identifies the properties and functions of system components, processes and interactions with assistance • identifies system components, processes and interactions with assistance	• identifies the properties and functions of system components, processes and interactions with direct instruction • identifies system components, processes and interactions with direct instruction
Contexts	• describes the impact of science on an aspect of society with independence	• describes the impact of science on an aspect of society with some independence	• identifies the impact of science on an aspect of society with independence	• identifies the impact of science on an aspect of society with assistance	• identifies the impact of science on an aspect of society with direct instruction
Inquiry Skills	• plans and conducts investigations in response to a question or problem with independence • draws evidence-based conclusions from investigations with independence • reflects on own thinking and learning in science with independence • communicates findings effectively with independence	• plans and conducts investigations in response to a question or problem with some independence • draws evidence-based conclusions from investigations with some independence • reflects on own thinking and learning in science with some independence • communicates findings effectively with some independence	• plans and conducts investigations in response to a question or problem with assistance • draws evidence-based conclusions from investigations with assistance • reflects on own thinking and learning in science with assistance • communicates findings with assistance	• plans and conducts investigations in response to a question or problem with repeated cueing • draws evidence-based conclusions from investigations with repeated cueing • reflects on own thinking and learning in science with repeated cueing • communicates findings with repeated cueing	• follows a procedure to conduct investigations to collect data with direct instruction • draws evidence-based conclusions from investigations with direct instruction • reflects on own thinking and learning in science with direct instruction • communicates findings with direct instruction

Safety, Circuits & Solenoids Value: 1.0

Safety, Circuits & Solenoids a Value: 0.5
Safety, Circuits & Solenoids b Value: 0.5

Unit description:

The science understanding strand comprises of two alternate electives. For a standard 1.0 unit, students must study either the electronic or mechatronic strand of science understandings. In both electives of this unit, students will identify electrical hazards and implement various safety measures. They will measure electrical quantities and apply basic principles to electronic or mechatronic components and circuits. Students will be introduced to electromagnetism and will use various tools and techniques in construction and analysis activities. Finally they will gain a historical and societal perspective on the development and application of electronics or mechatronics.

Specific Unit Goals

This unit should enable students to:

A Course	T Course	M Course
• describe electrical safety hazards and implement safety measures • analyse the operation of an electronic system • construct and test electronic or mechatronic systems	• analyse electrical safety hazards and implement safety measures • evaluate the operation of an electronic system • design, construct and test electronic or mechatronic systems	• Identify electrical safety hazards and implement safety measures • describe the operation of an electronic system • construct electronic or mechatronic systems

Content Descriptions

All knowledge, understanding and skills below must be delivered:

A Course	T course	M Course
Science Inquiry		
• tools e.g. DMM, pliers, screwdrivers, Megger, testing and tagging equipment	• tools e.g. DMM, pliers, screwdrivers, Megger, testing and tagging equipment	• tools
• use of test equipment (analog meters, digital multimeter, oscilloscope, signal generator, `logic analyser, protocol analyser, emulators, debuggers, etc)	• use of test equipment (analog meters, digital multimeter, oscilloscope, signal generator, `logic analyser, protocol analyser, emulators, debuggers, etc)	• use of test equipment
• design and testing methodologies	• design, integration, and testing methodologies - component	• design and testing

A Course	T course	M Course
• component, sub-system, system; spiral development techniques	• sub-system, system; spiral development techniques	• troubleshooting techniques
• troubleshooting techniques	• troubleshooting techniques	
• circuit development: simulation, prototyping and production e.g. breadboard, stripboard/veroboard, custom circuit boards, soldering skills	• circuit development: simulation, prototyping and production e.g. breadboard, stripboard/veroboard, custom circuit boards, soldering skills	• circuit development: simulation, prototyping and production e.g. breadboard, stripboard/veroboard, custom circuit boards, soldering skills
• safe work practices	• safe work practices	• safe work practices
• project work (build, program, test a system appropriate to the unit)	• project work (design, build, program, test and evaluate a system appropriate to the unit)	• project work (design, build, program, test and evaluate a system appropriate
• interpret information in datasheets or technical specifications	• analyse information in datasheets or technical specifications	
• investigate design prototypes; and predict possible outcomes	• research and construct questions for investigation and evaluation; design prototypes; and predict possible outcomes	• research a question for investigation
• design investigations, including the procedure/s to be followed, the materials required, and the type and amount of data to be collected and conduct risk assessments. This may include the design, construction and evaluation of a prototype.	• design investigations, including the procedure/s to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics. This may include the design, construction and evaluation of a prototype.	
• interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments	• analyse a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments	• describe scientific and media texts
• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes	• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes	• communicate to an audience for a specific purpose using appropriate language

A Course	T course	M Course
Science as a Human Endeavour		
• describe the history of electricity and electronics • identify ethical and legal issues • engineering compromises and trade-offs between competing design goals e.g. strength vs weight vs cost • the acceptance of scientific knowledge and the adoption of new technologies can be influenced by the social, economic and cultural context in which it is considered • people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk	• analyse the history of electricity • analyse ethical and legal issues • engineering compromises and trade-offs between competing design goals e.g. strength vs weight vs cost • the acceptance of scientific knowledge and the adoption of new technologies can be influenced by the social, economic and cultural context in which it is considered • people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk • science can be limited in its ability to provide definitive answers to public debate; there may be insufficient reliable data available, or interpretation of the data may be open to question • international collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region • scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability	• engineering compromises and trade-offs between competing design goals e.g. strength vs weight

