Aerospace Systems 2019 v1.1

General Senior Syllabus

This syllabus is for implementation with Year 11 students in 2019.

Queensland Government | Queensland Curriculum & Assessment Authority

For all Queensland schools

170146

Contents

1 Course overview

1.1 Introduction

1.1.1 Rationale

Technologies have been an integral part of society for as long as humans have had the desire to create solutions to improve their own and others' quality of life. Technologies have an impact on people and societies by transforming, restoring and sustaining the world in which we live.

Australia needs enterprising and innovative individuals with the ability to make discerning decisions concerning the development, use and impact of technologies. When developing technologies, these individuals need to be able to work independently and collaboratively to solve complex, open-ended problems. Subjects in the Technologies learning area prepare students to be effective problem-solvers as they learn about and work with contemporary and emerging technologies.

Students who study Aerospace Systems learn about the fundamentals, history and future of the aerospace industry. They gain knowledge of aeronautics, aerospace operations, human factors, safety management and systems thinking that enable them to solve real-world aerospace problems using the problem-solving process in Aerospace Systems.

In this subject, students use systems thinking habits, systems thinking strategies, and aerospace technology knowledge, concepts and principles to explore problems and develop solutions. Students learn to understand and interpret the relationships between and within connected systems and their component parts. They identify patterns in problematic aerospace systems situations and make proposals concerning solutions. This learnt ability provides students with the higher order cognitive capacity to engage with problems that exist in an exciting and dynamic technological world. Students develop and use skills that include analysis, decision-making, justification, recognition, comprehension and evaluation to develop solutions to aerospace problem situations. Students become self-directed learners and develop beneficial collaboration and management skills as they solve aerospace systems problems.

Students learn transferrable 21st century skills that support their life aspirations, including critical thinking, creative thinking, communication, collaboration and teamwork, personal and social skills, and information & communication technologies (ICT) skills. Students become adaptable and resilient through their problem-solving learning experiences, improving their ability to interpret events, analyse situations and comprehend cause-and-effect relationships. Through their study of Aerospace Systems, students appreciate that short-term fixes may have long-term implications. Students recognise the complexity of global, national and local community problem situations and understand the challenges faced in generating sustainable and durable solutions.

Assumed knowledge, prior learning or experience

Students will have prior knowledge of the Australian Curriculum: Technologies in Years 7 and 8. Similarly, students will have studied the Australian Curriculum: Mathematics and the Australian Curriculum: Science in Years 9 and 10. The areas of study and subject matter draw on aerospace, science, technology, engineering and mathematics knowledge.

Pathways

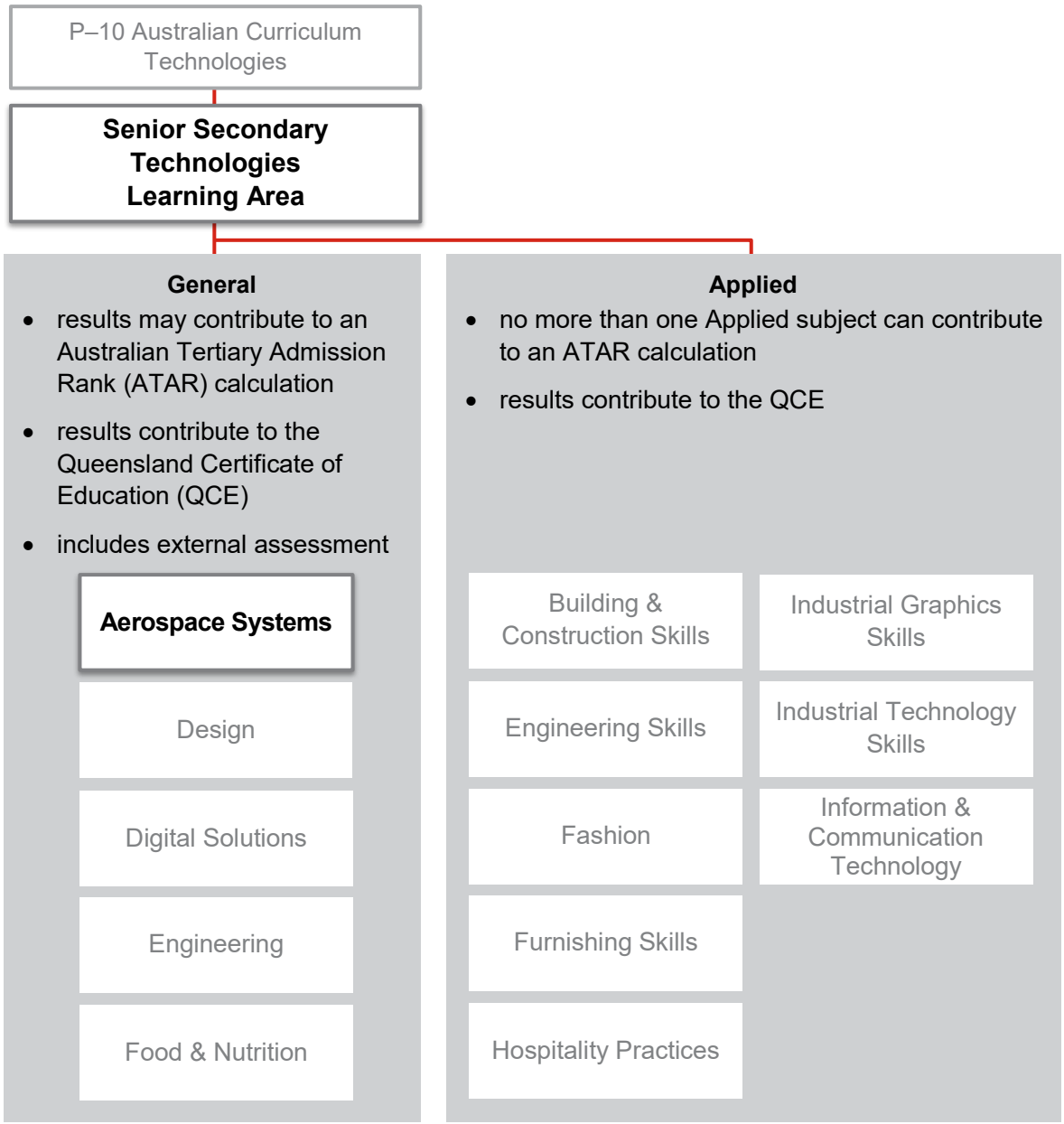
Aerospace Systems is a General subject suited to students who are interested in pathways beyond school that lead to tertiary studies, vocational education or work. A course of study in Aerospace Systems can establish a basis for further education and employment in the fields of

aviation management, flying streams, engineering and aerospace technical disciplines. The study of Aerospace Systems will also benefit students wishing to pursue post-school pathways in diploma and advanced diploma courses in the technical and paraprofessional areas of customer relationship management, workplace health and safety, engineering, human resource management, systems analysis and technology-related areas.

1.1.2 Learning area structure

All learning areas build on the P–10 Australian Curriculum.

Figure 1: Learning area structure



1.1.3 Course structure

Aerospace Systems is a course of study consisting of four units. Subject matter, learning experiences and assessment increase in complexity from Units 1 and 2 to Units 3 and 4 as students develop greater independence as learners.

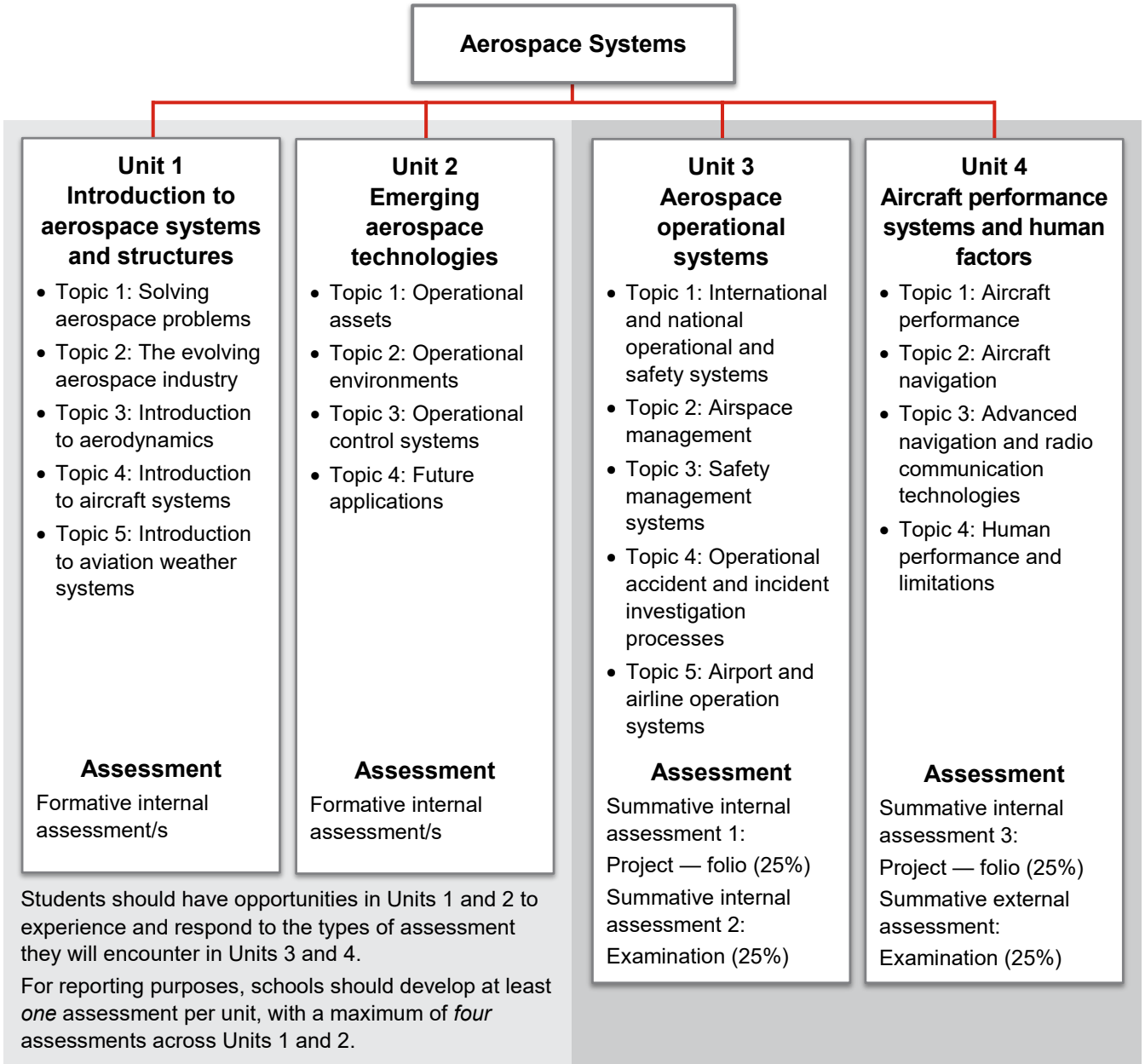
Units 1 and 2 provide foundational learning, which allows students to experience all syllabus objectives and begin engaging with the subject matter. Students should complete Units 1 and 2 before beginning Unit 3. It is recommended that Unit 3 be completed before Unit 4.

Units 3 and 4 consolidate student learning. Only the results from Units 3 and 4 will contribute to ATAR calculations.

Figure 2 outlines the structure of this course of study.

Each unit has been developed with a notional time of 55 hours of teaching and learning, including assessment.

Figure 2: Course structure



1.2 Teaching and learning

1.2.1 Syllabus objectives

The syllabus objectives outline what students have the opportunity to learn. Assessment provides evidence of how well students have achieved the objectives.

Syllabus objectives inform unit objectives, which are contextualised for the subject matter and requirements of the unit. Unit objectives, in turn, inform the assessment objectives, which are further contextualised for the requirements of the assessment instruments. The number of each objective remains constant at all levels, i.e. Syllabus objective 1 relates to Unit objective 1 and to Assessment objective 1 in each assessment instrument.

Syllabus objectives are described in terms of actions that operate on the subject matter. Students are required to use a range of cognitive processes in order to demonstrate and meet the syllabus objectives. These cognitive processes are described in the explanatory paragraph following each objective in terms of four levels: retrieval, comprehension, analytical processes (analysis), and knowledge utilisation, with each process building on the previous processes (see Marzano & Kendall 2007, 2008). That is, comprehension requires retrieval, and knowledge utilisation requires retrieval, comprehension and analytical processes (analysis).

By the conclusion of the course of study, students will:

Syllabus objective	Unit 1	Unit 2	Unit 3	Unit 4
1. recognise and describe aerospace systems problems, knowledge, concepts and principles	•	•	•	•
2. symbolise and explain ideas, solutions and relationships	•	•	•	•
3. analyse problems and information	•	•	•	•
4. determine solution success criteria for aerospace problems	•	•	•	•
5. synthesise information and ideas to propose possible solutions	•	•	•	•
6. generate solutions to provide data to assess the feasibility of proposals	•	•	•	•
7. evaluate and refine ideas and solutions to make justified recommendations	•	•	•	•
8. make decisions about and use mode-appropriate features, language and conventions for particular purposes and contexts	•	•	•	•

1. recognise and describe aerospace systems problems, knowledge, concepts and principles

When students recognise aerospace systems problems, knowledge, concepts and principles they identify or recall related aerospace technology knowledge, including mathematic calculations and scientific concepts and principles to acknowledge the characteristics of problems, the areas of possible weakness and the relationships between systems, subsystems and system components. Students describe by giving an account of the characteristics or features of problems, knowledge, concepts and principles.

2. **symbolise and explain ideas, solutions and relationships**

   When students symbolise, they represent idea and solution development, and relationships using visual frameworks, causal loop diagrams, flow charts, diagrams, sketches and pictures. When students explain, they use knowledge, understanding and reasoning to make ideas, solutions and the relationships between aerospace systems and system components plain or clear by describing them in more detail or revealing relevant facts.

3. **analyse problems and information**

   When students analyse problems and information, they research and investigate to explain and interpret, for the purpose of finding meaning or relationships. They determine the reasonableness of information and ascertain patterns, similarities and differences in order to identify elements, components and features, and their relationship to the structure of problems.

4. **determine solution success criteria for aerospace problems**

   When students determine solution success criteria for aerospace problems, they establish, conclude or ascertain solution requirements after consideration of elements, components and features, and their relationship to the structure of problems.

5. **synthesise information and ideas to propose possible solutions**

   When students synthesise information and ideas to propose possible solutions, they combine and integrate information and ideas and resolve uncertainties using knowledge gained through investigation, collaboration and testing to create new understanding.

6. **generate solutions to provide data to assess the feasibility of proposals**

   When students generate solutions, they produce or simulate a solution that, when tested, provides data to assess the proposal's capability to be reasonably achieved.

7. **evaluate and refine ideas and solutions to make justified recommendations**

   When students evaluate, they appraise ideas and solutions by weighing up or assessing strengths, implications and limitations against success criteria. When students refine ideas and solutions, they modify to make improvements relative to success criteria. They use data, provided by testing, to evaluate and refine ideas and solutions. When students make justified recommendations, they put forward a point of view or suggestion with supporting evidence to make enhancements.

8. **make decisions about and use mode-appropriate features, language and conventions for particular purposes and contexts**

   When students make decisions about mode-appropriate features and conventions, they use written, visual, and spoken features to express meaning for particular purposes in a range of contexts. Written communication includes language conventions, specific vocabulary and language features such as annotations, paragraphs and sentences. Visual communication includes photographs, sketches, drawings, diagrams and motion graphics. Spoken communication includes verbal and nonverbal features and may be for live or virtual audiences. Students use referencing conventions to practise ethical scholarship for particular purposes.

1.2.2 Underpinning factors

There are three skill sets that underpin senior syllabuses and are essential for defining the distinctive nature of subjects:

- literacy — the set of knowledge and skills about language and texts essential for understanding and conveying Aerospace Systems content
- numeracy — the knowledge, skills, behaviours and dispositions that students need to use mathematics in a wide range of situations, to recognise and understand the role of mathematics in the world, and to develop the dispositions and capacities to use mathematical knowledge and skills purposefully
- 21st century skills — the attributes and skills students need to prepare them for higher education, work and engagement in a complex and rapidly changing world.

These skill sets, which overlap and interact, are derived from current education, industry and community expectations and encompass the knowledge, skills, capabilities, behaviours and dispositions that will help students live and work successfully in the 21st century.

Together these three skill sets shape the development of senior subject syllabuses. Although coverage of each skill set may vary from syllabus to syllabus, students should be provided with opportunities to learn through and about these skills over the course of study. Each skill set contains identifiable knowledge and skills that can be directly assessed.