A Course	T course	M Course
Science understanding – Electronics elective Students study **either** this Electronics elective **or** the Mechatronics elective for this unit.		
• explain electrical safety: identifying electrical hazards (ladders, PPE, fire extinguishers, safety signs, risks), human physiological effects of electricity (cardiac arrest, burns, fibrillation, CPR), current WHS guideline, fuses, RCDs, circuit breakers	• analyse electrical safety: electrical hazards (ladders, PPE, fire extinguishers, safety signs, risks), human physiological effects of electricity (cardiac arrest, burns, fibrillation, CPR), current WHS guideline, fuses, RCDs, circuit breakers	• describe electrical safety
• explain electrical charge and electrostatics (charging and discharging, insulators and conductors, ESD prevention)	• analyse electrical charge and electrostatics (charging and discharging, insulators and conductors, ESD prevention)	• describe electrical charge
• basic electrical quantities (Voltage, Current, Resistance, Capacitance, Power) and their measurement, AC vs DC	• electrical quantities (Voltage, Current, Resistance, Capacitance, Power) and their measurement, AC vs DC	• basic electrical quantities
• basic components and their schematic symbols: sources of emf, resistors, capacitors	• components and their schematic symbols: sources of emf, resistors, capacitors	• basic components
• parallel, series, short, closed and open circuits, Ohm's and Kirchoff's laws (simplified)	• parallel, series, short, closed and open circuits, Ohm's and Kirchoff's laws	
• introductory solenoids, electromagnets and relays	• electromagnetism: magnetic fields, solenoids, electromagnets and relays	
• semiconductor materials and the PN junction, diodes and transistors	• semiconductor materials and the PN junction, diodes and transistors	• semiconductor materials, diodes and transistors
• suitable cables and wires for different purposes, AS3000 wiring rules	• suitable cables and wires for different purposes	
• safety and protective devices e.g. RCD, fuses, earth, circuit breakers etc	• safety and protective devices e.g. RCD, fuses, earth, circuit breakers etc	• safety and protective devices
• common accessories - GPO's, luminaires, switches		

A Course	T course	M Course
Science understanding – Mechatronics elective Students study **either** this Mechatronics elective **or** the Electronics elective for this unit.		
• explain electrical safety: identifying electrical hazards (ladders, PPE, fire extinguishers, safety signs, risks), human physiological effects of electricity (cardiac arrest, burns, fibrillation, CPR), current WHS guidelines, fuses, RCDs, circuit breakers	• analyse electrical safety: identifying electrical hazards (ladders, PPE, fire extinguishers, safety signs, risks), human physiological effects of electricity (cardiac arrest, burns, fibrillation, CPR), current WHS guidelines, fuses, RCDs, circuit breakers	• describe electrical safety
• explain electrical charge	• analyse electrical charge	• describe electrical charge
• basic electrical quantities (Voltage, Current, Resistance, Capacitance, Power) and their measurement	• electrical quantities (Voltage, Current, Resistance, Capacitance, Power) and their measurement. Ohm's and Kirchoff's laws	• basic electrical quantities
• basic components and their schematic symbols: sources of emf, resistors, capacitors	• components and their schematic symbols: sources of emf, resistors, capacitors	• basic components
• electromagnets, motors and solenoids	• electromagnets, motors and solenoids	
• diodes and transistors	• diodes and transistors	• diodes and transistors
• use of microcontrollers to control and investigate simple electronic circuits	• use of microcontrollers to control and investigate simple electronic circuits	
• physical systems and their interaction with electronic systems	• physical systems and their interaction with electronic systems	

A guide to reading and implementing content descriptions

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions. The lens which the teacher uses to demonstrate the content descriptions may be either guided through provision of electives within each unit or determined by the teacher when developing their program of learning.

A program of learning is what a college provides to implement the course for a subject. It is at the discretion of the teacher to emphasise some content descriptions over others. The teacher may teach additional (not listed) content provided it meets the specific unit goals. This will be informed by the student needs and interests.

Assessment

Refer to pages 11-13.

Semiconductors and Systems — Value: 1.0

Semiconductors and Systems a — **Value: 0.5**
Semiconductors and Systems b — **Value: 0.5**

Unit Description

The science understanding strand comprises of two alternate electives. For a standard 1.0 unit, students must study either the electronic or mechatronic strand in Science Understandings.. In the electronics elective, students will study the structures, operations and applications of a range of semiconductor devices in analog circuits. In the mechatronics elective, students will study the application of mechatronics to pilot and unpiloted vehicles, becoming familiar with their systems, sensors and other aspects of control.

Specific Unit Goals

This unit should enable students to:

A Course	T Course	M course
• analyse an electronic system based on the operations of its semiconductor components	• evaluate an electronic system based on the operations and limitations of its semiconductor components	• describe the operation of an electronic system
• design electronic or mechatronic systems	• design electronic or mechatronic systems	• build electronic or mechatronic systems

Content Descriptions

All knowledge, understanding and skills below must be delivered:

A course	T Course	M Course
Science Inquiry Skills		
• describe tools e.g. DMM, pliers, screwdrivers, Megger, testing and tagging equipment	• explain tools e.g. DMM, pliers, screwdrivers, Megger, testing and tagging equipment	• identify tools
• use of test equipment (analog meters, digital multimeter, oscilloscope, signal generator, `logic analyser, protocol analyser, emulators, debuggers, etc.)	• use of test equipment (analog meters, digital multimeter, oscilloscope, signal generator, `logic analyser, protocol analyser, emulators, debuggers, etc.)	• use of test equipment
• use integration and testing methodologies - component, sub-system, system; spiral development techniques	• design, integration, and testing methodologies - component, sub-system, system; spiral development techniques	• testing component, sub-system, system; spiral development techniques
• troubleshooting techniques	• troubleshooting techniques	• troubleshooting techniques

A course	T Course	M Course
• circuit development: simulation, prototyping and production e.g. breadboard, stripboard/veroboard, custom circuit boards, soldering skills	• circuit development: simulation, prototyping and production e.g. breadboard, stripboard/veroboard, custom circuit boards, soldering skills	• circuit development: simulation, prototyping and production e.g. breadboard, stripboard/veroboard, custom circuit boards, soldering skills
• safe work practices	• safe work practices	• safe work practices
• project work (design, build, program, test and evaluate a system appropriate to the unit)	• project work (design, build, program, test and evaluate a system appropriate to the unit)	• project work (design, build, program, test and evaluate a system appropriate to the unit)
• find and explain useful information in datasheets or technical specifications	• find and analyse useful information in datasheets or technical specifications	
• identify, research and construct questions for investigation and evaluation; examine prototypes; and predict possible outcomes	• research and construct questions for investigation and evaluation; design prototypes; and predict possible outcomes	• research a question for investigation
• design investigations, including the procedure/s to be followed, the materials required, and the type and amount of data to be collected and conduct risk assessments. This may include the design, construction and evaluation of a prototype	• design investigations, including the procedure/s to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics. This may include the design, construction and evaluation of a prototype	
• represent data in meaningful and useful ways, use evidence to make conclusions	• represent data in meaningful and useful ways, including the use of I-V graphs, waveform graphs, timing diagrams; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental, the nature of the procedure may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions	• represent data in meaningful and useful ways

A Course	T course	M Course
• interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments (	• interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments	• describe scientific and media texts
• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes	• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes	• communicate to an audience for a specific purpose using appropriate language
Science as a Human Endeavour		
explain the history of semiconductor devices	• analyse the history of semiconductor devices and their fabrication techniques	• describe the history of semiconductor devices
• explain ethical and legal issues	• analyse ethical and legal issues	
• engineering compromises and trade-offs between competing design goals e.g. strength vs weight vs cost	• engineering compromises and trade-offs between competing design goals e.g. strength vs weight vs cost	• engineering compromises and trade-offs between competing design goals e.g. strength vs weight
• the acceptance of scientific knowledge and the adoption of new technologies can be influenced by the social, economic and cultural context in which it is considered	• the acceptance of scientific knowledge and the adoption of new technologies can be influenced by the social, economic and cultural context in which it is considered	
• people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk (	• people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk	
	• science can be limited in its ability to provide definitive answers to public debate; there may be insufficient reliable data available, or interpretation of the data may be open to question	
	• international collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region	

A Course	T course	M Course
	• scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability	
Science understanding: Electronics elective		
• semiconductor materials, doping, the PN junction, biasing, diode characteristics – peak inverse voltage, forward voltage drops • diodes : rectifiers, LEDs, Zeners and their applications (e.g. diode bridges, voltage regulators, 7 segment displays) • transistors: structure/ symbols/cases, BJT and FET, switch and amplifier circuits, current gain, feedback loops, effect of coupling capacitor, phase inversion in amplification; voltage gain • SCR's and thyristors • integrated circuits- structure • operational amplifiers – basic characteristics and applications • linear power supplies – e.g. transformer, rectifier, filter, regulator (zeners and three pin regulators)	• semiconductor materials, valence bands, doping, the PN junction, biasing and barrier potentials, diode characteristics – peak inverse voltage, forward voltage drops • diodes : rectifiers, LEDs, Zeners and their applications (e.g. diode bridges, voltage regulators, 7 segment displays) • transistors: structure/ symbols/cases, BJT and FET, switch and amplifier circuits. current gain; offset, saturation, phase, feedback loops; effect of coupling capacitor values; phase inversion in amplification; voltage gain • SCR's and thyristors • integrated circuits- fabrication and structure • operational amplifiers – characteristics and applications • linear power supplies – e.g. transformer, rectifier, filter, regulator (zeners and three pin regulators)	• semiconductor materials • transistors • integrated circuits • operational amplifiers – applications
Science understanding: Mechatronics elective		
• explain the role of computer systems in vehicles with drivers e.g. cruise control, anti-lock brakes • describe important sensors in autonomous vehicles (e.g. accelerometers, gyroscopes, magnetometers, odometers)	• analyse the role of computer systems in vehicles with drivers e.g. cruise control, anti-lock brakes • analyse sensors in autonomous vehicles (e.g. accelerometers, gyroscopes, magnetometers, odometers, senor fusion)	• describe the role of computers in vehicles • identify sensors

A Course	T course	M Course
• autonomous vehicles	• autonomous vehicles, system integration and communication buses e.g. CAN, I2C	• autonomous vehicles
• control of vehicles: steering in ground vehicles, control surfaces in aircraft, thrust vectoring in rockets	• control of vehicles: steering in ground vehicles, control surfaces in aircraft, thrust vectoring in rockets	• control and steering
• active and passive stability	• active and passive stability, Control algorithms, for example the PID algorithm	
• GPS and navigation	• GPS and navigation	
	• manual, autonomous and semi-autonomous (fly-by-wire) systems	

A guide to reading and implementing content descriptions

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions. The lens which the teacher uses to demonstrate the content descriptions may be either guided through provision of electives within each unit or determined by the teacher when developing their program of learning.

A program of learning is what a college provides to implement the course for a subject. It is at the discretion of the teacher to emphasis some content descriptions over others. The teacher may teach additional (not listed) content provided that it meets the specific unit goals. This will be informed by the student needs and interests.

Assessment

Refer to pages 11-13.

Digital & Analog Interactions Value: 1.0

Digital & Analog Interactions Value: 0.5
Digital & Analog Interactions Value: 0.5

Unit Description:

The science understanding strand comprises of two alternate electives. For a standard 1.0 unit, students must study either the electronic or mechatronic strand . In the electronics elective, students will study the theory and application of digital electronics through a range of individual components and their uses in computer systems and analog interfaces. In the mechatronics elective, students will study the fundamentals of microcontrollers and their interactions with physical systems including I/O devices, programming and communications.

Specific Unit Goals

This unit should enable students to:

A Course	T Course	M course
• analyse an electronic system based on the operations of its digital components and its analog interfacing	• evaluate an electronic system based on the operations and limitations of its digital components and its analog interfacing	• describe the operation of a digital electronic system
• design electronic or mechatronic systems	• design electronic or mechatronic systems	• build electronic or mechatronic systems

Content Descriptions

All knowledge, understanding and skills below must be delivered:

A course	T Course	M Course
Science as a Human Endeavour		
• explain the history of digital systems and computers	• analyse the history of digital systems and computers	• describe the history of computers
• explain ethical and legal issues	• analyse ethical and legal issues	
• engineering compromises and trade-offs between competing design goals e.g. strength vs weight vs cost	• engineering compromises and trade-offs between competing design goals e.g. strength vs. weight vs cost	• engineering compromises and trade-offs between competing design goals e.g. strength vs weight
• the acceptance of scientific knowledge and the adoption of new technologies can be influenced by the social, economic and cultural context in which it is considered	• the acceptance of scientific knowledge and the adoption of new technologies can be influenced by the social, economic and cultural context in which it is considered	