Literacy in Aerospace Systems

Aerospace Systems requires students to develop literacy skills that allow them to effectively communicate graphical and technical information, ideas, and solutions to complex problems. Students learn how to organise and manipulate information in logical sequences to convey meaning to particular audiences for specific purposes. Students develop and enhance this capacity through their learning experiences and by documenting the problem-solving process in Aerospace Systems using a folio. Students improve their ability to use language conventions, textual features and mode-appropriate communication skills as they progress through the course of study.

These aspects of literacy knowledge and skills are embedded in the syllabus objectives, unit objectives and subject matter, and instrument-specific marking guides (ISMGs) for Aerospace Systems.

Numeracy in Aerospace Systems

Aerospace Systems requires students to use and develop numeracy skills as they interpret and use mathematical knowledge in a range of real-life aerospace situations. Students: use formulas, interpret graphical information and use their spatial knowledge to solve problems that involve their mathematical ability to calculate; interpret and draw conclusions from statistics; measure and record; and apply their knowledge of science concepts (such as mechanics, e.g. lift, drag and thrust) throughout the units of study.

These aspects of numeracy knowledge and skills are embedded in the syllabus objectives, unit objectives and subject matter, and ISMGs for Aerospace Systems.

21st century skills

The 21st century skills identified in this syllabus reflect a common agreement, both in Australia and internationally, on the skills and attributes students need to prepare them for higher education, work and engagement in a complex and rapidly changing world.

21st century skills	Associated skills	21st century skills	Associated skills
critical thinking	• analytical thinking • problem-solving • decision-making • reasoning • reflecting and evaluating • intellectual flexibility	creative thinking	• innovation • initiative and enterprise • curiosity and imagination • creativity • generating and applying new ideas • identifying alternatives • seeing or making new links
communication	• effective oral and written communication • using language, symbols and texts • communicating ideas effectively with diverse audiences	collaboration and teamwork	• relating to others (interacting with others) • recognising and using diverse perspectives • participating and contributing • community connections
personal and social skills	• adaptability/flexibility • management (self, career, time, planning and organising) • character (resilience, mindfulness, open- and fair-mindedness, self-awareness) • leadership • citizenship • cultural awareness • ethical (and moral) understanding	information & communication technologies (ICT) skills	• operations and concepts • accessing and analysing information • being productive users of technology • digital citizenship (being safe, positive and responsible online)

Aerospace Systems helps develop the following 21st century skills:

- critical thinking
  - problem-solving using the problem-solving process in Aerospace Systems
  - analytical thinking in recognising the relationships between systems, subsystems and system components, contributing factors and areas of weakness to identify the elements, components, features and structure of problems to determine success criteria
  - decision-making by proposing solutions and making justified recommendations
  - intellectual flexibility by being open to alternative ideas and new learning
  - evaluating ideas and solutions using success criteria
- communication
  - using effective oral, written and visual communication, using language, symbols and texts to communicate ideas, solutions and information to specified audiences
  - manipulating and using specialised language, terminology, symbols and diagrams to communicate in aerospace contexts

- personal and social skills
  - developing personal, social, ethical, economic, legal and environmental understandings in aerospace contexts
  - demonstrating adaptability and flexibility to create sustainable systems solutions in a range of aerospace contexts
  - developing the ability to self-manage (self, time, planning and organising) while problem-solving in Aerospace Systems contexts
  - developing and enhancing the personal characteristics of resilience, mindfulness, open- and fair-mindedness, and self-awareness during Aerospace Systems problem-solving
- creative thinking
  - generating and applying new ideas to create and identify strategies to enhance opportunities to develop innovative solutions
  - demonstrating initiative and enterprise to be self-directed in learning and problem-solving
  - demonstrating curiosity and imagination to motivate learning in aerospace contexts
  - synthesising information and ideas to create new understanding
  - evaluating and refining ideas and solutions to identify alternative possibilities and make new links to knowledge
- collaboration and teamwork
  - relating and interacting with others to solve problems in aerospace contexts
  - recognising and using diverse perspectives to determine the social, ethical, economic, legal and environmental impacts of systems solutions
  - participating and contributing to create personal, team and community connections
- information & communication technologies (ICT) skills
  - accessing, collating, evaluating, analysing and presenting information, including systems data and information in spreadsheets, tables, diagrams and graphs
  - being productive users of information and communication technologies to manipulate digital information to effectively communicate development of solutions to a specified audience.

These elements of 21st century skills are embedded in the syllabus objectives, unit objectives and subject matter, and ISMGs for Aerospace Systems.

1.2.3 Aboriginal perspectives and Torres Strait Islander perspectives

The QCAA is committed to reconciliation in Australia. As part of its commitment, the QCAA affirms that:

- Aboriginal peoples and Torres Strait Islander peoples are the first Australians, and have the oldest living cultures in human history
- Aboriginal peoples and Torres Strait Islander peoples have strong cultural traditions and speak diverse languages and dialects, other than Standard Australian English
- teaching and learning in Queensland schools should provide opportunities for students to deepen their knowledge of Australia by engaging with the perspectives of Aboriginal peoples and Torres Strait Islander peoples

- positive outcomes for Aboriginal students and Torres Strait Islander students are supported by successfully embedding Aboriginal perspectives and Torres Strait Islander perspectives across planning, teaching and assessing student achievement.

Guidelines about Aboriginal perspectives and Torres Strait Islander perspectives and resources for teaching are available at www.qcaa.qld.edu.au/k-12-policies/aboriginal-torres-strait-islander-perspectives.

Where appropriate, Aboriginal perspectives and Torres Strait Islander perspectives have been embedded in the subject matter.

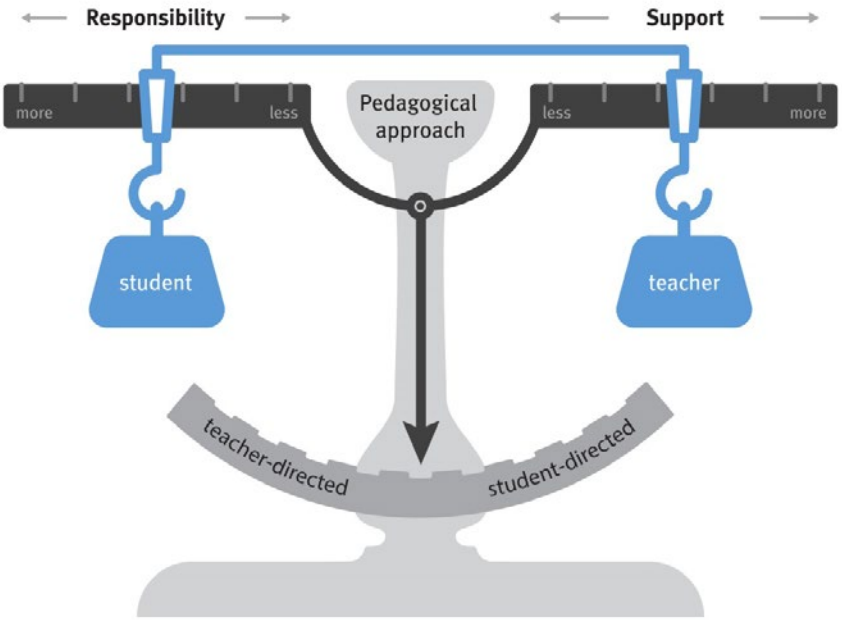
In Aerospace Systems, opportunities exist across all four units for student exploration of Aboriginal perspectives and Torres Strait Islander perspectives during aerospace systems problem-solving. Students gain an appreciation for and an understanding of Aboriginal peoples' and Torres Strait Islander peoples' communities and cultures as they develop, generate, evaluate and refine sustainable systems solutions. These solutions should be developed respectfully in recognition of Aboriginal peoples' and Torres Strait Islander peoples' culture, history and society, and with an appreciation for the limitations placed on access to specific places and spaces that have sacred traditional and spiritual importance.

1.2.4 Pedagogical and conceptual frameworks

Problem-based learning framework

In the Technologies learning area, the problem-based learning framework (as represented in Figure 3) provides the overarching pedagogical basis for the implementation of subject-specific problem-solving processes. Problem-based learning places students in real-world situations where they use skills associated with critical thinking, creative thinking, communication, collaboration and teamwork, personal and social interactions and information & communication technologies (ICT) in order to develop solutions that acknowledge personal, social, ethical, economic, environmental, legal and sustainability impacts.

Figure 3: Problem-based learning framework in the Technologies learning area



In Aerospace Systems:

- problem-based learning is an active process of knowledge construction that uses open-ended problems as a stimulus for student learning
- problems that support problem-based learning should
  - challenge and motivate students to engage their interest
  - provide opportunities for students to examine the problem from multiple perspectives or disciplines
  - provide multiple possible solutions and solution paths
  - require students to comprehend and use a breadth and depth of knowledge during problem-solving
  - recognise students' prior knowledge
  - recognise students' stage of cognitive development
  - provide opportunities to allow all students to explore innovative open-ended solutions
  - relate to the real-world
- the learning environment is organised to represent the complex nature of the problems students are required to solve, e.g. the learning area values collaboration using teamwork and brainstorming, as these are strategies used during real-world problem-solving
- the teacher is responsible for scaffolding student learning and cognition during problem-solving as a coach, guide or facilitator to maintain the independence and self-directedness of student learning
- self-directed learning does not mean students are self-taught; instead, teachers balance their participation so that students maintain responsibility for learning, e.g. students make decisions about the knowledge and skills they require to effectively solve a problem, supported by the teacher's questioning and cueing strategies
- the perception of student self-direction in the learning process is fundamental to problem-based learning.

Aerospace Systems problems

Central to problem-based learning is the provision or identification of suitably challenging, subject-specific, context-relevant, real-world problems. Student engagement with these problems facilitates student learning of aerospace subject matter. Problems suitable for Aerospace Systems:

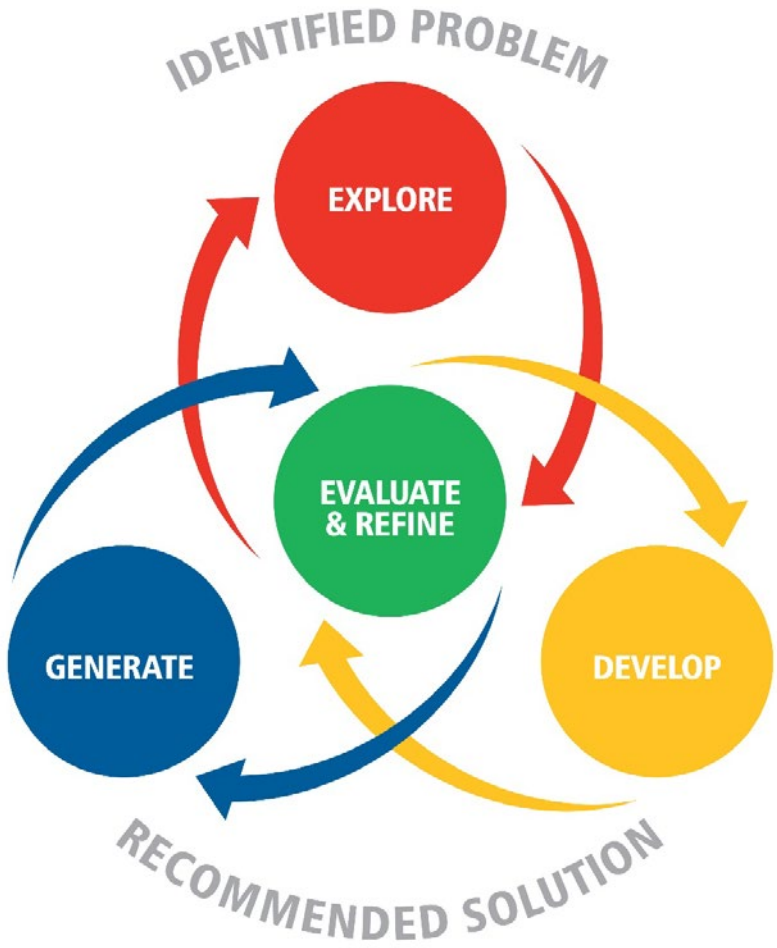
- are identified by students and/or by others in situations related to unit-specific and subject-relevant core systems thinking and aerospace concepts and principles
- promote purposeful activities undertaken in response to an identified real-world related problem that requires a solution in an aerospace context
- require the use of systems thinking habits and systems thinking strategies, and aerospace technology knowledge, concepts and principles to develop and test solutions
- are resolved using the problem-solving process.

The problem-solving process in Aerospace Systems

The problem-solving process in Aerospace Systems is analytical and technical in nature. The process is iterative and proceeds through a number of phases, requiring students to recognise and describe aerospace problems. Students examine problem-related systems, subsystems and system components to recognise structure and comprehend relationships so they can determine solution success criteria. Students use systems thinking habits and systems thinking strategies, and aerospace technology knowledge, concepts and principles to develop, test and refine a range of possible solutions. Students decide on a feasible solution to the original aerospace systems problem, and evaluate the proposed solution using success criteria and justify recommendations for future improvements.

The problem-solving process in Aerospace Systems involves student engagement with the four phases of explore, develop, generate, and evaluate and refine.

Figure 4: The problem-solving process in Aerospace Systems



To explore the problem, students:

- recognise and describe characteristics of the problem in relation to related aerospace systems, subsystems and system components
- symbolise the incorporated aerospace systems using visual frameworks, including systems diagrams and models
- research and investigate similar situations to understand the nature of the problem

- analyse contributing factors and areas of weakness to identify the elements, components and features, and their relationship to the structure of the problem
- recognise and describe causes and effects using causal loops and feedback loops
- communicate and discuss with others and team members
- determine solution success criteria considering the elements, components and features, and their relationship to the structure of the problem.

To develop ideas, students:

- investigate historic solutions and analyse positive and negative consequences
- research and investigate the application of potential future aerospace technologies and technologies in related fields
- analyse aeronautical data about the problem, e.g. charts, publications, operation information (logs and manuals), surveys, interviews and experiments
- collaborate with team members or others to brainstorm ideas for possible solutions
- symbolise and explain synthesis of ideas using visual frameworks, feedback loops, flow charts, diagrams, sketches and pictures
- evaluate and refine ideas in relation to solution success criteria
- graphically represent the relationship between various ideas and solution success criteria, e.g. PMI (plus, minus, interesting) charts
- propose possible short- and long-term outcomes
- gain feedback on possible solutions, e.g. surveys or interviews
- propose a solution.

To generate solutions, students:

- generate the proposed solution for testing
- test, simulate or hypothetically apply the proposed solution in the original problem situation to provide data
- evaluate the appropriateness of the proposed solution through collaboration with team members or industry experts using the success criteria
- refine the solution to match with solution success criteria
- communicate the solution to a specified audience using oral, written or graphical modes
- implement the solution by producing, simulating or hypothetically applying it in the original problem situation to provide data.

To evaluate and refine, students:

- evaluate the solution and its impact on related systems and system components in relation to the solution success criteria
- assess whether the solution is short- or long-term
- recommend and justify future modifications or enhancements.

1.2.5 Subject matter

Subject matter is the body of information, mental procedures and psychomotor procedures (see Marzano & Kendall 2007, 2008) that are necessary for students' learning and engagement with Aerospace Systems. It is particular to each unit in the course of study and provides the basis for student learning experiences.

Subject matter has a direct relationship to the unit objectives, but is of a finer granularity and is more specific. These statements of learning are constructed in a similar way to objectives. Each statement:

- describes an action (or combination of actions) — what the student is expected to do
- describes the element — expressed as information, mental procedures and/or psychomotor procedures
- is contextualised to the topic or circumstance particular to the unit.

Problem-solving, systems thinking and aerospace technology knowledge, concepts and principles form the basis for learning in Aerospace Systems. Students gain knowledge and skills through a range of aerospace contexts. Students use and develop this knowledge to solve actual, probable and/or possible aerospace systems problems.

1.3 Assessment — general information

Assessments are formative for Units 1 and 2, and summative for Units 3 and 4.

Assessment	Unit 1	Unit 2	Unit 3	Unit 4
Formative assessments	•	•		
Summative internal assessment 1			•	
Summative internal assessment 2			•	
Summative internal assessment 3				•
Summative external assessment				•

1.3.1 Formative assessments — Units 1 and 2

Formative assessments provide feedback to both students and teachers about each student's progress in the course of study.

Schools develop internal assessments for each senior subject based on the learning described in Units 1 and 2 of the subject syllabus. Each unit objective must be assessed at least once.

For reporting purposes, schools should devise at least *two* but no more than *four* assessments for Units 1 and 2 of this subject. At least *one* assessment must be completed for *each* unit.