A Course	T course	M Course
	• science can be limited in its ability to provide definitive answers to public debate; there may be insufficient reliable data available, or interpretation of the data may be open to question • international collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region • scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability	
Science Inquiry Skills		
• tools e.g. DMM, pliers, screwdrivers, Megger, testing and tagging equipment • use of test equipment (analog meters, digital multimeter, oscilloscope, signal generator, `logic analyser, protocol analyser, emulators, debuggers, etc) • design and testing methodologies - component, sub-system, system; spiral development techniques • troubleshooting techniques • circuit development: simulation, prototyping and production eg, breadboard, stripboard/veroboard, custom circuit boards, soldering skills • explain safe work practices • project work (build, program and test a system appropriate to the unit)	• tools e.g. DMM, pliers, screwdrivers, Megger, testing and tagging equipment • use of test equipment (analog meters, digital multimeter, oscilloscope, signal generator, `logic analyser, protocol analyser, emulators, debuggers, etc) • design, integration, and testing methodologies - component, sub-system, system; spiral development techniques • troubleshooting techniques • circuit development: simulation, prototyping and production eg, breadboard, stripboard/veroboard, custom circuit boards, soldering skills • evaluate safe work practices • project work (design, build, program, test and evaluate a system appropriate to the unit)	• tools • use of test equipment • design and testing • troubleshooting techniques • circuit development: simulation, prototyping and production eg, breadboard, stripboard/veroboard, custom circuit boards, soldering skills • describe safe work practices • project work (build a system appropriate to the unit)

A Course	T course	M Course
• find useful information in datasheets or technical specifications	• find useful information in datasheets or technical specifications	
• investigations, including the procedure/s to be followed, the materials required, and the type and amount of data to be collected and conduct risk assessments. This may include the design, construction and evaluation of a prototype	• design investigations, including the procedure/s to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics. This may include the design, construction and evaluation of a prototype	
• represent data in meaningful and useful ways, use evidence to make conclusions	• represent data in meaningful and useful ways, including the use of I-V graphs, waveform graphs, timing diagrams; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental, the nature of the procedure may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions	• represent data in meaningful and useful ways
• interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments	• interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments	• describe scientific and media texts
• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes	• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes	• communicate to an audience for a specific purpose using appropriate language

A Course	T course	M Course
Science understanding: Electronics elective		
• number systems – base 2, base 10 (	• number systems – base 2, base 10	• number systems – base 2, base 10
• symbols, pin layout of IC, boolean expression and truth tables for AND, OR, NOT, NAND, NOR, XOR gates (	• symbols, pin layout of IC, boolean expression and truth tables for AND, OR, NOT, NAND, NOR, XOR gates	• AND, OR, NOT
• combinational circuits using basic gates e.g. half and full adder, encoders – decoders	• combinational circuits using basic gates e.g. half and full adder, encoders – decoders	• simple logic circuits
	• introduction to minimisation techniques e.g. Demorgan's theorem and Karnaugh map	
• sequential logic e.g. flip-flops, registers, counters; Schmitt triggers, saw tooth generator; sine/square converters; multivibrators; RS and D type flip-flops; D/A and A/D converters; oscillators; timers (555)	• sequential logic e.g. flip-flops, registers, counters; Schmitt triggers, saw tooth generator; sine/square converters; multivibrators; RS and D type flip-flops; D/A and A/D converters; oscillators; timers (555)	
• basic system parts e.g. (CPU, buses, ports, clock); memory systems, RAM, ROM, DRAM, EPROM, CD-ROM, memory sticks etc; storage types and capacities; data protection, peripherals, display devices; types of computer systems; evaluation Stamps	• system parts e.g. (CPU, buses, ports, clock); memory systems, RAM, ROM, DRAM, EPROM, CD-ROM, memory sticks etc; storage types and capacities; data protection, peripherals, display devices; types of computer systems; evaluation Stamps	

A Course	T course	M Course
Science understanding: Mechatronics elective		
• microcontroller inputs and outputs	• microcontroller inputs and outputs • microcontroller types (e.g. PIC, AVR, ARM etc. 8 bit, 32 bit etc)	• microcontroller inputs and outputs
• input systems e.g., touch, temperature, light, acceleration, rotation, image processing	• input systems e.g., touch, temperature, light, acceleration, rotation, image processing	• input systems
• output systems e.g. motors, solenoids, relays, lights, sound, hydraulics	• output systems e.g. motors, solenoids, relays, lights, sound, hydraulics	• output systems
• switching high current or high voltage components with transistors, h-bridges or relays	• switching high current or high voltage components with transistors, h-bridges or relays	
• use of a graphical or text-based programming language (e.g. accessing digital and analog inputs and outputs, conditionals, loops)	• use of a graphical or text-based programming language (e.g. accessing digital and analog inputs and outputs, conditionals, loops) • digital concepts: clocking, edges, Logic voltage levels for either TTL or CMOS	
• analog concepts: A/D conversion, Pulse width modulation as duty cycle	• analog concepts: A/D conversion, Pulse width modulation as duty cycle	
• communication between chips: e.g.Pulse width modulation, analog voltages, serial communication(e.g. UART, I2C, SPI, IEEE802.x, USB, etc)	• communication between chips: e.g. Pulse width modulation, analog voltages, serial communication(e.g. UART, I2C, SPI, IEEE802.x, USB, etc) • application of microcontrollers to the control of physical systems	

A guide to reading and implementing content descriptions

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions. The lens which the teacher uses to demonstrate the content descriptions may be either guided through provision of electives within each unit or determined by the teacher when developing their program of learning.

A program of learning is what a college provides to implement the course for a subject. It is at the discretion of the teacher to emphasis some content descriptions over others. The teacher may teach additional (not listed) content provided that it meets the specific unit goals. This will be informed by the student needs and interests.

Assessment

Refer to pages 11-13.

AC & Advanced Applications Value: 1.0

AC & Advanced Applications a **Value: 0.5**
AC & Advanced Applications b **Value: 0.5**

Unit Description:

The science understanding strand comprises of two alternate electives. For a standard 1.0 unit, students must study either the electronic or mechatronic strand. In the electronic elective, students will study electromagnetism in its application to a range of devices and in the generation and use of alternating current. In the mechatronics elective, students will study advanced microcontroller systems, programming and techniques.

Unit Goals

This unit should enable students to:

A Course	T Course	M course
• analyse an electronic system based on the operations of its electromagnetic and AC components	• evaluate an electronic system based on the operations and limitations of its electromagnetic and AC components	• describe the operation of an electromagnetic/AC system
• design electronic or mechatronic systems	• design electronic or mechatronic systems	• build electronic or mechatronic systems

Content Descriptions

All knowledge, understanding and skills below must be delivered:

A course	T Course	M Course
Science as a Human Endeavour		
• explain history of electromagnetism	• analyse history of electromagnetism	• describe history of electromagnetism
• explain ethical and legal issues	• analyse ethical and legal issues	
• engineering compromises and trade-offs between competing design goals e.g. strength vs weight vs cost	• engineering compromises and trade-offs between competing design goals e.g. strength vs weight vs cost	• engineering compromises and trade-offs between competing design goals e.g. strength vs weight
• acceptance of scientific knowledge and the adoption of new technologies can be influenced by the social, economic and cultural context in which it is considered	• acceptance of scientific knowledge and the adoption of new technologies can be influenced by the social, economic and cultural context in which it is considered	

A Course	T course	M Course
• people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk	• people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk • science can be limited in its ability to provide definitive answers to public debate; there may be insufficient reliable data available, or interpretation of the data may be open to question • international collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region • scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability	
Science Inquiry Skills		
• use tools e.g. DMM, pliers, screwdrivers, megger, testing and tagging equipment • use of test equipment (analog meters, digital multimeter, oscilloscope, signal generator, `logic analyser, protocol analyser, emulators, debuggers, etc.) • testing methodologies - component, sub-system, system; spiral development techniques • troubleshooting techniques • circuit development: simulation, prototyping and production e.g. breadboard, stripboard/veroboard, custom circuit boards, soldering skills • safe work practices	• use tools e.g. DMM, pliers, screwdrivers, megger, testing and tagging equipment • use of test equipment (analog meters, digital multimeter, oscilloscope, signal generator, `logic analyser, protocol analyser, emulators, debuggers, etc.) • design, integration, and testing methodologies - component, sub-system, system; spiral development techniques • troubleshooting techniques • circuit development: simulation, prototyping and production e.g. breadboard, stripboard/veroboard, custom circuit boards, soldering skills • safe work practices	• use basic tools • use of test equipment • testing methodologies • troubleshooting techniques • circuit development: simulation, prototyping and production e.g. breadboard, stripboard/veroboard, custom circuit boards, soldering skills • safe work practices

A Course	T course	M Course
• project work (design, build, program, test and evaluate a system appropriate to the unit)	• project work (design, build, program, test and evaluate a system appropriate to the unit)	• project work (design, build, program, test and evaluate a system appropriate to the unit)
• find useful information in datasheets or technical specifications	• find useful information in datasheets or technical specifications	
• identify, research and construct questions for investigation and evaluation; design prototypes; and predict possible outcomes	• identify, research and construct questions for investigation and evaluation; design prototypes; and predict possible outcomes (	• research a question for investigation
• design investigations, including the procedure/s to be followed, the materials required, and the type and amount of data to be collected and conduct risk assessments. This may include the design, construction and evaluation of a prototype.	• design investigations, including the procedure/s to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics. This may include the design, construction and evaluation of a prototype.	
• represent data in meaningful and useful ways, use evidence to make conclusions	• represent data in meaningful and useful ways, including the use of I-V graphs, waveform graphs, timing diagrams; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental, the nature of the procedure may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions	• represent data in meaningful and useful ways
• interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments	• interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments	• describe scientific and media texts
• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes	• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes	• communicate to an audience for a specific purpose using appropriate language

A Course	T course	M Course
Science understanding – Electronics elective		
• magnetism – dipoles, domains, field, laws	• magnetism – dipoles, domains, field, laws	
• electromagnetism – qualitative understanding especially induced emf, Electromagnetic induction (including Faraday for SHE) and the alternator	• electromagnetism – qualitative understanding especially induced emf, Electromagnetic induction (including Faraday for SHE) and the alternator	• electromagnetism
• applications – relays, motors, generators, loudspeakers, microphones, transformers, induction coil, meters	• applications – relays, motors, generators, loudspeakers, microphones, transformers, induction coil, meters	• applications
• alternating current and its characteristics: frequency, period, voltage (VP-P, VP, VRMS), current, Ohm's law, phase, power	• alternating current and its characteristics: frequency, period, voltage (VP-P, VP, VRMS), current, Ohm's law, phase, power	• alternating current
	• reactive components – capacitors and inductors, RC and LC circuits, reactance and impedance, audio systems	
• electricity distribution: turbines, generators, transformers, transmission lines, pylons and Nikola Tesla. power-energy unit -kilowatt-hour, tariffs	• electricity distribution: turbines, generators, transformers, transmission lines, pylons and Nikola Tesla. power-energy unit -kilowatt-hour, tariffs	
	• radio and TV: AM and FM; demodulation; modulating a transmitter, resonant circuits; aerials	
Science understanding – Mechatronics elective		
• digital concepts (e.g. thresholds, ports)	• advanced digital concepts (e.g. thresholds, ports)	• digital concepts
• analog concepts (pre-amplification, noise filtering, resolution, digital audio)	• advanced analog concepts (pre-amplification, noise filtering, resolution, digital audio)	• analog concepts
• interface buses in more detail e.g. dedicated peripherals vs bitbanging; MSB first vs LSB first; parity bits; other protocols not covered in unit 3. Controlling external subsystems such as complex sensors	• interface buses in more detail e.g. dedicated peripherals vs bitbanging; MSB first vs LSB first; parity bits; other protocols not covered in unit 3. Controlling external subsystems such as complex sensors	• Interface buses

A Course	T course	M Course
• use of a text-based programming language	• more advanced use of a text-based programming language (e.g. writing functions, efficient code to optimise clock cycles and/or ROM and/or RAM usage)	• use of a text-based or graphical programming language
• Feedback and Closed Loop Systems - input information used to control outputs	• advanced microcontroller techniques: e.g. Interrupts, Registers, direct port manipulation, assembly commands	• Feedback and Closed Loop Systems
• open loop control	• alternatives to microcontrollers (Embedded systems with an operating system , programmable logic, FPGAs, PSOC, ASIC etc)	• open loop control

Electives

In all units, Science Understandings has an electronics or mechatronics strand. Each of these two electives has its own content descriptions.