The sequencing, scope and scale of assessments for Units 1 and 2 are matters for each school to decide and should reflect the local context.

Teachers are encouraged to use the A–E descriptors in the Reporting standards (Section 1.4) to provide formative feedback to students and to report on progress.

1.3.2 Summative assessments — Units 3 and 4

Students will complete a total of *four* summative assessments — three internal and one external — that count towards their final mark in each subject.

Schools develop *three* internal assessments for each senior subject, based on the learning described in Units 3 and 4 of the syllabus.

The three summative internal assessments will be endorsed and the results confirmed by the QCAA. These results will be combined with a single external assessment developed and marked by the QCAA. The external assessment results for Aerospace Systems will contribute 25% towards a student's result.

Summative internal assessment — instrument-specific marking guides

This syllabus provides ISMGs for the three summative internal assessments in Units 3 and 4.

The ISMGs describe the characteristics evident in student responses and align with the identified assessment objectives. Assessment objectives are drawn from the unit objectives and are contextualised for the requirements of the assessment instrument.

Criteria

Each ISMG groups assessment objectives into criteria. An assessment objective may appear in multiple criteria, or in a single criterion of an assessment.

Making judgments

Assessment evidence of student performance in each criterion is matched to a performance level descriptor, which describes the typical characteristics of student work.

Where a student response has characteristics from more than one performance level, a best-fit approach is used. Where a performance level has a two-mark range, it must be decided if the best fit is the higher or lower mark of the range.

Authentication

Schools and teachers must have strategies in place for ensuring that work submitted for internal summative assessment is the student's own. Authentication strategies outlined in QCAA guidelines, which include guidance for drafting, scaffolding and teacher feedback, must be adhered to.

Summative external assessment

The summative external assessment adds valuable evidence of achievement to a student's profile. External assessment is:

- common to all schools
- administered under the same conditions at the same time and on the same day
- developed and marked by the QCAA according to a commonly applied marking scheme.

The external assessment contributes 25% to the student's result in Aerospace Systems. It is not privileged over the school-based assessment.

1.4 Reporting standards

Reporting standards are summary statements that succinctly describe typical performance at each of the five levels (A–E). They reflect the cognitive taxonomy and objectives of the course of study.

The primary purpose of reporting standards is for twice-yearly reporting on student progress. These descriptors can also be used to help teachers provide formative feedback to students and to align ISMGs.

Reporting standards

A
The student, for a range of aerospace situations, demonstrates: accurate and discriminating recognition and discerning description of aerospace systems problems, knowledge, concepts and principles; adept symbolisation and discerning explanation of ideas, solutions and relationships. The student demonstrates insightful analysis of problems and relevant information, and astute determination of essential solution success criteria. The student demonstrates: coherent and logical synthesis of relevant information and ideas to propose possible solutions; critical evaluation and discerning refinement of ideas and solutions using success criteria to make astute recommendations justified by evidence; purposeful generation of solutions to provide valid data to critically assess the feasibility of proposals; discerning decision-making about, and fluent use of, mode-appropriate features, language and conventions to communicate development of solutions for purpose.
B
The student, for a range of aerospace situations, demonstrates: accurate recognition and effective description of aerospace systems problems, knowledge, concepts and principles; methodical symbolisation and effective explanation of ideas, solutions and relationships. The student demonstrates considered analysis of problems and relevant information, and logical determination of effective solution success criteria. The student demonstrates: logical synthesis of relevant information and ideas to propose possible solutions; reasoned evaluation and effective refinement of ideas and solutions using success criteria to make considered recommendations justified by evidence; effective generation of solutions to provide valid data to effectively assess the feasibility of proposals; effective decision-making about, and proficient use of, mode-appropriate features, language and conventions to communicate development of solutions for purpose.
C
The student, in a range of aerospace contexts, demonstrates: appropriate recognition and description of aerospace systems problems, knowledge, concepts and principles; competent symbolisation of and adequate explanation of some ideas, solutions and relationships. The student demonstrates appropriate analysis of problems and information, and reasonable determination of some solution success criteria. The student demonstrates: simple synthesis of information and ideas to propose possible solutions; feasible evaluation and adequate refinement of ideas and solutions using some success criteria to make fundamental recommendations justified by evidence; adequate generation of solutions to provide relevant data to assess the feasibility of proposals; appropriate decision-making about, and use of, mode-appropriate features, language and conventions to communicate development of solutions for purpose.

D
The student, for a range of aerospace situations, demonstrates: variable recognition and superficial description of aspects of problems, concepts or principles; variable symbolisation or superficial explanation of aspects of ideas, solutions or relationships. The student demonstrates superficial analysis of problems and partial information, and vague determination of some solution success criteria. The student demonstrates: rudimentary synthesis of partial information or ideas to propose solutions; superficial evaluation of ideas or solutions using some success criteria to make elementary recommendations; partial generation of solutions to provide elements of data to partially assess the feasibility of proposals; variable decision-making about, and inconsistent use of, mode-appropriate features, language and conventions to communicate.
E
The student, for a range of aerospace situations, demonstrates recognition of aspects of problems, concepts or principles and disjointed symbolisation or explanation of aspects of ideas or solutions. The student demonstrates the making of statements about problems, concepts or principles. The student demonstrates: unclear combinations of information or ideas; identification of a change to an idea or a solution; generation of elements of solutions; unclear or fragmented use of mode-appropriate features, language and conventions.

2 Unit 1: Introduction to aerospace systems and structures

2.1 Unit description

In Unit 1, students are introduced to the technology, concepts and principles associated with the aerospace industry. They learn about the global, national and local importance of the industry. Students investigate the industry's historical development and consider the challenges associated with meeting the transportation needs and expectations of future societies. Students explore problems associated with the increasing global demand for safe and efficient aircraft, pilots, support staff, maintenance staff and ground and airspace support systems. In this unit, students gain a basic understanding of aerodynamics and aircraft flight systems, concepts and principles such as lift, weight and drag, instability, high- and low-speed flight control, piston and gas turbine engines, electrical supply, control force and fuel delivery. Students gain an understanding of the potential impacts of weather conditions on various aerospace operations and the systems used to mitigate disruption.

Students learn about and use systems thinking habits and systems thinking strategies, such as visual frameworks, causal loops and feedback loops to recognise and classify the interrelationships that exist within and between various aerospace systems.

Unit requirements

In this unit, teachers combine and balance direct instruction with instruction developed using the various phases of the problem-solving process in Aerospace Systems. Teachers should provide appropriately structured real-world problems or situations that enable students to experience systems thinking and the associated aerospace technology knowledge, concepts and principles. Students should be provided with opportunities to collaboratively make decisions in groups as they learn about and through problem-solving.

Notional time allocation by topic and assessment

	Unit topic	Notional hours
Topic 1	Solving aerospace problems	5
Topic 2	The evolving aerospace industry	5
Topic 3	Introduction to aerodynamics	10
Topic 4	Introduction to aircraft systems	8
Topic 5	Introduction to aviation weather systems	7
Assessment integrated within the unit		20

2.2 Unit objectives

Unit objectives are drawn from the syllabus objectives and are contextualised for the subject matter and requirements of the unit. Each unit objective must be assessed at least once.

Students will:

1. recognise and describe problems, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aerospace systems and structures
2. symbolise and explain ideas, solutions and relationships in relation to aerospace systems and structures
3. analyse problems and information in relation to aerospace systems and structures
4. determine solution success criteria for aerospace systems and structures problems
5. synthesise information and ideas to propose possible aerospace systems and structures solutions
6. generate aerospace systems and structures solutions to provide data to assess the feasibility of proposals
7. evaluate and refine ideas and solutions to make justified recommendations
8. make decisions about and use mode-appropriate features, language and conventions to communicate development of solutions.

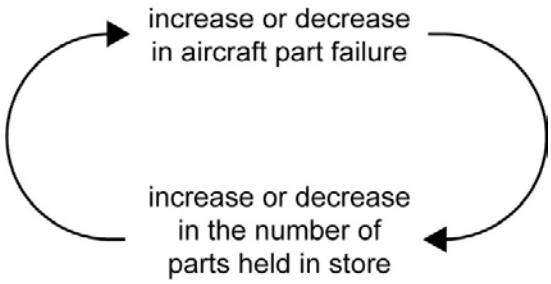
2.3 Topic 1: Solving aerospace problems

Guiding question: What is the problem-solving process in Aerospace Systems?

Subject matter

In this topic, students will:

- recognise and describe the phases of the iterative problem-solving process in Aerospace Systems
- recognise teamwork/collaboration skills and strategies, including listening, questioning, persuading, respecting, helping, sharing, participating
- describe brainstorming, research and written communication skills
- solve basic problems using the problem-solving process in Aerospace Systems, e.g. create a series of paper planes to perform certain in-flight manoeuvres
- define a system
- recognise and describe examples of aerospace systems, including aircraft and airport safety systems, airport and airline organisational systems and aircraft performance systems
- define systems thinking
- recognise and describe the Waters Foundation's (2017) fourteen systems thinking habits, (looking at the big picture, change over time, systems structure, interdependencies, connections, changes in perspective, assumptions, considering issues fully, mental models, leverage, consequences, accumulations, time delays, and successive approximation)
- recognise systems thinking strategies, including
  - iceberg visual frameworks
  - feedback loops (balancing and reinforcing)
  - causal loop diagrams
- define and compare reinforcing and balancing feedback loops
- create a causal loop diagram showing feedback within a basic system, e.g. the causal loop diagram below communicates the simplistic warehouse storage system for aircraft spare parts. An increase in failures would require an increase in the number of parts kept in store and a decrease would necessitate a corresponding decrease in the number of parts required. The increase or decrease in one element of the simple warehouse storage system reinforces the increase or decrease in the other



- explain the benefits of using reinforcing or balancing feedback loops to solve aerospace problems.

2.4 Topic 2: The evolving aerospace industry

Guiding question: How will the aerospace industry manage the increasing future demand for aircraft, pilots, maintenance and support systems?

Subject matter
In this topic, students will: • investigate the major milestones in aerospace, including – pre–20th century examples of aerospace concepts, including boomerangs, kites, rockets, balloons, gliders and early attempts at aircraft development – materials, including timber, natural fibres, aluminium and modern composite materials – power plants, including piston and jet engines – pioneers, including international and Australian – the evolution of aviation governing and safety organisations – the different roles played by various aircraft types at key points in history (1901 to the present) • recognise and describe aircraft features and configurations, including wings, tail, undercarriage and engines, and their associated locations • explore the historical growth of domestic and international airline carriers and their current and future importance both economically and socially • investigate the historic development of military aerospace technologies and infrastructure to predict future possibilities • explore aerospace industry career pathways, including – airside and landside ground operations – airspace operations.

2.5 Topic 3: Introduction to aerodynamics

Guiding question: By what means do aircraft overcome the problems associated with weight, drag, instability and high- and low-speed flight?

Subject matter

In this topic, students will:

- recognise and describe the components of a basic aircraft structure and primary flight controls for fixed- and rotary-wing aircraft
- investigate the airframe construction techniques of monocoque and stressed skin
- investigate airframe construction materials, including aluminium, aluminium alloys and composite materials
- define the forces of lift, weight, thrust and drag and their relationship to each other
- explain the theories of generating lift and aerofoils (Newton's third law and Bernoulli's principle)
- investigate the concepts of angle of attack, types of drag, ground effect, boundary layer, load factor, centre of gravity, centre of pressure (lift), stalls and spins
  - calculate scenarios using the lift and drag equations and use the drag curve, with the following formulas
    - $lift = C_L \frac{1}{2} \rho V^2 A$
    - $drag = C_D \frac{1}{2} \rho V^2 A$
- investigate wing designs, including laminar and conventional aerofoils, angle of incidence, aerofoil variation, aspect ratio and fineness ratio, dihedral and anhedral wings, fences, winglets, slots and slats, spoilers and speed brakes, and flap variations
- develop ideas for and create various wing shapes to demonstrate an understanding of lift
- conduct experiments on common objects to identify forms that generate lift forces
- comprehend the concept of static stability and dynamic stability, including longitudinal, lateral and directional stability
- define high-speed flight, including subsonic, transonic and supersonic flight
- investigate the primary and secondary effects of controls.

2.6 Topic 4: Introduction to aircraft systems

Guiding question: What are the design considerations associated with piston and gas turbine engines, electrical supply, control force and fuel delivery in the construction and use of small and slow aircraft compared to large and fast high-altitude aircraft?

Subject matter

In this topic, students will:
• comprehend the similarities and differences between piston-driven and gas turbine engines
• explore propeller design, including variable and fixed pitch
• define and explain the operation of the following systems and how they are used in modern aircraft
  – electrical, including simple circuits and components
  – fuel, including types of fuel and basic components
  – hydraulics, including types of fluids and components
  – pneumatics, including air conditioning, pressurisation and components
  – avionics, including communication, navigation and surveillance
  – six primary flight instruments
  ▪ airspeed indicator (pitot static)
  ▪ attitude indicator (gyro)
  ▪ altimeter (pitot static)
  ▪ vertical speed indicator (pitot static)
  ▪ heading indicator (gyro)
  ▪ turn coordinator (gyro)
• determine how faults in one aircraft system, e.g. electrical system can lead to flow-on effects to related systems, e.g. computer systems, hydraulic and pneumatic systems
• determine how the relationship between various aircraft systems can be represented using causal loop diagrams
• recognise the systems engineering approach to modern aircraft design
• comprehend the similarities and differences between the systems of small and slow aircraft and large and fast high-altitude aircraft
• symbolise the interdependence of various aircraft systems using systems diagrams.

2.7 Topic 5: Introduction to aviation weather systems

Guiding question: How do weather conditions have an impact on aerospace systems and what strategies are used to mitigate any negative influence on performance?

Subject matter
In this topic, students will: • sketch and classify the composition and structure of the atmosphere • identify and classify basic cloud types, including – high-level clouds (cirrus and cirrostratus) – mid-level clouds (altocumulus and altostratus) – low-level clouds (nimbostratus and stratocumulus) • investigate the processes in the formation of clouds, including – orographic uplift – convectional lifting – convergence or frontal lifting – radiative cooling • recognise ISA (international standard atmosphere) conditions (temperature 15°C, pressure 1013hPa, humidity 0%, at sea level and environmental lapse rates for temperature minus 2°C per 304.8 metres (1000 ft.) and pressure 1hPa per 9.14 metres (30 ft.)) • analyse and interpret synoptic weather charts, including – high- and low-pressure systems and the relationship to wind creation – pressure identification (isobars) – hot and cold fronts, troughs and ridges – prediction of wind conditions and pressure • calculate temperature and pressure changes with altitude • interpret Terminal Area Forecast (TAF) and Meteorological Encoded Terminal Area Report (METAR) reports, including comprehension of – location code – the calculation of date-time group (Zulu time to local time conversion) – wind identification (speed and direction) – cloud coverage identification and reporting (overcast complete cloud cover (OVC), broken, cloud cover in 5/8 to 7/8 of sky (BKN), scattered cloud cover in 3/8 to 4/8 of sky (SCT), cloud cover in 1/8 to 2/8 of sky (FEW), no clouds below (CLR), ceiling and visibility okay (CAVOK), and altitude) – visibility reporting (0–9999 metres) – the relationship between temperature and dew point temperature – QNH (barometric pressure above sea level) • analyse weather forecasting in relation to aircraft operations.

2.8 Assessment guidance

In constructing assessment instruments for Unit 1, schools should ensure that the objectives cover, or are chosen from, the unit objectives. If one assessment instrument is developed for a unit, it must assess all the unit objectives. If more than one assessment instrument is developed, the unit objectives must be covered across those instruments.

The suggested assessment techniques for Unit 1 are a project — folio and an examination.

3 Unit 2: Emerging aerospace technologies

3.1 Unit description

Unit 2 includes learning experiences beyond traditional aircraft to build on students' technology knowledge of contemporary aerospace. These emerging technologies include satellites, space vehicles and remotely piloted aircraft systems (RPAS) and are finding innovative 21st century applications, for example, ways in which aerospace-related technologies can be used to solve problems for people and communities in need. Students develop their knowledge and understanding of the applications of these future-focused and sometimes non-traditional aerospace technologies (or assets) and operations (asset deployment) to solve problems through use of systems thinking habits and systems thinking strategies. In this unit, students engage with real-world problems to develop innovative future-focused solutions.

Unit requirements

In this unit, teachers combine and balance direct instruction with instruction developed using the various phases of the problem-solving process in Aerospace Systems. Teachers should provide appropriately structured real-world problems or situations that enable students to experience systems thinking and the associated aerospace technology knowledge, concepts and principles. Students should be provided with opportunities to collaboratively make decisions in groups as they learn about and through problem-solving.