For a standard 1.0 and half standard 0.5 units, a student is required to study one elective.

A guide to reading and implementing content descriptions

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions. The lens which the teacher uses to demonstrate the content descriptions may be either guided through provision of electives within each unit or determined by the teacher when developing their program of learning.

A program of learning is what a college provides to implement the course for a subject. It is at the discretion of the teacher to emphasis some content descriptions over others. The teacher may teach additional (not listed) content provided that it meets the specific unit goals. This will be informed by the

Assessment

Refer to pages 11-13.

Independent Study — Value: 1.0

Independent Study a — **Value: 0.5**
Independent Study b — **Value: 0.5**

Prerequisites

Students must have studied at least **THREE** standard 1.0 units from this course. A student can only study a maximum of one Independent Study unit in each course. An Independent Study unit requires the principal's written approval. Independent Study units are only available to individual students in Year 12. Principal approval is also required for a student in Year 12 to enrol concurrently in an Independent unit and the third 1.0 unit in a course of study.

Unit Description

In this unit, students apply and extend their understanding from previous units to a substantial project.

An Independent Study unit has an important place in senior secondary courses. It is a valuable pedagogical approach that empowers students to make decisions about their own learning. An Independent Study unit can be proposed by an individual student for their own independent study and negotiated with their teacher. The program of learning for an Independent Study unit must meet the unit goals and content descriptions as they appear in the course.

Unit Goals

This unit should enable students to:

A Course	T Course	M course
• design and build a prototype of an electronic or mechatronic system	• design and build a prototype of an electronic or mechatronic system	• build an electronic or mechatronic system
• analyse the operation of the prototype and evaluate its effectiveness	• analyse the operation of the prototype and evaluate its effectiveness	• investigate the operation of the system

Content Descriptions

All knowledge, understanding and skills below must be delivered:

A course	T Course	M Course
Science as a Human Endeavour		
• ethical and legal issues	• ethical and legal issues	
• engineering compromises and trade-offs between competing design goals e.g. strength vs weight vs cost	• engineering compromises and trade-offs between competing design goals e.g. strength vs weight vs cost	• engineering compromises and trade-offs between competing design goals e.g. strength vs weight
• the acceptance of scientific knowledge and the adoption of new technologies can be influenced by the social, economic and cultural context in which it is considered	• the acceptance of scientific knowledge and the adoption of new technologies can be influenced by the social, economic and cultural context in which it is considered	

A Course	T course	M Course
• people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk	• people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk • international collaboration is often required when investing in large-scale science projects or addressing issues for the Asia-Pacific region • scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability	
Science Inquiry Skills		
• tools e.g. DMM, pliers, screwdrivers, Megger, testing and tagging equipment	• tools e.g. DMM, pliers, screwdrivers, Megger, testing and tagging equipment	• tools
• use of test equipment (analog meters, digital multimeter, oscilloscope, signal generator, `logic analyser, protocol analyser, emulators, debuggers, etc)	• use of test equipment (analog meters, digital multimeter, oscilloscope, signal generator, `logic analyser, protocol analyser, emulators, debuggers, etc)	• use of test equipment
• design, integration, and testing methodologies - component, sub-system, system; spiral development techniques	• design, integration, and testing methodologies - component, sub-system, system; spiral development techniques	• design and testing
• troubleshooting techniques	• troubleshooting techniques	• troubleshooting techniques
• circuit development: simulation, prototyping and production e.g. breadboard, stripboard/veroboard, custom circuit boards, soldering skills	• circuit development: simulation, prototyping and production e.g. breadboard, stripboard/veroboard, custom circuit boards, soldering skills	• circuit development: simulation, prototyping and production e.g. breadboard, stripboard/veroboard, custom circuit boards, soldering skills
• safe work practices	• safe work practices	• safe work practices
• project work (design, build, program, test and evaluate a system appropriate to the unit)	• project work (design, build, program, test and evaluate a system appropriate to the unit)	• project work (design, build, program, test and evaluate a system appropriate to the unit)
• find useful information in datasheets or technical specifications (	• find useful information in datasheets or technical specifications	
• identify, research and construct questions for investigation and evaluation; design prototypes; and predict possible outcomes	• identify, research and construct questions for investigation and evaluation; design prototypes; and predict possible outcomes	• research a question for investigation

A course	T Course	M Course
• design investigations, including the procedure/s to be followed, the materials required, and the type and amount of data to be collected and conduct risk assessments. This may include the design, construction and evaluation of a prototype.	• design investigations, including the procedure/s to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics. This may include the design, construction and evaluation of a prototype.	
• represent data in meaningful and useful ways, use evidence to make conclusions	• represent data in meaningful and useful ways, including the use of I-V graphs, waveform graphs, timing diagrams; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental, the nature of the procedure may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions	• represent data in meaningful and useful ways
• interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments	• interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments	• describe scientific and media texts
• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes	• communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes	• communicate to an audience for a specific purpose using appropriate language
Science understanding		
	• demonstrates knowledge and understanding of electronics or mechatronics concepts • applies electronics or mechatronics concepts to new situations • evaluate prototypes and design improvements	

A guide to reading and implementing content descriptions

Content descriptions specify the knowledge, understanding and skills that students are expected to learn and that teachers are expected to teach. Teachers are required to develop a program of learning that allows students to demonstrate all the content descriptions. The lens which the teacher uses to demonstrate the content descriptions may be either guided through provision of electives within each unit or determined by the teacher when developing their program of learning.

A program of learning is what a college provides to implement the course for a subject. It is at the discretion of the teacher to emphasis some content descriptions over others. The teacher may teach additional (not listed) content provided that it meets the specific unit goals. This will be informed by the student needs and interests.

Electives

In all units, Science Understandings has an electronics or mechatronics strand. Each of these two electives has its own content descriptions.

Assessment

Refer to pages 11-13.