Topic 4 includes subject matter in relation to the problem-solving process in Aerospace Systems and students should experience this learning separately from assessment. Teachers may provide learning experiences that incorporate subject matter from the other topics in Unit 2 during this problem-solving activity.

Notional time allocation by topic and assessment

	Unit topic	Notional hours
Topic 1	Operational assets	12
Topic 2	Operational environments	5
Topic 3	Operational control systems	8
Topic 4	Future applications	10
Assessment integrated within the unit		20

3.2 Unit objectives

Unit objectives are drawn from the syllabus objectives and are contextualised for the subject matter and requirements of the unit. Each unit objective must be assessed at least once.

Students will:

1. recognise and describe problems, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to assets and asset-related operational systems
2. symbolise and explain ideas, solutions and relationships in relation to assets and asset-related operational systems
3. analyse problems and information in relation to assets and asset-related operational systems
4. determine solution success criteria for assets and asset-related operational system problems
5. synthesise information and ideas to propose possible assets and asset-related operational systems solutions
6. generate assets and asset-related operational systems solutions to provide data to assess the feasibility of proposals
7. evaluate and refine ideas and solutions to make justified recommendations
8. make decisions about and use mode-appropriate features, language and conventions to communicate development of solutions.

3.3 Topic 1: Operational assets

Guiding question: What assets need to be developed and how will they be used, given the nature of problems to be solved?

Subject matter

In this topic, students will:

- identify operations and associated payload types, including passengers (pax), cargo, search and rescue (SAR), disaster relief, surveillance, space exploration, aerial/satellite imagery, satellite weather prediction, and monitoring and data collection
- identify, compare and contrast the main asset types based on functionality, including lighter than air, fixed-wing, multi-rotor, rotary-wing, space-based
- comprehend the importance of wing and power loading
- calculate performance for fixed-wing aircraft using the formulas
  - wing loading = stall speed

    $$wing\ loading = \frac{weight\ of\ aircraft\ (kg)}{wing\ area\ (m^2)}$$
  - power loading = performance for small RPAS

    $$power\ loading = \frac{power\ (watts)}{weight\ (kg)}$$
- calculate performance for multi-rotor aircraft using the formulas
  - current draw

    $$I\ (motor\ current)\ = \frac{P\ (motor\ power)}{U\ (battery\ voltage)}$$
  - endurance = performance for small RPAS

    $$T\ (time\ in\ minutes) = \frac{C\ (battery\ capcity\ in\ amp\ hours)}{I\ (current)}$$
- investigate stability and augmentation systems, including autopilots, accelerometers and gyros, flight modes (manual, stabilised, loiter, autonomous)
- classify
  - sensors, including optical, thermal, acoustic
  - gimbals, including stabilised, two-axis, three-axis
- explore the emerging development of electric flight, including batteries, brushless motors, propellers
- describe the different types of control environments, including National Aeronautics and Space Administration (NASA) mission control, RPAS ground control station, air traffic control (ATC)
- examine types of space vehicles, including expendable launch vehicles (ELV), semi-reusable launch vehicles (e.g. space shuttle), reusable launch vehicles, human-rated, satellites, International Space Station (ISS)
- analyse and critique next-generation launchers, including single stage to orbit (SSTO), e.g. Virgin Galactic
- describe staging of a rocket in terms of payload mass and economics
- investigate return-to-earth payload deployment protection methods
- comprehend various failsafe technologies, e.g. return to home, self-destruct, mission abort
- brainstorm possible future problem situations in an emerging need area and consider the social, ethical, legal, environmental or economic implications for idea and solution development
- determine success criteria to solve a future problem.

3.4 Topic 2: Operational environments

Guiding question: In what types of environments can operations exist?

Subject matter
In this topic, students will: • explain the key geographical and mapping concepts of earth geometry, including latitude, longitude, great circles, prime meridian, poles, equator) and Global Navigation Satellite System (GNSS), e.g. GPS concepts and waypoints, speed (knots), magnetic variation • classify the different types of Australian airspace i.e. Class A, C, D, E, and G • investigate operation planning environmental factors, including weather and terrain • recognise equatorial 0°, polar 90°, inclined orbits between 0° and 90°, Geostationary Earth Orbit (GEO), and satellite constellation orbits • explain Newton's cannon thought experiment in relation to orbital and escape velocity • explain weightlessness and equilibrium in relation to an orbiting body.

3.5 Topic 3: Operational control systems

Guiding question: In what ways are aerospace operations conducted given the constraints of asset technologies, location, time, expertise and success criteria?

Subject matter

In this topic, students will:
• explore the relationship between operational requirements, including data collection and/or analysis and duration and payload, environmental and economic considerations using systems thinking visual frameworks and feedback loop diagrams
• investigate the differences between the human-in-the-loop decision-making in manned and remotely piloted vehicles
• represent operational system relationships using systems thinking strategies, i.e. causal loop diagrams
• comprehend the role of situational awareness, i.e. monitoring flight variables through the scanning of systems and the environment
• use systems thinking habits and systems thinking strategies in regards to operational planning, including
  – assess the areas of likely failure and discuss how to mitigate against these
  – recognise and describe the long-term impacts versus short-term gains
  – consider the likelihood of success or failure/loss and propose an outcome based on operation variables
  – generate an operations strategy/plan
  – payload deployment considerations.

3.6 Topic 4: Future applications

Guiding question: How might asset technologies impact our future lives on Earth and beyond?

Subject matter

In this topic, students will:

- investigate current aerospace activities that use non-traditional aerospace technologies, including RPAS used in agriculture, property surveillance, SAR, emergency services
- explore everyday applications for non-traditional aerospace technologies and analyse market potential, e.g. hazardous inspections, delivery systems, ecological inspections, power grid monitoring, surf lifesaving (shark spotting, surf conditions)
- identify and describe potential ethical and safety issues concerning the application of non-traditional aerospace technologies
- explore current space technologies and investigate possible and probable developments for everyday applications, e.g. flying cars, sub-orbital flight, jet packs and other forms of personal transportation devices
- investigate future Earth and space exploration, transportation and research, e.g. future manned Moon and Mars missions
- use the problem-solving process in Aerospace Systems to solve an identified future problem, e.g. traffic congestion, personal safety or security, delivery systems, including
  - exploration of the problem
    - recognise and describe characteristics of the problem in relation to related aerospace systems, subsystems and system components
    - symbolise the incorporated aerospace systems with visual frameworks, feedback loops, flow charts, diagrams, sketches or pictures
    - research and investigate similar situations to understand the nature of the problem
    - analyse contributing factors and areas of weakness to identify the elements, components, features and structure of the problem
    - describe causes and effects using causal and feedback loops
    - determine solution success criteria considering the elements, components, features and structure of the problem
  - development of ideas
    - investigate historic solutions and analyse positive and negative consequences
    - research and investigate the application of potential future aerospace and related technologies
    - symbolise and explain synthesis of ideas using visual frameworks, feedback loops, flow charts, diagrams, sketches and/or pictures with appropriate annotations
    - evaluate various ideas in relation to solution success criteria
    - communicate the relationship between various ideas and solution success criteria, e.g. plus, minus, interesting (PMI) charts
    - propose possible short- and long-term outcomes
    - propose a solution
  - generation of the solution
    - generate the proposed solution for testing
    - test, simulate or hypothetically apply the proposed solution in the original problem situation to provide data
    - refine the solution to match with solution success criteria
    - communicate the solution to a specified audience using oral, written or visual modes
    - implement by producing, simulating or hypothetically applying the solution in the original problem situation to provide data
  - evaluation and refinement
    - evaluate the solution and its impact on related systems and system components using the solution success criteria
    - assess whether the solution is short- or long-term
    - recommend and justify future modifications or enhancements

3.7 Assessment guidance

In constructing assessment instruments for Unit 2, schools should ensure that the objectives cover, or are chosen from, the unit objectives. If one assessment instrument is developed for a unit, it must assess all the unit objectives. If more than one assessment instrument is developed, the unit objectives must be covered across those instruments.

The suggested assessment techniques for Unit 2 are a project — folio and an examination.

4 Unit 3: Aerospace operational systems

4.1 Unit description

In Unit 3, students will study the operational systems used in the commercially competitive air transportation industry. The unit topics provide a focus for student learning, and problem-solving engages students in the development of practical solutions to actual, possible or probable operational problems. Students use systems thinking habits and systems thinking strategies, including visual frameworks and causal loop diagrams to explore and document the relationships between and within aerospace operational systems. Real-world situations, case studies and simulations are used to support student learning.

Learning in this unit equips students with an appreciation for the role that aerospace operational systems and their interconnectivity play in promoting public confidence in a highly competitive and safety-conscious industry.

Unit requirements

In this unit, teachers combine and balance direct instruction with instruction developed using the various phases of the problem-solving process in Aerospace Systems. Teachers should provide appropriately structured real-world problems or situations that enable students to experience systems thinking and the associated aerospace technology knowledge, concepts and principles. Students should be provided with opportunities to collaboratively make decisions in groups as they learn about and through problem-solving.

Notional time allocation by topic and assessment

	Unit topic	Notional hours
Topic 1	International and national operational and safety systems	4
Topic 2	Airspace management	6
Topic 3	Safety management systems	10
Topic 4	Operational accident and incident investigation processes	7
Topic 5	Airport and airline operation systems	8
Assessment integrated within the unit		20

4.2 Unit objectives

Unit objectives are drawn from the syllabus objectives and are contextualised for the subject matter and requirements of the unit. Each unit objective must be assessed at least once.

Students will:

Unit objective	IA1	IA2
1. recognise and describe problems, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to operational systems	●	●
2. symbolise and explain ideas, solutions and relationships in relation to operational systems	●	●
3. analyse problems and information in relation to operational systems	●	●
4. determine solution success criteria for operational systems problems	●	
5. synthesise information and ideas to propose possible operational systems solutions	●	●
6. generate operational systems solutions to provide data to assess the feasibility of proposals	●	
7. evaluate and refine ideas and solutions to make justified recommendations	●	●
8. make decisions about and use mode-appropriate features, language and conventions to communicate development of solutions.	●	

4.3 Topic 1: International and national operational and safety systems

Guiding question: What is the purpose of a global approach to aviation oversight and service systems?

Subject matter
In this topic, students will: • comprehend the need for a global approach to aerospace operations and safety in a growing and connected world, including – aviation rules, including rules of the air, air traffic procedures and runway markings – aircraft maintenance standards – security, customs and quarantine – common language and communication protocols – navigation safety (charts, maps and meteorology) • recognise the significance of the Chicago Convention; the creation of the International Civil Aviation Organisation (ICAO) and its governance; its leadership role in areas; and that safety is at the core of ICAO's fundamental objectives • determine the influence of ICAO on the Civil Aviation Safety Authority (CASA) • identify and explain the functions of CASA • recognise and critique the role of the International Air Transport Association (IATA) • brainstorm problem scenarios collaboratively (in small groups) in relation to the absence of accepted worldwide aviation regulations, and propose a range of ideas for solving the identified problems.

4.4 Topic 2: Airspace management

Guiding question: How is airspace managed to prevent aircraft accidents and incidents?

Subject matter
In this topic, students will: • identify and explain the functions of Airservices Australia • investigate air traffic principles, including air traffic control, air traffic separation, flight information regions, air traffic advisory services, flight information services and alerting services • recognise a time zone as being a region in which the same standard time is used and that local time in a time zone is defined by its offset (difference) from Coordinated Universal Time (UTC), the world's time standard • recognise the three aviation emergency phases used by ATC (uncertainty, alert and distress) and how they relate to the urgency of a situation • identify and explain flight rules and procedures with respect to: classification of airspace; Visual Flight Rules (VFR) versus Instrument Flight Rules (IFR); separation standards; meteorology, including Visual Meteorological Conditions (VMC); and Instrument Meteorological Conditions (IMC) • explain the requirements for flight plans, including principles (i.e. aircraft type and characteristics, the flight of the aircraft, the flight rules in use and on-board equipment); completing; and lodging • recognise and use aeronautical communications, including – the phonetic alphabet – the basic structure of a radio call, including who you are calling, who you are, where you are and what your intentions are • comprehend the need for aeronautical information services, including Airservices Australia charts and publications • investigate relevant case studies and propose solutions to identified airspace management problems • communicate air traffic control systems that contribute to safe and efficient airspace management using causal and/or feedback loop diagrams.

4.5 Topic 3: Safety management systems

Guiding question: How does the aerospace industry reduce accidents and incidents associated with the environment, engineering and human error?

Subject matter

In this topic, students will:

- comprehend that a 'culture of safety' is vital to the aerospace industry, and recognise
  - its context in aviation
  - the evolution of safety, including technical, human and organisational factors
- recognise Patrick Hudson's (2001) safety maturity model and the need to develop a 'just' safety culture
- recognise that technical reliability is a major endeavour of the industry
- recognise that the human-machine interface, including human-in-the-loop decision-making in the aerospace industry, is a critical component in maintaining safety and the confidence of the travelling public
- analyse the SHELL model to represent the main components of human factors, i.e.
  - software (S) — the rules, procedures and written documents that are part of the standard operating procedures
  - hardware (H) — the air traffic control suites, configuration, controls and surfaces, displays and functional systems
  - environment (E) — the situation in which the LHS system must function; the social, economic and natural environments
  - liveware (L) — the human beings involved in the system, including the controller with other controllers, flight crews, engineers and maintenance people, management and administration people and human performance, capabilities and limitations
- investigate a human error accident by applying the SHELL model
- investigate the role of safety in high-consequence industries, e.g. nuclear, oil and gas exploration, to reinforce the need for aviation to take a systems approach to the maintenance of safety standards
- identify general safety hazards in the aerospace industry using the categories of weather, technical failures, human failures and organisational failures
- comprehend the relevance of James Reason's (1997) 'Swiss cheese model' to explain the reasons for organisational accidents, including the concepts of active failures and latent conditions
- explore the elements of a safety management system, including
  - safety policy and objectives
  - safety risk management
  - safety assurance
  - safety promotion with both the aviation safety regulator and all operators requiring a documented system to be in place
- explain and use the risk management process of
  - hazard identification
  - risk analysis probability and severity
  - risk assessment and tolerability
  - risk control and mitigation
- describe the importance of emergency response planning in aviation
- identify and solve a safety management problem associated with landside or airside operations at a busy international airport, e.g. Dubai, Heathrow.

4.6 Topic 4: Operational accident and incident investigation processes

Guiding question: Why are accidents and incidents investigated?

Subject matter

In this topic, students will:
• identify and explain the functions of the Australian Transport Safety Bureau (ATSB)
• comprehend the aviation accident and incident investigation process, including
  – the objectives of an investigation
  – accident site coordination and security
  – hazards at accident sites
  – protection of the aircraft wreckage and associated evidence
  – custody and removal of evidence into secure storage
• explain the organisation and conduct of an investigation, including the purpose of the preliminary and final reports
• comprehend an ATSB final report of a major aviation accident
• conduct an investigation into a recent school or local community accident or incident and represent the identified causal chain using a causal loop diagram.

4.7 Topic 5: Airport and airline operation systems

Guiding question: How do airports and airlines minimise inefficiency, restrict waste and maintain regulatory standards to remain profitable, despite high costs and low profitability margins?

Subject matter
In this topic, students will: • recognise how airlines approach air travel as a business, including their structure, marketing, and passenger yield management strategies, including calculations involving – available seat kilometres (ASK) – revenue passenger kilometres (RPK) – passenger load factor (PLF) (see load factor) – cost for available seat kilometres (CASK) – revenue available seat kilometres (RASK) – passenger yield (PY) • comprehend that scheduled and on-occurrence maintenance and inspections ensure that passengers fly safely • define and explain how the industry is classified into general groupings of international, domestic and regional airlines • identify the difference between full-service, hybrid/new-world, and low-cost carriers • explore the factors that lead to route and aircraft selection, including 'hub-and-spoke' as opposed to 'point-to-point' network design models • comprehend airport design considerations, including – location – runway design – taxiway and tarmac design – terminal design – environmental – accessibility – security – ground support services – other infrastructure • comprehend that the breadth of the airport business is expanding with major revenue streams in addition to aeronautical revenue, including – landside transport revenue, e.g. car parking and car rental – retail revenue, e.g. leasing retail space – airport terminal revenue, e.g. aircraft parking, passenger transit fees – other commercial activities • solve a problem associated with an unprofitable airline route or aircraft using systems thinking habits and systems thinking strategies, including maintenance costs, the travelling public on the route, flight, ground and human resources costs.

4.8 Assessment

4.8.1 Summative internal assessment 1 (IA1): Project — folio (25%)

Description

This assessment focuses on a problem-solving process that requires the application of a range of cognitive, technical and creative skills and theoretical understandings. Students document the iterative process undertaken to develop a solution to a problem. The response is a coherent work that includes written paragraphs and annotations, diagrams, sketches, drawings, photographs, tables, spreadsheets and prototypes.

This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop a response.

Assessment objectives

This assessment technique is used to determine student achievement in the following objectives:

1. recognise and describe the operational systems problem, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aerospace management, safety, airline and/or airport operations
2. symbolise and explain ideas, a solution and relationships in relation to aerospace management, safety, airline and/or airport operations
3. analyse the operational systems problem and information in relation to aerospace management, safety, airline and/or airport operations
4. determine solution success criteria for the operational systems problem
5. synthesise information and ideas to propose a possible aerospace management, safety, airline and/or airport operations solution
6. generate an aerospace management, safety, airline and/or airport operations solution to provide data to assess the feasibility of the proposal
7. evaluate and refine ideas and a solution to make justified recommendations
8. make decisions about and use mode-appropriate features, language and conventions to communicate development of the solution.

Specifications

Description

In Aerospace Systems, a folio involves students documenting the application of a problem-solving process in response to an identified real-world aerospace problem. The response will include the following folio and referencing conventions:

- headings that organise and communicate the student's thinking through the iterative phases of the problem-solving process in Aerospace Systems
- a table of contents page
- a reference list and a recognised system of in-text referencing.

For this assessment, teachers will provide an appropriate aerospace operational systems problem, for example:

- investigate why the current location of an airport has created a concern for local communities and propose a solution to the identified cause/s
- investigate an aircraft accident or incident and propose a solution to the identified cause/s
- propose an equitable solution for an airline that is experiencing a financial loss on several of its routes.

The folio will be in two parts and include the following assessable evidence.

Part A documents the development of an operational systems problem solution, including:

- recognition and description of the characteristics of the operational systems problem in relation to related aerospace systems, subsystems and system components
- symbolisation and explanation of the incorporated aerospace systems, the development of ideas and the solution with visual frameworks, causal and feedback loops, flow charts, diagrams, sketches and/or pictures
- analysis of aerospace systems, technology and research information, contributing factors, and areas of weakness, to identify the elements, components, and features, and their relationship to the structure of the aerospace operational systems problem
- determination of solution success criteria considering the identified elements, components and features, and their relationship to the structure of the aerospace operational systems problem
- synthesis of aerospace systems, technology, and research information, and ideas to propose a possible solution to the aerospace operational systems problem
- generation of the proposed solution for the aerospace operational systems problem, and testing, simulating or hypothesising to provide data (e.g. pictures, tables, surveys, interview recordings, audio-visual recording) for evaluation including (if applicable) annotated photographs or screen captures of the solution prior to and after testing, simulating or hypothesising
- evaluation and refinement of ideas and the solution for the aerospace operational systems problem in relation to solution success criteria
- recommendation and justification of future modifications or enhancements to ideas and the solution to the aerospace operational systems problem
- communication of the development of ideas and the solution for the aerospace operational systems problem using written and visual features, e.g. PMI (plus, minus, interesting) charts, tables, pictures, bubble diagrams, feedback loops
- communication of data using diagrams, tables and/or spreadsheets.

Part B communicates a summary report to the specified client drawn from Part A documentation and includes key visual frameworks, feedback loops, flow charts, diagrams, sketches or pictures that provide a concise account of the preferred solution, including the key features of the solution and any recommendations made to inform future solution development.

Conditions

- Duration: 5–7 weeks
- Length:
  - Part A: 7–9 single-sided A3 pages or equivalent digital media
  - Part B: 2–3 single-sided A4 pages or equivalent digital media
- Other:
  - the table of contents and reference list are not included in the page count
  - schools should implement authentication strategies that reflect QCAA guidelines.

Summary of the instrument-specific marking guide

The following table summarises the mark allocation for the objectives assessed in the folio.

Criterion	Objectives	Marks
Retrieving and comprehending	1 and 2	5
Analysing	3 and 4	7
Synthesising and evaluating	5, 6 and 7	9
Communicating	8	4
Total		**25**

Instrument-specific marking guide

Criterion: Retrieving and comprehending

Assessment objectives

1. recognise and describe the operational systems problem, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aerospace management, safety, airline and/or airport operations
2. symbolise and explain ideas, a solution and relationships in relation to aerospace management, safety, airline and/or airport operations

The student work has the following characteristics:	Marks
• accurate and discriminating recognition and discerning description of the operational systems problem, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aerospace management, safety, airline and/or airport operations • adept symbolisation and discerning explanation of ideas, a solution and relationships in relation to aerospace management, safety, airline and/or airport operations with visual frameworks, causal and feedback loops, flow charts, diagrams, sketches and/or pictures.	4–5
• accurate recognition and appropriate description of the operational systems problem, aerospace technology knowledge, concepts and principles, and some systems thinking habits and systems thinking strategies in relation to aerospace management, safety, airline and/or airport operations • competent symbolisation and appropriate explanation of some ideas, a solution and relationships in relation to aerospace management, safety, airline and/or airport operations with visual frameworks, causal and feedback loops, flow charts, diagrams, sketches and/or pictures.	2–3
• variable recognition and superficial description of aspects of the operational systems problem, concepts or principles in relation to aerospace management, safety, airline and/or airport operations • variable symbolisation or superficial explanation of aspects of ideas, a solution, or relationships in relation to aerospace management, safety, airline and/or airport operations.	1
• does not satisfy any of the descriptors above.	0

Criterion: Analysing

Assessment objectives

3. analyse the operational systems problem and information in relation to aerospace management, safety, airline and/or airport operations
4. determine solution success criteria for the operational systems problem

The student work has the following characteristics:	Marks
• insightful analysis of the operational systems problem, and relevant aerospace systems, technology, and research information in relation to aerospace management, safety, airline and/or airport operations to identify the relevant elements, components and features, and their relationship to the structure of the problem • astute determination of essential solution success criteria for the operational systems problem.	6–7
• considered analysis of the operational systems problem, and relevant aerospace systems, technology, and research information in relation to aerospace management, safety, airline and/or airport operations to identify the relevant elements, components and features, and their relationship to the structure of the problem • logical determination of effective solution success criteria for the operational systems problem.	4–5
• appropriate analysis of the operational systems problem and aerospace systems, technology, and research information in relation to aerospace management, safety, airline and/or airport operations to identify some of the elements, components and features of the problem • reasonable determination of some solution success criteria for the operational systems problem.	2–3
• statements about the operational systems problem, or information in relation to aerospace management, safety, airline and/or airport operations • vague determination of some success criteria for the operational systems problem.	1
• does not satisfy any of the descriptors above.	0

Criterion: Synthesising and evaluating

Assessment objectives

5. synthesise information and ideas to propose a possible aerospace management, safety, airline and/or airport operations solution
6. generate an aerospace management, safety, airline and/or airport operations solution to provide data to assess the feasibility of the proposal
7. evaluate and refine ideas and a solution to make justified recommendations

The student work has the following characteristics:	Marks
• coherent and logical synthesis of relevant aerospace systems, technology and research information, and ideas to propose a possible aerospace management, safety, airline and/or airport operations solution • purposeful generation of an aerospace management, safety, airline and/or airport operations solution to provide valid data to critically assess the feasibility of a proposal • critical evaluation and discerning refinement of ideas and a solution using success criteria to make astute recommendations justified by data and research evidence.	8–9
• logical synthesis of relevant aerospace systems, technology and research information, and ideas to propose a possible aerospace management, safety, airline and/or airport operations solution • effective generation of an aerospace management, safety, airline and/or airport operations solution to provide valid data to effectively assess the feasibility of a proposal • reasoned evaluation and effective refinement of ideas and a solution using success criteria to make considered recommendations justified by data and research evidence.	6–7
• simple synthesis of aerospace systems, technology, and research information and ideas to propose a possible aerospace management, safety, airline and/or airport operations solution • adequate generation of an aerospace management, safety, airline and/or airport operations solution to provide relevant data to assess the feasibility of a proposal • feasible evaluation and adequate refinement of ideas and a solution using some success criteria to make fundamental recommendations justified by data and research evidence.	4–5
• rudimentary synthesis of partial aerospace systems, technology, or research information and/or ideas to propose an aerospace management, safety, airline and/or airport operations solution • partial generation of an aerospace management, safety, airline and/or airport operations solution to provide elements of data to partially assess the feasibility of a proposal • superficial evaluation of ideas or a solution using some success criteria to make elementary recommendations.	2–3
• unclear combinations of information or ideas • generation of elements of an aerospace management, safety, airline and/or airport operations solution • identification of a change about an idea or the solution.	1
• does not satisfy any of the descriptors above.	0

Criterion: Communicating

Assessment objective

8. make decisions about and use mode-appropriate features, language and conventions to communicate development of the solution

The student work has the following characteristics:	Marks
• discerning decision-making about, and fluent use of, – written and visual features to communicate about a solution – language for a technical audience – grammatically accurate language structures – folio and referencing conventions.	3–4
• variable decision-making about, and inconsistent use of, – written and visual features – suitable language – grammar and language structures – folio or referencing conventions.	1–2
• does not satisfy any of the descriptors above.	0

4.8.2 Summative internal assessment 2 (IA2): Examination (25%)

Description

This assessment is a supervised test that assesses the application of a range of cognitions to multiple provided items — questions, scenarios and problems.

Student responses must be completed individually, under supervised conditions, and in a set timeframe.

Assessment objectives

This assessment technique is used to determine student achievement in the following objectives:

1. recognise and describe problems, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aerospace operational systems
2. symbolise and explain ideas, solutions and relationships in relation to aerospace operational systems
3. analyse problems and information in relation to aerospace operational systems
5. synthesise information and ideas to propose possible aerospace operational systems solutions
7. evaluate and refine ideas and solutions to make justified recommendations.

Note: Objectives 4, 6 and 8 are not assessed in this instrument.

Specifications

Description

Short response

- consists of a number of items that may ask students to respond to the following activities
  - sketching, drawing, graphs, tables and diagrams
  - writing multiple-choice, single-word, sentence or short-paragraph responses drawn from Unit 3 subject matter in each topic
  - calculating using concepts and principles drawn from Unit 3, Topic 5 subject matter
  - responding to seen or unseen stimulus materials
- where applicable, students are required to write in full sentences, constructing a response so that ideas are maintained, developed and justified
- the examination must assess a balance across the assessment objectives
- the total number of marks used in an examination marking scheme is a school decision. However, in order to correctly apply the ISMG, the percentage allocation of marks must match the following specifications.

Mark allocations

Percentage of marks	Degree of difficulty
~ 20%	**Complex unfamiliar** This item type requires students to choose and apply appropriate procedures in a situation where: • relationships and interactions have a number of elements and connections are made with knowledge, concepts and principles in relation to aerospace operational systems, and • all the information to solve the problem is not immediately identifiable, that is – the required procedure is not clear from the way the question is posed, and – in a context in which students have had limited prior experience. Typically, these items focus on objectives 3, 5 and 7, and can provide evidence of objectives 1 and 2. They require sustained analysis, synthesis and evaluation of relevant information to develop responses.
~ 20%	**Complex familiar** This item type requires students to show competence with the use and comprehension of definitions, procedures, concepts and techniques in a situation where: • relationships and interactions have a number of elements and connections are made with knowledge, concepts and principles in relation to aerospace operational systems, and • all of the information to solve the problem is identifiable, that is – the required procedure is clear from the way the question is posed, or – in a context that has been a focus of prior learning. Typically, these items focus on objectives 3, 5 and 7, and can provide evidence of objectives 1 and 2. They require analysis and synthesis, and some evaluation of relevant information to develop responses.
~ 60%	**Simple familiar** This item type requires students to show competence with the use and comprehension of definitions, procedures, concepts and techniques in a situation where: • relationships and interactions are obvious and have few elements and • all of the information to solve the problem is identifiable, that is – the required procedure is clear from the way the question is posed, or – in a context that has been a focus of prior learning. Typically, these items focus on objectives 1, 3 and 5, and can provide evidence of objective 2. They require recognition and description, and some analysis and synthesis of information to develop responses.

Conditions

- Time: 2 hours plus perusal (10 minutes)
- Length: 800–1000 words in total or equivalent, including
  - a number of multiple-choice, single-word or sentence response items
  - a number of short-paragraph response items of 50–150 words per item
  - a number of items requiring calculations

- the number of short-response items should allow students to complete the response in the set time

- Other
  - seen stimulus — teachers must ensure the purpose of the technique is not compromised
  - unseen stimulus — materials or questions must not be copied from information or texts that students have previously been exposed to or have used directly in class
  - when stimulus materials are used, they will be succinct enough to allow students sufficient time to engage with them; for stimulus materials that are lengthy, complex or large in number, they will be shared with students prior to the administration of the assessment instrument
  - only the QCAA formula sheet must be provided
  - notes are not permitted
  - use of technology is required: non-programmable scientific calculator only permitted
  - protractor and ruler required.

Summary of the instrument-specific marking guide

The following table summarises the criteria, assessment objectives and mark allocation for the objectives assessed in the examination.

Criterion	Objectives	Marks
Aerospace systems knowledge and problem-solving	1, 2, 3, 5 and 7	25
Total		**25**

Note: Unit objectives 4, 6 and 8 are not assessed in this instrument.

Instrument-specific marking guide

Criterion: Aerospace systems knowledge and problem-solving

Assessment objectives

1. recognise and describe problems, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aerospace operational systems
2. symbolise and explain ideas, solutions and relationships in relation to aerospace operational systems
3. analyse problems and information in relation to aerospace operational systems
5. synthesise information and ideas to propose possible aerospace operational systems solutions
7. evaluate and refine ideas and solutions to make justified recommendations.

The student work has the following characteristics:	Cut-off	Marks
• across the full range of simple familiar, complex familiar and complex unfamiliar situations – accurate and discriminating recognition and discerning description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; adept symbolisation and discerning explanation of ideas, solutions and relationships; insightful and accurate analysis of problems and information; coherent and logical synthesis of information and ideas to propose possible solutions; critical evaluation and discerning refinement of ideas and solutions to make astutely justified recommendations.	> 96%	25
	> 93%	24
• in a comprehensive range of simple familiar, complex familiar and complex unfamiliar situations – accurate and discriminating recognition and discerning description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; adept symbolisation and discerning explanation of ideas, solutions and relationships; insightful and accurate analysis of problems and information; coherent and logical synthesis of information and ideas to propose possible solutions; critical evaluation and discerning refinement of ideas and solutions to make astutely justified recommendations.	> 89%	23
	> 86%	22
• in a comprehensive range of simple familiar situations, and in complex familiar and complex unfamiliar situations – accurate recognition and effective description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; methodical symbolisation and effective explanation of ideas, solutions and relationships; considered analysis of problems and information; logical synthesis of information and ideas to propose possible solutions; reasoned evaluation and effective refinement of ideas and solutions to make considered recommendations.	> 82%	21
	> 78%	20
• in a range of simple familiar situations, and in complex familiar and complex unfamiliar situations – accurate recognition and effective description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; methodical symbolisation and effective explanation of ideas and solutions; considered analysis of problems and information; logical synthesis of information and ideas to propose possible solutions; reasoned evaluation and effective refinement of ideas and solutions to make considered recommendations	> 75%	19
	> 71%	18
• in a range of simple familiar situations and in complex familiar situations – appropriate recognition and description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; competent symbolisation and appropriate explanation of ideas and solutions; appropriate analysis of problems and information; simple synthesis of information and ideas to propose possible solutions; feasible evaluation and adequate refinement of ideas and solutions to make fundamental recommendations.	> 68%	17
	> 64%	16
• in a range of simple familiar situations and in some complex familiar situations – appropriate recognition and description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; competent symbolisation and appropriate explanation of ideas and solutions; appropriate analysis of problems and information; simple synthesis of information and ideas to propose possible solutions; feasible evaluation and adequate refinement of ideas and solutions to make fundamental recommendations.	> 60%	15
	> 57%	14

The student work has the following characteristics:	Cut-off	Marks
• in simple familiar situations – appropriate recognition and description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; variable symbolisation and appropriate explanation of ideas and solutions; appropriate analysis of problems and information; simple synthesis of information and ideas to propose possible solutions; feasible evaluation and adequate refinement of ideas and solutions to make fundamental recommendations.	> 53%	13
	> 50%	12
• in simple familiar situations – variable recognition and superficial description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; variable symbolisation and superficial explanation of ideas and solutions; superficial analysis of problems and information; rudimentary synthesis of information and ideas to propose possible solutions; superficial evaluation and adequate refinement of ideas and solutions to make elementary recommendations.	> 46%	11
	> 42%	10
• in some simple familiar situations – variable recognition and superficial description of aspects of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; superficial explanation of ideas and solutions; superficial analysis of problems and information; rudimentary synthesis of information and ideas to propose partial possible solutions; superficial evaluation of ideas and solutions to make elementary recommendations.	> 37%	9
	> 33%	8
• in a limited range of simple familiar situations – variable recognition and superficial description of aspects of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; superficial explanation of ideas and solutions; superficial analysis of aspects of problems and information; unclear combination of information and ideas; superficial evaluation of ideas and solutions.	> 28%	7
	> 24%	6
• disjointed recognition and statements about aspects of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; identification of a change about ideas, solutions and information; unclear combination of information and ideas.	> 19%	5
	> 14%	4
• statements about aspects of aerospace operational systems problems, knowledge, concepts and principles; statements about ideas, solutions and information; isolated and unclear combination of information and ideas.	> 10%	3
	> 5%	2
• isolated and unclear statements about aspects of aerospace operational systems problems, knowledge, concepts and principles.	> 0%	1
• does not satisfy any of the descriptors above.		0

5 Unit 4: Aircraft performance systems and human factors

5.1 Unit description

In Unit 4, students study aircraft performance systems and human factors to understand the issues that impact on their operation in aerospace contexts. Unit topics provide an instructional focus for problem-solving experiences that promote students' understanding of the necessity for continual development of aircraft systems technologies. Students use systems thinking habits and systems thinking strategies to explore aircraft operational systems in order to solve actual, possible or probable problems. Through their study of this unit, students develop an understanding of the interdependencies that exist between and within the various systems that function to maintain the safe and efficient operation of innovative contemporary aircraft.