Appendix A – Implementation Guidelines

Available course patterns

A standard 1.0 value unit is delivered over at least 55 hours. To be awarded a course, students must complete at least the minimum units over the whole minor, major, major/minor or double major course.

Course	Number of standard units to meet course requirements
Minor	Minimum of 2 units
Major	Minimum of 3.5 units

Units in this course can be delivered in any order.

Prerequisites for the course or units within the course

For the Independent Study unit (if applicable), students must have studied a minimum of **THREE** standard 1.0 units from this course. An independent study unit requires the principal's written approval and is only available to individual students in Year 12.

Arrangements for students continuing study in this course

Students who studied the previous course may undertake any units in this course provided there is no duplication of content.

Duplication of Content Rules

Students cannot be given credit towards the requirements for a Senior Secondary Certificate for a unit that significantly duplicates content in a unit studied in another course. The responsibility for preventing undesirable overlap of content studied by a student rests with the principal and the teacher delivering the course. Students will only be given credit for covering the content once.

Guidelines for Delivery

Program of Learning

A program of learning is what a school provides to implement the course for a subject. This meets the requirements for context, scope and sequence set out in the Board endorsed course. Students follow programs of learning in a college as part of their senior secondary studies. The detail, design and layout of a program of learning are a college decision.

The program of learning must be documented to show the planned learning activities and experiences that meet the needs of particular groups of students, taking into account their interests, prior knowledge, abilities and backgrounds. The program of learning is a record of the learning experiences that enable students to achieve the knowledge, understanding and skills of the content descriptions. There is no requirement to submit a program of learning to the OBSSS for approval. The Principal will need to sign off at the end of Year 12 that courses have been delivered as accredited.

Content Descriptions

Are all content descriptions of equal importance? No. It depends on the focus of study. Teachers can customise their program of learning to meet their own students' needs, adding additional content descriptions if desired or emphasising some over others. A teacher must balance student needs with their responsibility to teach all content descriptions. It is mandatory that teachers address all content descriptions and that students engage with all content descriptions.

Half standard 0.5 units

Half standard units appear on the course adoption form but are not explicitly documented in courses. It is at the discretion of the college principal to split a standard 1.0 unit into two half standard 0.5 units. Colleges are required to adopt the half standard 0.5 units. However, colleges are not required to submit explicit documentation outlining their half standard 0.5 units to the BSSS. Colleges must assess students using the half standard 0.5 assessment task weightings outlined in the framework. It is the responsibility of the college principal to ensure that all content is delivered in units approved by the Board.

Moderation

Moderation is a system designed and implemented to:

- provide comparability in the system of school-based assessment
- form the basis for valid and reliable assessment in senior secondary schools
- involve the ACT Board of Senior Secondary Studies and colleges in cooperation and partnership
- maintain the quality of school-based assessment and the credibility, validity and acceptability of Board certificates.

Moderation commences within individual colleges. Teachers develop assessment programs and instruments, apply assessment criteria, and allocate Unit Grades, according to the relevant Course Framework. Teachers within course teaching groups conduct consensus discussions to moderate marking or grading of individual assessment instruments and unit grade decisions.

The Moderation Model

Moderation within the ACT encompasses structured, consensus-based peer review of Unit Grades for all accredited courses over two Moderation Days. In addition to Moderation Days, there is statistical moderation of course scores, including small group procedures, for T courses.

Moderation by Structured, Consensus-based Peer Review

Consensus-based peer review involves the review of student work against system wide criteria and standards and the validation of Unit Grades. This is done by matching student performance with the criteria and standards outlined in the Achievement Standards, as stated in the Framework. Advice is then given to colleges to assist teachers with, or confirm, their judgments. In addition, feedback is given on the construction of assessment instruments.

Preparation for Structured, Consensus-based Peer Review

Each year, teachers of Year 11 are asked to retain originals or copies of student work completed in Semester 2. Similarly, teachers of a Year 12 class should retain originals or copies of student work completed in Semester 1. Assessment and other documentation required by the Office of the Board of Senior Secondary Studies should also be kept. Year 11 work from Semester 2 of the previous year is presented for review at Moderation Day 1 in March, and Year 12 work from Semester 1 is presented for review at Moderation Day 2 in August.

In the lead up to Moderation Day, a College Course Presentation (comprised of a document folder and a set of student portfolios) is prepared for each A, T and M course/units offered by the school and is sent into the Office of the Board of Senior Secondary Studies.

The College Course Presentation

The package of materials (College Course Presentation) presented by a college for review on Moderation Days in each course area will comprise the following:

- a folder containing supporting documentation as requested by the Office of the Board through memoranda to colleges, including marking schemes and rubrics for each assessment item
- a set of student portfolios containing marked and/or graded written and non-written assessment responses and completed criteria and standards feedback forms. Evidence of all assessment responses on which the Unit Grade decision has been made is to be included in the student review portfolios.

Specific requirements for subject areas and types of evidence to be presented for each Moderation Day will be outlined by the Board Secretariat through the *Requirements for Moderation Memoranda* and Information Papers.

Visual evidence for judgements made about practical performances

It is a requirement that schools’ judgements of standards to practical performances (A/T/M) be supported by visual evidence (still photos or video).

The photographic evidence submitted must be drawn from practical skills performed as part of the assessment process.

Teachers should consult the BSSS website for current information regarding all moderation requirements including subject specific and photographic evidence.

Appendix B – Course Developers

Name	**College**
Conan O'Brien	Gungahlin College
Insia Mustansir	Lake Tuggeranong College
David Stewart	Trinity Christian School

Appendix C – Common Curriculum Elements

Common curriculum elements assist in the development of high-quality assessment tasks by encouraging breadth and depth and discrimination in levels of achievement.