Learning in this unit equips students with an appreciation for the role that applied aerospace technologies play in the promotion of public confidence in a highly competitive and safety-conscious industry.

Unit requirements

In this unit, teachers combine and balance direct instruction with instruction developed using the various phases of the problem-solving process in Aerospace Systems. Teachers should provide appropriately structured real-world problems or situations that enable students to experience systems thinking and the associated aerospace technology knowledge, concepts and principles. Students should be provided with opportunities to collaboratively make decisions in groups as they learn about and through problem-solving.

Notional time allocation by topic and assessment

	Unit topic	Notional hours
Topic 1	Aircraft performance	12
Topic 2	Aircraft navigation	10
Topic 3	Advanced navigation and radio communication technologies	5
Topic 4	Human performance and limitations	8
Assessment integrated within the unit		20

5.2 Unit objectives

Unit objectives are drawn from the syllabus objectives and are contextualised for the subject matter and requirements of the unit. Each unit objective must be assessed at least once.

Students will:

Unit objective	IA3	EA
1. recognise and describe problems, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aircraft performance systems and human factors	•	•
2. symbolise and explain ideas, solutions and relationships in relation to aircraft performance systems and human factors	•	•
3. analyse problems and information in relation to aircraft performance systems and human factors	•	•
4. determine solution success criteria for aircraft performance systems and human factors problems	•	
5. synthesise information and ideas to propose possible aircraft performance systems and human factors solutions	•	•
6. generate aircraft performance systems and human factors solutions to provide data to assess the feasibility of proposals	•	
7. evaluate and refine ideas and solutions to make justified recommendations	•	•
8. make decisions about and use mode-appropriate features, language and conventions to communicate development of solutions.	•	

5.3 Topic 1: Aircraft performance

Guiding question: Aircraft performance standards are maintained by an array of systems. Why and how do they sometimes fail?

Subject matter

In this topic, students will:

- describe and explain the function, limitations and data output of the six key flight instruments
  - airspeed indicator (pitot static)
  - attitude indicator (gyro)
  - altimeter (pitot static)
  - vertical speed indicator (pitot static)
  - heading indicator (gyro)
  - turn coordinator (gyro)
- interpret the information from the six key flight instruments to make decisions in real-world situations
- define and explain airspeed limitations of
  - normal operating speed (Vno)
  - never exceed speed (Vne)
  - maximum manoeuvring speed (Va)
  - turbulence penetration speed (Vb)
  - flap operating speed (Vfo)
  - flap extension speed (Vfe)
  - stall speed (Vs) in clean and landing configuration
- examine turbine engines and investigate the differences between turbofan, turbojet and turboprop engines and analyse their individual advantages and limitations
- recognise the difference between centrifugal and axial flow jet engines
- investigate the environmental impacts of operating jet engines, including noise, local air quality and emissions
- investigate the effect of altitude on piston and turbine engine performance
- examine the purpose, components and operation of basic aircraft electrical, hydraulic, pressurisation, fuel and de-icing systems, including airframe and engine
- calculate pressure and density altitude using the formulas

$$pressure\ altitude = airfield\ elevation + (ISA\ pressure - QNH) \times 30$$
$$density\ altitude = pressure\ altitude + [120 \times (OAT - ISA\ Temp)]$$
$$OAT = outside\ air\ temperature\ in\ ℃$$
$$ISA\ temperature = 15℃ - 1.98℃\ per\ 1000ft.\ (304.8\ metres)$$
$$ISA\ pressure = 1013\ hPa\ @\ sea\ level - 1\ hPa\ per\ 30ft$$

- determine flight performance parameters using take-off, landing and loading charts
- brainstorm possible or probable aircraft problem situations and consider the consequences given the array of aircraft safety systems designed to negate aircraft flight failure.

5.4 Topic 2: Aircraft navigation

Guiding question: How do navigation systems support safe travel arrangements and how are in-flight problems solved?

Subject matter

In this topic, students will:

- interpret aeronautical charts, including World Aeronautical Chart (WAC), Visual Navigation Chart (VNC), and Visual Terminal Chart (VTC); students will
  - use plotter (or ruler and protractor) to find distance and bearing
  - convert true bearing to a magnetic bearing
  - identify ground height to calculate minimum safe altitude
  - apply the hemispheric rule (odds and evens) for altitude selection
  - recognise airspace boundaries
- interpret *En Route Supplement Australia* (ERSA), including to
  - access runway direction, slope, elevation and length information
  - comprehend local airfield information, including facilities and dangers
  - identify location of key infrastructure, e.g. terminals and windsocks
  - identify PRD: prohibited, restricted, danger area information
- interpret area forecast to obtain wind speed and direction at various heights
- calculate crosswind, head/tail wind, drift/crab angle, heading to steer, speed/distance/time and fuel using a flight computer
- comprehend regulatory requirements for maintaining a fuel reserve (45 minutes of flight time)
- tabulate calculated data into a flight plan using the CASA flight plan format (SP107)
- calculate a track error, track made good, closing angle, track change required and track to intercept using a flight computer or the 1 in 60 rule
- calculate any changes in estimated time of arrival (ETA), estimated time en route (ETE), ground speed and fuel information due to unplanned events
- use systems thinking habits and systems thinking strategies and problem-solving to determine alternative solutions to a given navigation problem, e.g. fog at a destination airport or aircraft engine or instrument failure.

5.5 Topic 3: Advanced navigation and radio communication technologies

Guiding question: How can pilots compensate for failure in navigation and radio communications systems and maintain safe aircraft operation?

Subject matter
In this topic, students will: • describe an electronic flight information systems (EFIS), head-up display (HUD) and glass cockpit • analyse the presentation of information on EFIS and HUD displays and determine the advantages and disadvantages of each in terms of aircraft operations • define and explain the operation, purpose and limitations of – primary surveillance radar (PSR) – secondary surveillance radar (SSR) – visual approach slope guidance systems (T-VASIS, VASIS, PAPI) – instrument landing system (ILS) – automatic dependent surveillance broadcast (ADS-B) – traffic collision avoidance systems (TCAS) – global navigation satellite systems, including Global Positioning System (GPS), Globalnaya Navigazionnaya Sputnikovaya Sistema (GLONASS), Gallileo • generate solutions to a cockpit-related instrumentation failure by analysing using systems visual frameworks and feedback loops during problem-solving.

5.6 Topic 4: Human performance and limitations

Guiding question: What impact does the aerospace environment have on the human mind and body, and what are the limitations of the human-in-the-loop in aerospace systems?

Subject matter
In this topic, students will: • investigate the effects of health and fitness on human performance in an aerospace environment, including – body mass index (BMI) – diet – hydration – smoking – general health, e.g. cold and flu – emotional health • comprehend the effects of alcohol and drugs on human performance • examine the effects of noise on human performance and the importance of the ear in relation to balance and orientation • explore vision issues in aerospace and the effects on human performance, including – binocular vision – empty field myopia – effects of low oxygen – scanning – illusions and perception • comprehend the causes of disorientation that may be felt due to the three sensing mechanisms

Subject matter

  - eyes
  - inner ear
  - skeletal muscles and joints
- explain the effect of G force on the human body
- describe and explain the causes, symptoms and remedies of hypoxia and hyperventilation
- explore the role of human decision-making, personality and attitudes in aerospace situations
- examine the relationships between human error, human behaviour, sleep, stress and fatigue
- investigate the importance of cockpit design, including ergonomics, standardisation, cognitive load reduction, and information interpretation, with regard to electronic flight information systems (EFIS) and head-up display (HUD)
- comprehend the importance of effective crew resource management, including
  - language
  - culture
  - environment
  - leadership
  - communication
  - leadership versus authority
- explain the factors affecting situation awareness, including
  - system design — ergonomics requires information to be presented in a user-friendly way; the individual should be able to gain the information they require more easily, improving situational awareness
  - stress and workload — stress affects people's abilities to process information; in high-stress and high-workload situations, people are not able to process as much information and therefore situational awareness suffers
  - automation — automatic systems need to be actively monitored, along with flight instruments and controls; failure to do so reduces the operator's situational awareness
  - physiological factors — factors such as illness and medication can have a drastic effect on information processing and therefore on situational awareness
  - preconceptions — a preconception about what is going to happen reduces situational awareness and can lead to incorrect and potentially harmful actions
  - abilities, experience and training — current training supports automatic execution of the correct actions when real-life emergency situations occur
- identify and solve a problem associated with the relationship between human and aircraft systems given the physiological effects of flight stress, using the problem-solving process in Aerospace Systems.

5.7 Assessment

5.7.1 Summative internal assessment 3 (IA3): Project — folio (25%)

Description

This assessment focuses on a problem-solving process that requires the application of a range of cognitive, technical and creative skills and theoretical understandings. Students document the iterative process undertaken to develop a solution to a problem. The response is a coherent work that includes written paragraphs and annotations, diagrams, sketches, drawings, photographs, tables, spreadsheets and prototypes.

This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop a response.

Assessment objectives

This assessment technique is used to determine student achievement in the following objectives:

1. recognise and describe the aircraft performance systems and/or human factors problem, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aircraft performance systems and/or human factors
2. symbolise and explain ideas, a solution and relationships in relation to aircraft performance systems and/or human factors
3. analyse the aircraft performance systems and/or human factors problem and information in relation to aircraft performance systems and/or human factors
4. determine solution success criteria for the aircraft performance systems and/or human factors problem
5. synthesise information and ideas to propose a possible aircraft performance systems and/or human factors solution
6. generate an aircraft performance systems and/or human factors solution to provide data to assess the feasibility of the proposal
7. evaluate and refine ideas and a solution to make justified recommendations
8. make decisions about and use mode-appropriate features, language and conventions to communicate development of the solution.

Specifications

Description

In Aerospace Systems, a folio involves students documenting the application of a problem-solving process in response to an identified real-world aerospace problem. The response will include the following folio and referencing conventions:

- headings that organise and communicate the student's thinking through the iterative phases of the problem-solving process in Aerospace Systems
- a table of contents page
- a reference list and a recognised system of in-text referencing.

For this assessment, teachers will provide an appropriate aircraft performance systems and/or human factors problem context, for example:

- modifying aircraft cockpit design to support greater pilot situational awareness during unusually stressful operational circumstances
- planning a multi-stage flight with diversions, taking into account altitude density, airspace, take-off and landing performance tasks and weather
- investigating a case study of an aircraft accident associated with human factors to develop an education program (e.g. in a multimedia format) to provide to an aerospace industry stakeholder.

The folio will be in two parts and include the following assessable evidence.

Part A documents the development of an aircraft performance systems and/or human factors problem, including:

- recognition and description of the characteristics of the aircraft performance systems and/or human factors problem in relation to related aerospace systems, subsystems and system components
- symbolisation and explanation of the incorporated aerospace systems, the development of ideas and the solution with visual frameworks, causal and feedback loops, flow charts, diagrams, sketches and/or pictures
- analysis of aerospace systems, technology and research information, contributing factors and areas of weakness to identify the elements, components, and features, and their relationship to the structure of the aircraft performance systems and/or human factors problem
- determination of solution success criteria considering the identified elements, components and features, and their relationship to the structure of the aircraft performance systems and/or human factors problem
- synthesis of aerospace systems, technology, and research information, and ideas to propose a possible solution to the aircraft performance systems and/or human factors problem
- generation of the proposed solution for the aircraft performance systems and/or human factors problem and testing, simulating or hypothesising to provide data (e.g. pictures, tables, surveys, interview recordings, audio-visual recording) for evaluation including (if applicable), annotated photographs or screen captures of the solution prior to and after testing, simulating or hypothesising
- evaluation and refinement of ideas and the solution for the aircraft performance systems and/or human factors problem in relation to solution success criteria
- recommendation and justification of future modifications or enhancements to ideas and the solution to the aircraft performance systems and/or human factors problem
- communication of the development of ideas and the solution for an aircraft performance systems and/or human factors problem using written and visual features, e.g. PMI (plus, minus, interesting) charts, tables, pictures, bubble diagrams, feedback loops
- communication of data using diagrams, tables and/or spreadsheets

Part B communicates a summary report to the specified client drawn from Part A documentation and includes key visual frameworks, feedback loops, flow charts, diagrams, sketches or pictures that provide a concise account of the preferred solution, including the key features of the solution and any recommendations made to inform future solution development.

Conditions

- Duration: 5–7 weeks
- Length
  - Part A: 7–9 single-sided A3 pages or equivalent digital media
  - Part B: 2–3 single-sided A4 pages or equivalent digital media
- Other
  - the table of contents and reference list are not included in the page count
  - schools should implement authentication strategies that reflect QCAA guidelines.

Summary of the instrument-specific marking guide

The following table summarises the mark allocation for the objectives assessed in the folio.

Criterion	Objectives	Marks
Retrieving and comprehending	1 and 2	5
Analysing	3 and 4	7
Synthesising and evaluating	5, 6 and 7	9
Communicating	8	4
Total		**25**

Instrument-specific marking guide

Criterion: Retrieving and comprehending

Assessment objectives

1. recognise and describe the aircraft performance systems and/or human factors problem, aerospace and systems thinking concepts and principles in relation to aircraft performance systems and/or human factors
2. symbolise and explain ideas, a solution and relationships in relation to aircraft performance systems and/or human factors

The student work has the following characteristics:	Marks
• accurate and discriminating recognition and discerning description of the aircraft performance systems and/or human factors problem, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aircraft performance systems and/or human factors • adept symbolisation and discerning explanation of ideas, a solution and relationships in relation to aircraft performance systems and/or human factors with visual frameworks, causal and feedback loops, flow charts, diagrams, sketches and/or pictures.	4–5
• accurate recognition and appropriate description of the aircraft performance systems and/or human factors problem, aerospace technology knowledge, concepts and principles, and some systems thinking habits and systems thinking strategies in relation to aircraft performance systems and/or human factors • competent symbolisation and appropriate explanation of some ideas, a solution and relationships in relation to aircraft performance systems and/or human factors with visual frameworks, causal and feedback loops, flow charts, diagrams, sketches and/or pictures.	2–3
• variable recognition and superficial description of aspects of the aircraft performance systems and/or human factors problem, concepts or principles in relation to aircraft performance systems and/or human factors • variable symbolisation or superficial explanation of aspects of ideas, a solution or relationships in relation to aircraft performance systems and/or human factors.	1
• does not satisfy any of the descriptors above.	0

Criterion: Analysing

Assessment objectives

3. analyse the aircraft performance systems and/or human factors problem and information in relation to aircraft performance systems and/or human factors
4. determine solution success criteria for the aircraft performance systems and/or human factors problem

The student work has the following characteristics:	Marks
• insightful analysis of the aircraft performance systems and/or human factors problem and relevant aerospace systems, technology, and research information in relation to aircraft performance systems and/or human factors to identify the relevant elements, components and features, and their relationship to the structure of the problem • astute determination of essential solution success criteria for the aircraft performance systems and/or human factors problem.	6–7
• considered analysis of the aircraft performance systems and/or human factors problem and relevant aerospace systems, technology, and research information in relation to aircraft performance systems and/or human factors to identify the relevant elements, components and features, and their relationship to the structure of the problem • logical determination of effective solution success criteria for the aircraft performance systems and/or human factors problem.	4–5
• appropriate analysis of the aircraft performance systems and/or human factors problem and aerospace systems, technology, and research information in relation to aircraft performance systems and/or human factors to identify some of the elements, components and features of the problem • reasonable determination of some solution success criteria for the aircraft performance systems and/or human factors problem.	2–3
• statements about the aircraft performance systems and/or human factors problem, or information in relation to aircraft performance systems and/or human factors • vague determination of some solution success criteria for the aircraft performance systems and/or human factors problem.	1
• does not satisfy any of the descriptors above.	0

Criterion: Synthesising and evaluating

Assessment objectives

5. synthesise information and ideas to propose a possible aircraft performance systems and/or human factors solution
6. generate an aircraft performance systems and/or human factors solution to provide data to assess the feasibility of the proposal
7. evaluate and refine ideas and a solution to make justified recommendations

The student work has the following characteristics:	Marks
• coherent and logical synthesis of relevant aerospace systems, technology, and research information and ideas to propose a possible aircraft performance systems and/or human factors solution • purposeful generation of an aircraft performance systems and/or human factors solution to provide valid data to critically assess the feasibility of a proposal • critical evaluation and discerning refinement of ideas and a solution using success criteria to make astute recommendations justified by data and research evidence.	8–9
• logical synthesis of relevant aerospace systems, technology, and research information and ideas to propose a possible aircraft performance systems and/or human factors solution • effective generation of an aircraft performance systems and/or human factors solution to provide valid data to effectively assess the feasibility of a proposal • reasoned evaluation and effective refinement of ideas and a solution using success criteria to make considered recommendations justified by data and research evidence.	6–7
• simple synthesis of aerospace systems, technology, and research information and ideas to propose a possible aircraft performance systems and/or human factors solution • adequate generation of an aircraft performance systems and/or human factors solution to provide relevant data to assess the feasibility of a proposal • feasible evaluation and adequate refinement of ideas and a solution using some success criteria to make fundamental recommendations justified by data and research evidence.	4–5
• rudimentary synthesis of partial aerospace systems, technology, or research information and/or ideas to propose an aircraft performance systems and/or human factors solution • partial generation of an aircraft performance systems and/or human factors solution to provide elements of data to partially assess the feasibility of a proposal • superficial evaluation of ideas or a solution using some success criteria to make elementary recommendations.	2–3
• unclear combinations of information or ideas • generation of elements of an aircraft performance systems and/or human factors solution • identification of a change about an idea or the solution.	1
• does not satisfy any of the descriptors above.	0

Criterion: Communicating

Assessment objective

8. make decisions about and use mode-appropriate features, language and conventions to communicate development of the solution

The student work has the following characteristics:	Marks
• discerning decision-making about, and fluent use of, – written and visual features to communicate about a solution – language for a technical audience – grammatically accurate language structures – folio and referencing conventions.	3–4
• variable decision-making about, and inconsistent use of, – written and visual features – suitable language – grammar and language structures – folio or referencing conventions.	1–2
• does not satisfy any of the descriptors above.	0

5.7.2 Summative external assessment (EA): Examination (25%)

General information

Summative external assessment is developed and marked by the QCAA. In Aerospace Systems it contributes 25% to a student's overall subject result.

The external assessment in Aerospace Systems is common to all schools and administered under the same conditions, at the same time, on the same day.

Description

The examination assesses the application of a range of cognitions to multiple provided items — questions, scenarios and problems.

Student responses must be completed individually, under supervised conditions, and in a set timeframe.

Assessment objectives

This assessment technique is used to determine student achievement in the following objectives:

1. recognise and describe problems, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aircraft performance systems and human factors
2. symbolise and explain ideas, solutions and relationships in relation to aircraft performance systems and human factors
3. analyse problems and information in relation to aircraft performance systems and human factors
5. synthesise information and ideas to propose possible aircraft performance systems and human factors solutions
7. evaluate and refine ideas and solutions to make justified recommendations.

Note: Objectives 4, 6 and 8 are not assessed in this instrument.

Specifications

Description

Short response

- consists of a number of items that may ask students to respond to the following activities
  - sketching, drawing, graphs, tables and diagrams
  - writing multiple-choice, single-word, sentence or short-paragraph responses drawn from Unit 4 subject matter in each topic
  - calculating using formulas drawn from across Unit 4 subject matter
  - responding to unseen stimulus materials
- where applicable, students are required to write in full sentences, constructing a response so that ideas are maintained, developed and justified
- the examination must assess a balance across the assessment objectives

- the percentage allocation of marks must match the following specifications.

Mark allocations

Percentage of marks	Degree of difficulty
~ 20%	**Complex unfamiliar** This item type requires students to choose and apply appropriate procedures in a situation where: • relationships and interactions have a number of elements and connections are made with knowledge, concepts and principles in relation to aircraft performance systems and human factors, and • all the information to solve the problem is not immediately identifiable, that is – the required procedure is not clear from the way the question is posed, and – in a context in which students have had limited prior experience. Typically, these items focus on objectives 3, 5 and 7, and can provide evidence of objectives 1 and 2. They require sustained analysis, synthesis and evaluation of relevant information to develop responses.
~ 20%	**Complex familiar** This item type requires students to show competence with the use and comprehension of definitions, procedures, concepts and techniques in a situation where: • relationships and interactions have a number of elements and connections are made with knowledge, concepts and principles in relation to aircraft performance systems and human factors, and • all of the information to solve the problem is identifiable, that is – the required procedure is clear from the way the question is posed, or – in a context that has been a focus of prior learning. Typically, these items focus on objectives 3, 5 and 7, and can provide evidence of objectives 1 and 2. They require analysis and synthesis, and some evaluation of relevant information to develop responses.
~ 60%	**Simple familiar** This item type requires students to show competence with the use and comprehension of definitions, procedures, concepts and techniques in a situation where: • relationships and interactions are obvious and have few elements and • all of the information to solve the problem is identifiable, that is – the required procedure is clear from the way the question is posed, or – in a context that has been a focus of prior learning. Typically, these items focus on objectives 1, 3 and 5, and can provide evidence of objective 2. They require recognition and description, and some analysis and synthesis of information to develop responses.

Conditions

- Time: 2 hours plus perusal (10 minutes)
- Length: 800–1000 words in total or equivalent, including
  - a number of multiple-choice, single-word or sentence response items
  - a number of short-paragraph response items of 50–150 words per item
  - a number of items requiring calculations

- Other
  - only the QCAA formula sheet must be provided
  - notes are not permitted
  - use of technology is required: non-programmable scientific and flight calculator only permitted
  - protractor and ruler required.

Instrument-specific marking guide

No ISMG is provided for the external assessment.

6 Glossary

Term	Explanation
A	
aerofoil	a body shaped so as to produce an aerodynamic reaction (lift) normal to its direction of motion
aeronautics	all the activities concerned with aerial locomotion; the science of designing, building and operating aircraft
accident	an occurrence associated with the operation of an aircraft, which takes place between the time any person boards the aircraft with the intention of flight and until all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage
accomplished	highly trained or skilled in a particular activity; perfected in knowledge or training; expert
accuracy	the condition or quality of being true, correct or exact; freedom from error or defect; precision or exactness; correctness; in science, the extent to which a measurement result represents the quantity it purports to measure; an accurate measurement result includes an estimate of the true value and an estimate of the uncertainty
accurate	precise and exact; to the point; consistent with or exactly conforming to a truth, standard, rule, model, convention or known facts; free from error or defect; meticulous; correct in all details
adept	very/highly skilled or proficient at something; expert
adequate	satisfactory or acceptable in quality or quantity equal to the requirement or occasion
Airservices Australia	the organisation responsible for providing the Australian aviation industry with a safe, secure, efficient, and environmentally-responsible air navigation and aviation rescue firefighting services
air traffic control	ATC
analyse	dissect to ascertain and examine constituent parts and/or their relationships; break down or examine in order to identify the essential elements, features, components or structure; determine the logic and reasonableness of information; examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences
angle of attack	the angle formed by the relative airflow and the chord line of an aerofoil
angle of incidence	the angle formed by the chord line of an aerofoil and the longitudinal axis of the aircraft
anhedral	the downward angle from horizontal of the wings or tailplane of a fixed-wing aircraft
annotated	made or furnished critical or explanatory notes, or comments to a picture, drawing, sketch or diagram

Term	Explanation
applied learning	the acquisition and application of knowledge, understanding and skills in real-world or lifelike contexts that may encompass workplace, industry and community situations; it emphasises learning through doing and includes both theory and the application of theory, connecting subject knowledge and understanding with the development of practical skills
Applied subject	a subject whose primary pathway is work and vocational education; it emphasises applied learning and community connections; a subject for which a syllabus has been developed by the QCAA with the following characteristics: results from courses developed from Applied syllabuses contribute to the QCE; results may contribute to ATAR calculations
apply	use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation
appraise	evaluate the worth, significance or status of something; judge or consider a text or piece of work
appreciate	recognise or make a judgment about the value or worth of something; understand fully; grasp the full implications of
appropriate	acceptable; suitable or fitting for a particular purpose, circumstance, context etc.
apt	suitable to the purpose or occasion; fitting, appropriate
area of study	a division of, or a section within a unit
argue	give reasons for or against something; challenge or debate an issue or idea; persuade, prove or try to prove by giving reasons
ASK	available seat kilometres; a measure of an airline flight's passenger carrying capacity
aspect	a particular part of a feature of something; a facet, phase or part of a whole
aspect ratio	the ratio of the wing's span and its mean chord, e.g. a glider has a high aspect ratio wing, while a Cessna has a medium to low aspect ratio wing
assess	measure, determine, evaluate, estimate or make a judgment about the value, quality, outcomes, results, size, significance, nature or extent of something
assessment	purposeful and systematic collection of information about students' achievements
assessment instrument	a tool or device used to gather information about student achievement
assessment objectives	drawn from the unit objectives and contextualised for the requirements of the assessment instrument (see also 'syllabus objectives', 'unit objectives')
assessment technique	the method used to gather evidence about student achievement, e.g. examination, project, investigation
astute	showing an ability to accurately assess situations or people; of keen discernment
ATAR	Australian Tertiary Admission Rank

Term	Explanation
ATC	Air traffic control
ATSB	Australia Transport Safety Bureau
Australia Transport Safety Bureau	ATSB
Australian airspace	Class A: this high-level en route controlled airspace is used predominately by commercial and passenger jets; only instrument flight rules (IFR) flights are permitted and they require an air traffic control (ATC) clearance; all flights are provided with an air traffic control service and are positively separated from each other Class C: this is the controlled airspace surrounding major airports; both IFR and visual flight rules (VFR) flights are permitted and must communicate with air traffic control; IFR aircraft are positively separated from both IFR and VFR aircraft; VFR aircraft are provided traffic information on other VFR aircraft Class D: this is the controlled airspace that surrounds general aviation and regional airports equipped with a control tower; all flights require ATC clearance Class E: this mid-level en route controlled airspace is open to both IFR and VFR aircraft; IFR flights are required to communicate with ATC and must request ATC clearance Class G: this airspace is uncontrolled; both IFR and VFR aircraft are permitted and neither require ATC clearance (Airservices Australia)
authoritative	able to be trusted as being accurate or true; reliable; commanding and self-confident; likely to be respected and obeyed
automation	the use of various control systems for operating equipment such as machinery, processes in factories, steering and stabilisation of ships, aircraft and other applications with minimal or reduced human intervention
available seat kilometres	ASK; a measure of an airline flight's passenger carrying capacity
B	
balanced	keeping or showing a balance; not biased; fairly judged or presented; taking everything into account in a fair, well-judged way
basic	fundamental
Bernoulli's principle	as airflow increases, the pressure will decrease
BKN	broken; in meteorological reporting, cloud cover in 5/8 to 7/8 of sky
boundary layer	a thin layer of near-stationary air surrounding an aerofoil
broken	BKN; in meteorological reporting, cloud cover in 5/8 to 7/8 of sky
C	
calculate	determine or find (e.g. a number, answer) by using mathematical processes; obtain a numerical answer showing the relevant stages in the working; ascertain/determine from given facts, figures or information
CASA	Civil Aviation Safety Authority (Australia); responsible for the regulation of civil aviation in Australia

Term	Explanation
CASK	cost for available seat kilometres; expressed in cents to operate each seat per kilometre offered
categorise	place in or assign to a particular class or group; arrange or order by classes or categories; classify, sort out, sort, separate
causal chain	an ordered sequence or chain of events where one event is dependent on a previous event
challenging	difficult but interesting; testing one's abilities; demanding and thought-provoking; usually involving unfamiliar or less familiar elements
characteristic	a typical feature or quality
Chicago Convention	put in place to establish ICAO and the rules of airspace, aircraft registration and safety, and to provide details of the rights of the signatories in relation to air travel; it was signed by 52 states on 7 December 1944 and came into effect on 4 April 1947
Civil Aviation Safety Authority (Australia)	CASA; responsible for the regulation of civil aviation in Australia
clarify	make clear or intelligible; explain; make a statement or situation less confused and more comprehensible
clarity	clearness of thought or expression; the quality of being coherent and intelligible; free from obscurity of sense; without ambiguity; explicit; easy to perceive, understand or interpret
class time	includes the time made available for students to independently respond to extended assessment tasks and any associated and required teaching and learning time
classify	arrange, distribute or order in classes or categories according to shared qualities or characteristics
clear	free from confusion, uncertainty, or doubt; easily seen, heard or understood
clearly	in a clear manner; plainly and openly, without ambiguity
coherent	having a natural or due agreement of parts; connected; consistent; logical, orderly; well-structured and makes sense; rational, with parts that are harmonious; having an internally consistent relation of parts
cohesive	characterised by being united, bound together or having integrated meaning; forming a united whole
comment	express an opinion, observation or reaction in speech or writing; give a judgment based on a given statement or result of a calculation
communicate	convey knowledge and/or understandings to others; make known; transmit
compare	display recognition of similarities and differences and recognise the significance of these similarities and differences

Term	Explanation
competent	having suitable or sufficient skills, knowledge, experience, etc. for some purpose; adequate but not exceptional; capable; suitable or sufficient for the purpose; having the necessary ability, knowledge or skill to do something successfully; efficient and capable (of a person); acceptable and satisfactory, though not outstanding
composite materials	materials made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components; the individual components remain separate and distinct within the finished structure; the new material may be preferred for many reasons: common examples include materials that are stronger, lighter or less expensive when compared to traditional materials; typical engineered composite materials include: • composite building materials such as cements and concrete • reinforced plastics such as fibre-reinforced polymer • metal composites • ceramic composites (composite ceramic and metal matrices) (also called 'composition materials' or shortened to 'composites')
complex	composed or consisting of many different and interconnected parts or factors; compound; composite; characterised by an involved combination of parts; complicated; intricate; a complex whole or system; a complicated assembly of particulars
components	parts (made of two or more elements) that make up a whole object or system and perform specific functions
comprehend	understand the meaning or nature of; grasp mentally
comprehensive	inclusive; of large content or scope; including or dealing with all or nearly all elements or aspects of something; wide-ranging; detailed and thorough, including all that is relevant
concepts	abstract ideas, formed by mentally combining all its characteristics or particulars; a theoretical construct; a generalised mental operation
concise	expressing much in few words; giving a lot of information clearly and in a few words; brief, comprehensive and to the point; succinct, clear, without repetition of information
concisely	in a way that is brief but comprehensive; expressing much in few words; clearly and succinctly
conduct	direct in action or course; manage; organise; carry out
consider	think deliberately or carefully about something, typically before making a decision; take something into account when making a judgment; view attentively or scrutinise; reflect on
considerable	worthy of consideration; fairly large or great; thought about deliberately, with a purpose
considered	formed after careful and deliberate thought