Organisers	Elements	Examples
create, compose and apply	apply	ideas and procedures in unfamiliar situations, content and processes in non-routine settings
	compose	oral, written and multimodal texts, music, visual images, responses to complex topics, new outcomes
	represent	images, symbols or signs
	create	creative thinking to identify areas for change, growth and innovation, recognise opportunities, experiment to achieve innovative solutions, construct objects, imagine alternatives
	manipulate	images, text, data, points of view
analyse, synthesise and evaluate	justify	arguments, points of view, phenomena, choices
	hypothesise	statement/theory that can be tested by data
	extrapolate	trends, cause/effect, impact of a decision
	predict	data, trends, inferences
	evaluate	text, images, points of view, solutions, phenomenon, graphics
	test	validity of assumptions, ideas, procedures, strategies
	argue	trends, cause/effect, strengths and weaknesses
	reflect	on strengths and weaknesses
	synthesise	data and knowledge, points of view from several sources
	analyse	text, images, graphs, data, points of view
	examine	data, visual images, arguments, points of view
	investigate	issues, problems
organise, sequence and explain	sequence	text, data, relationships, arguments, patterns
	visualise	trends, futures, patterns, cause and effect
	compare/contrast	data, visual images, arguments, points of view
	discuss	issues, data, relationships, choices/options
	interpret	symbols, text, images, graphs
	explain	explicit/implicit assumptions, bias, themes/arguments, cause/effect, strengths/weaknesses
	translate	data, visual images, arguments, points of view
	assess	probabilities, choices/options
	select	main points, words, ideas in text
identify, summarise and plan	reproduce	information, data, words, images, graphics
	respond	data, visual images, arguments, points of view
	relate	events, processes, situations
	demonstrate	probabilities, choices/options
	describe	data, visual images, arguments, points of view
	plan	strategies, ideas in text, arguments
	classify	information, data, words, images
	identify	spatial relationships, patterns, interrelationships
	summarise	main points, words, ideas in text, review, draft and edit

Appendix D – Glossary of Verbs

Verbs	Definition
Analyse	Consider in detail for the purpose of finding meaning or relationships, and identifying patterns, similarities and differences
Apply	Use, utilise or employ in a particular situation
Argue	Give reasons for or against something
Assess	Make a Judgement about the value of
Classify	Arrange into named categories in order to sort, group or identify
Compare	Estimate, measure or note how things are similar or dissimilar
Compose	The activity that occurs when students produce written, spoken, or visual texts
Contrast	Compare in such a way as to emphasise differences
Create	Bring into existence, to originate
Demonstrate	Give a practical exhibition an explanation
Describe	Give an account of characteristics or features
Discuss	Talk or write about a topic, taking into account different issues or ideas
Evaluate	Examine and judge the merit or significance of something
Examine	Determine the nature or condition of
Explain	Provide additional information that demonstrates understanding of reasoning and /or application
Extrapolate	Infer from what is known
Hypothesise	Put forward a supposition or conjecture to account for certain facts and used as a basis for further investigation by which it may be proved or disproved
Identify	Recognise and name
Interpret	Draw meaning from
Investigate	Planning, inquiry into and drawing conclusions about
Justify	Show how argument or conclusion is right or reasonable
Manipulate	Adapt or change
Plan	Strategize, develop a series of steps, processes
Predict	Suggest what might happen in the future or as a consequence of something
Reflect	The thought process by which students develop an understanding and appreciation of their own learning. This process draws on both cognitive and affective experience
Relate	Tell or report about happenings, events or circumstances
Represent	Use words, images, symbols or signs to convey meaning
Reproduce	Copy or make close imitation
Respond	React to a person or text
Select	Choose in preference to another or others
Sequence	Arrange in order
Summarise	Give a brief statement of the main points
Synthesise	Combine elements (information/ideas/components) into a coherent whole
Test	Examine qualities or abilities
Translate	Express in another language or form, or in simpler terms
Visualise	The ability to decode, interpret, create, question, challenge and evaluate texts that communicate with visual images as well as, or rather than, words

Appendix E – Glossary for ACT Senior Secondary Curriculum

Courses will detail what teachers are expected to teach and students are expected to learn for year 11 and 12. They will describe the knowledge, understanding and skills that students will be expected to develop for each learning area across the years of schooling.

Learning areas are broad areas of the curriculum, including English, mathematics, science, the arts, languages, health and physical education.

A **subject** is a discrete area of study that is part of a learning area. There may be one or more subjects in a single learning area.

Frameworks are system documents for Years 11 and 12 which provide the basis for the development and accreditation of any course within a designated learning area. In addition, frameworks provide a common basis for assessment, moderation and reporting of student outcomes in courses based on the framework.

The **course** sets out the requirements for the implementation of a subject. Key elements of a course include the rationale, goals, content descriptions, assessment, and achievement standards as designated by the framework.

BSSS courses will be organised into units. A unit is a distinct focus of study within a course. A standard 1.0 unit is delivered for a minimum of 55 hours generally over one semester.

Core units are foundational units that provide students with the breadth of the subject.

Additional units are avenues of learning that cannot be provided for within the four core 1.0 standard units by an adjustment to the program of learning.

An **independent study unit** is a pedagogical approach that empowers students to make decisions about their own learning. Independent study units can be proposed by a student and negotiated with their teacher, but must meet the specific unit goals and content descriptions as they appear in the course.

An **elective** is a lens for demonstrating the content descriptions within a standard 1.0 or half standard 0.5 unit.

A **lens** is a particular focus or viewpoint within a broader study.

Content descriptions refer to the subject-based knowledge, understanding and skills to be taught and learned.

A **program of learning** is what a college develops to implement the course for a subject and to ensure that the content descriptions are taught and learned.

Achievement standards provide an indication of typical performance at five different levels (corresponding to grades A to E) following completion of study of senior secondary course content for units in a subject.

ACT senior secondary system **curriculum** comprises all BSSS approved courses of study.

Appendix F – Course Adoption

Condition of Adoption

This course and units are consistent with the philosophy and goals of the college and as an adopting college have the human and physical resources to implement the course.

Adoption Process

Course adoption must be initiated electronically by an email from the principal or their nominated delegate to bssscertification@ed.act.edu.au. A nominated delegate must CC the principal.

The email will include the **Conditions of Adoption** statement above, and the table below adding the **College** name, **Course** title, **A** and/or **T** and/or **M** and/or **V** to the **Classification/s** section of the table, and the relevant **Framework**.

College:				
Course Title:	**Electronics & Mechatronics**			
Classification/s:	**A**	**T**	**M**	
Framework:	Science 2020			
Dates of Course Accreditation:	**from**	2017	**to**	2022