Term	Explanation
consistent	agreeing or accordant; compatible; not self-opposed or self-contradictory, constantly adhering to the same principles; acting in the same way over time, especially so as to be fair or accurate; unchanging in nature, standard, or effect over time; not containing any logical contradictions (of an argument); constant in achievement or effect over a period of time
constraints	limitations or restrictions that must be considered and accommodated when providing a solution to a problem, e.g. teacher-specified limitations, available time, physical realities, legalities
construct	create or put together (e.g. an argument) by arranging ideas or items; display information in a diagrammatic or logical form; make; build
contrast	display recognition of differences by deliberate juxtaposition of contrary elements; show how things are different or opposite; give an account of the differences between two or more items or situations, referring to both or all of them throughout
control system	a device or set of devices to manage, command, direct or regulate the behaviour of other devices or systems; a mechanical, optical or electronic system that is used to maintain a desired output
controlled	shows the exercise of restraint or direction over; held in check; restrained, managed or kept within certain bounds
convention	a rule, method, practice or procedure widely observed in a group, especially to facilitate social interaction, and established by general consent or usage
convincing	persuaded by argument or proof; leaving no margin of doubt; clear; capable of causing someone to believe that something is true or real; persuading or assuring by argument or evidence; appearing worthy of belief; credible or plausible
cost for available seat kilometres	CASK; expressed in cents to operate each seat per kilometre offered
course	a defined amount of learning developed from a subject syllabus
create	bring something into being or existence; produce or evolve from one's own thought or imagination; reorganise or put elements together into a new pattern or structure or to form a coherent or functional whole
creative	resulting from originality of thought or expression; relating to or involving the use of the imagination or original ideas to create something; having good imagination or original ideas
credible	capable or worthy of being believed; believable; convincing
criterion	the property or characteristic by which something is judged or appraised
critical	involving skilful judgment as to truth, merit, etc.; involving the objective analysis and evaluation of an issue in order to form a judgment; expressing or involving an analysis of the merits and faults of a work of literature, music, or art; incorporating a detailed and scholarly analysis and commentary (of a text); rationally appraising for logical consistency and merit
critique	review (e.g. a theory, practice, performance) in a detailed, analytical and critical way

Term	Explanation
cursory	hasty, and therefore not thorough or detailed; performed with little attention to detail; going rapidly over something, without noticing details; hasty; superficial
D	
data	documented information or evidence of any kind that lends itself to scientific interpretation; data may be quantitative or qualitative
decide	reach a resolution as a result of consideration; make a choice from a number of alternatives
deduce	reach a conclusion that is necessarily true, provided a given set of assumptions is true; arrive at, reach or draw a logical conclusion from reasoning and the information given
defensible	justifiable by argument; capable of being defended in argument
define	give the meaning of a word, phrase, concept or physical quantity; state meaning and identify or describe qualities
demonstrate	prove or make clear by argument, reasoning or evidence, illustrating with practical example; show by example; give a practical exhibition
derive	arrive at by reasoning; manipulate a mathematical relationship to give a new equation or relationship in mathematics, obtain the derivative of a function
describe	give an account (written or spoken) of a situation, event, pattern or process, or of the characteristics or features of something
design	produce a plan, simulation, model or similar; plan, form or conceive in the mind in English, select, organise and use particular elements in the process of text construction for particular purposes; these elements may be linguistic (words), visual (images), audio (sounds), gestural (body language), spatial (arrangement on the page or screen) and multimodal (a combination of more than one)
detailed	executed with great attention to the fine points; meticulous; including many of the parts or facts
determine	establish, conclude or ascertain after consideration, observation, investigation or calculation; decide or come to a resolution
develop	elaborate, expand or enlarge in detail; add detail and fullness to; cause to become more complex or intricate
devise	think out; plan; contrive; invent
diagrams	symbolic representations of information according to some visualisation technique; often two-dimensional and geometric; symbols, charts, graphs and maps are forms of diagrams
differentiate	identify the difference/s in or between two or more things; distinguish, discriminate; recognise or ascertain what makes something distinct from similar things in mathematics, obtain the derivative of a function

Term	Explanation
dihedral	the upward angle from horizontal of the wings or tailplane of a fixed-wing aircraft
discerning	discriminating; showing intellectual perception; showing good judgment; making thoughtful and astute choices; selected for value or relevance
discriminate	note, observe or recognise a difference; make or constitute a distinction in or between; differentiate; note or distinguish as different
discriminating	differentiating; distinctive; perceiving differences or distinctions with nicety; possessing discrimination; perceptive and judicious; making judgments about quality; having or showing refined taste or good judgment
discuss	examine by argument; sift the considerations for and against; debate; talk or write about a topic, including a range of arguments, factors or hypotheses; consider, taking into account different issues and ideas, points for and/or against, and supporting opinions or conclusions with evidence
disjointed	disconnected; incoherent; lacking a coherent order/sequence or connection
distinguish	recognise as distinct or different; note points of difference between; discriminate; discern; make clear a difference/s between two or more concepts or items
diverse	of various kinds or forms; different from each other
document	support (e.g. an assertion, claim, statement) with evidence (e.g. decisive information, written references, citations)
drag	the force that acts opposite to the direction of motion
draw conclusions	make a judgment based on reasoning and evidence
dynamic stability	how an aircraft responds over time to a disturbance
E	
effective	successful in producing the intended, desired or expected result; meeting the assigned purpose
efficiency	measure of the extent to which input is productively used for an intended task or function
efficient	working in a well-organised and competent way; maximum productivity with minimal expenditure of effort; acting or producing effectively with a minimum of waste, expense or unnecessary effort
elements	constituent parts of a more complex whole; a fundamental, essential or irreducible part of a composite entity; two or more elements make a component
elementary	simple or uncompounded; relating to or dealing with elements, rudiments or first principles (of a subject); of the most basic kind; straightforward and uncomplicated
En Route Supplement Australia	ERSA; a joint military and Airservices Australia publication that contains information vital for planning a flight and for the pilot in flight; the ERSA contains pictorial representations of all licensed airports

Term	Explanation
environment	one of the outputs of technologies processes and/or a place or space in which technologies processes operate; may be natural, managed, constructed or digital
environmental lapse rate	the rate at which atmospheric temperature decreases with an increase in altitude, i.e. –2 °C every 304.8 m (1000 ft)
environmental sustainability	practices that have minimal impact on an ecosystem's health, and allow renewal of natural systems and value environmental qualities that support life
erroneous	based on or containing error; mistaken; incorrect
ERSA	*En Route Supplement Australia*; a joint military and Airservices Australia publication that contains information vital for planning a flight and for the pilot in flight; the ERSA contains pictorial representations of all licensed airports
essential	absolutely necessary; indispensable; of critical importance for achieving something
evaluate	make an appraisal by weighing up or assessing strengths, implications and limitations; make judgments about ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria
examination	a supervised test that assesses the application of a range of cognitions to one or more provided items such as questions, scenarios and/or problems; student responses are completed individually, under supervised conditions and in a set timeframe
examine	investigate, inspect or scrutinise; inquire or search into; consider or discuss an argument or concept in a way that uncovers the assumptions and interrelationships of the issue
experiment	try out or test new ideas or methods, especially in order to discover or prove something; undertake or perform a scientific procedure to test a hypothesis, make a discovery or demonstrate a known fact
explain	make an idea or situation plain or clear by describing it in more detail or revealing relevant facts; give an account; provide additional information
explicit	clearly and distinctly expressing all that is meant; unequivocal; clearly developed or formulated; leaving nothing merely implied or suggested
explore	look into both closely and broadly; scrutinise; inquire into or discuss something in detail
express	convey, show or communicate (e.g. a thought, opinion, feeling, emotion, idea or viewpoint) (in words, art, music or movement) convey or suggest a representation of; depict
extended response	an open-ended assessment technique that focuses on the interpretation, analysis, examination and/or evaluation of ideas and information in response to a particular situation or stimulus; while students may undertake some research when writing of the extended response, it is not the focus of this technique; an extended response occurs over an extended and defined period of time

Term	Explanation
Extension subject	a two-unit subject (Units 3 and 4) for which a syllabus has been developed by QCAA, that is an extension of one or more General subject/s, studied concurrently with, Units 3 and 4 of that subject or after completion of, Units 3 and 4 of that subject
extensive	of great extent; wide; broad; far-reaching; comprehensive; lengthy; detailed; large in amount or scale
external assessment	summative assessment that occurs towards the end of a course of study and is common to all schools; developed and marked by the QCAA according to a commonly applied marking scheme
external examination	a supervised test, developed and marked by the QCAA, that assesses the application of a range of cognitions to multiple provided items such as questions, scenarios and/or problems; student responses are completed individually, under supervised conditions, and in a set timeframe
extrapolate	infer or estimate by extending or projecting known information; conjecture; infer from what is known; extend the application of something (e.g. a method or conclusion) to an unknown situation by assuming that existing trends will continue or similar methods will be applicable
F	
factual	relating to or based on facts; concerned with what is actually the case; actually occurring; having verified existence
familiar	well-acquainted; thoroughly conversant with; well-known from long or close association; often encountered or experienced; common; (of materials, texts, skills or circumstances) having been the focus of learning experiences or previously encountered in prior learning activities
feasible	capable of being achieved, accomplished or put into effect; reasonable enough to be believed or accepted; probable; likely
features	prominent or conspicuous elements, components or characteristics of a structured whole
FEW	in meteorological reporting, cloud cover in 1/8 to 2/8 of sky
fineness ratio	the ratio of the thickness of a wing and its mean chord, e.g. a fighter jet would have a high fineness ratio, while an A380 Airbus would have a low fineness ratio
flap	device used to increase the lift of an aircraft wing at a given airspeed
flap extension speed	Vfe; maximum velocity (V) with flaps (f) extended (e)
flap operating speed	Vfo; maximum velocity (V) where flaps (f) can be operated (o)
flow charts	diagrams that shows step-by-step progression through a procedure or system especially using connecting lines, arrows and a set of conventional symbols; used to illustrate a solution model to a given problem
fluent	spoken or written with ease; able to speak or write smoothly, easily or readily; articulate; eloquent; in artistic performance, characteristic of a highly developed and excellently controlled technique; flowing; polished; flowing smoothly, easily and effortlessly

Term	Explanation
fluently	in a graceful and seemingly effortless manner; in a way that progresses smoothly and readily
formative assessment	assessment whose major purpose is to improve teaching and student achievement
fragmented	disorganised; broken down; disjointed or isolated
frequent	happening or occurring often at short intervals; constant, habitual, or regular
fundamental	forming a necessary base or core; of central importance; affecting or relating to the essential nature of something; part of a foundation or basis
G	
General subject	a subject for which a syllabus has been developed by the QCAA with the following characteristics: results from courses developed from General syllabuses contribute to the QCE; General subjects have an external assessment component; results may contribute to ATAR calculations
generate	produce; create; bring into existence
G force	used as a unit of stress measurement for bodies undergoing acceleration
global navigation satellite system	GNSS; satellite navigation system with global coverage providing geo-spatial positioning, e.g. GPS is a GNSS
global positioning system	GPS; a global navigation satellite system
GNSS	global navigation satellite system; satellite navigation system with global coverage providing geo-spatial positioning, e.g. GPS is a GNSS
GPS	global positioning system; a global navigation satellite system
ground control station	land- or sea-based control environment, most often designed for human control of remote piloted aircraft systems (RPAS)
ground effect	slightly increased air pressure between the lower surface of the wing and the ground
ground speed	GS; the speed of an aircraft in relation to the ground
GS	ground speed, i.e. the speed of an aircraft in relation to the ground
H	
hemispheric rule	used for aircraft to create safe separation at cruising altitudes; aircraft planning to fly in an easterly direction are required to fly at odd-numbered flight levels, and aircraft flying in a westerly direction must fly at even-numbered flight levels
hypoxia	a condition in which the body or a region of the body is deprived of adequate oxygen supply at the tissue level
I	
IATA	International Air Transport Association; an association of airlines, provides many of the commercial policies and standards used by airlines and airport services

Term	Explanation
ICAO	International Civil Aviation Organisation; put in place to manage the administration and governance of the Convention on International Civil Aviation (Chicago Convention).
identify	distinguish; locate, recognise and name; establish or indicate who or what someone or something is; provide an answer from a number of possibilities; recognise and state a distinguishing factor or feature
illogical	lacking sense or sound reasoning; contrary to or disregardful of the rules of logic; unreasonable
implement	put something into effect, e.g. a plan or proposal
implicit	implied, rather than expressly stated; not plainly expressed; capable of being inferred from something else
improbable	not probable; unlikely to be true or to happen; not easy to believe
inaccurate	not accurate
inappropriate	not suitable or proper in the circumstances
incident	an occurrence other than an accident associated with the operation of an aircraft, which affects or could affect the safety of operations
inconsistent	lacking agreement, as one thing with another, or two or more things in relation to each other; at variance; not consistent; not in keeping; not in accordance; incompatible, incongruous
independent	thinking or acting for oneself, not influenced by others
in-depth	comprehensive and with thorough coverage; extensive or profound; well-balanced or fully developed
infer	derive or conclude something from evidence and reasoning, rather than from explicit statements; listen or read beyond what has been literally expressed; imply or hint at
informed	knowledgeable; learned; having relevant knowledge; being conversant with the topic; based on an understanding of the facts of the situation (of a decision or judgment)
innovation	either something new or a change made to an existing product, process, idea, or field
innovative	new and original; introducing new ideas; original and creative in thinking
input	something put into a system to activate or modify a process, e.g. people, raw materials, power, energy, money, time, equipment, software and data
insightful	showing understanding of a situation or process; understanding relationships in complex situations; informed by observation and deduction
instrument-specific marking guide	ISMG; a tool for marking that describes the characteristics evident in student responses and aligns with the identified objectives for the assessment (see 'assessment objectives')

Term	Explanation
integral	*adjective* necessary for the completeness of the whole; essential or fundamental; *noun* in mathematics, the result of integration; an expression from which a given function, equation, or system of equations is derived by differentiation
intended	designed, meant; done on purpose, intentional
internal assessment	assessments that are developed by schools; summative internal assessments are endorsed by the QCAA before use in schools and results externally confirmed contribute towards a student's final result
International Air Transport Association	IATA
International Civil Aviation Organisation	ICAO
International Space Station	ISS; the habitable low-Earth orbit space station or artificial satellite
international standard atmosphere	ISA; a standard set of readings used as a benchmark in the aerospace environment
interpret	use knowledge and understanding to recognise trends and draw conclusions from given information; make clear or explicit; elucidate or understand in a particular way; bring out the meaning of, e.g. a dramatic or musical work, by performance or execution; bring out the meaning of an artwork by artistic representation or performance; give one's own interpretation of; identify or draw meaning from, or give meaning to, information presented in various forms, such as words, symbols, pictures or graphs
investigate	carry out an examination or formal inquiry in order to establish or obtain facts and reach new conclusions; search, inquire into, interpret and draw conclusions about data and information
investigation	an assessment technique that requires students to research a specific problem, question, issue, design challenge or hypothesis through the collection, analysis and synthesis of primary and/or secondary data; it uses research or investigative practices to assess a range of cognitions in a particular context; an investigation occurs over an extended and defined period of time
irrelevant	not relevant; not applicable or pertinent; not connected with or relevant to something
ISA	international standard atmosphere; a standard set of readings used as a benchmark in the aerospace environment
ISA pressure	international standard atmosphere pressure; always 1013 hPa at sea level
ISA temperature	international standard atmosphere temperature; always 15°C at sea level

Term	Explanation
ISMG	instrument-specific marking guide; a tool for marking that describes the characteristics evident in student responses and aligns with the identified objectives for the assessment (see 'assessment objectives')
isolated	detached, separate, or unconnected with other things; one-off; something set apart or characterised as different in some way
ISS	International Space Station; the habitable low-Earth orbit space station or artificial satellite
iterative	recursive; revisiting earlier parts of a process to further clarify meaning or refine ideas and solutions
J	
judge	form an opinion or conclusion about; apply both procedural and deliberative operations to make a determination
justified	sound reasons or evidence are provided to support an argument, statement or conclusion
justify	give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable
L	
learning area	a grouping of subjects, with related characteristics, within a broad field of learning, e.g. the Arts, sciences, languages
lift	the force that directly opposes the weight of an airplane and holds the airplane in the air
load factor	a number which yields the inertial load when multiplied by the weight of an object.
logical	rational and valid; internally consistent; reasonable; reasoning in accordance with the principles/rules of logic or formal argument; characterised by or capable of clear, sound reasoning; (of an action, decision, etc.) expected or sensible under the circumstances
logically	according to the rules of logic or formal argument; in a way that shows clear, sound reasoning; in a way that is expected or sensible
M	
make decisions	select from available options; weigh up positives and negatives of each option and consider all the alternatives to arrive at a position
manage	to bring about or succeed in accomplishing; to take charge or care of; to handle, direct, govern or control in action or use
manipulate	adapt or change to suit one's purpose
mass	the measure of an object's resistance to acceleration (a change in its state of motion) when a force is applied; the SI unit of mass is the kilogram (kg)
maximum manoeuvring speed	Va; the speed above which any full application of a single flight control may exceed the aircraft's structural limitations

Term	Explanation
mechanics	study of the application of mechanics to solve problems involving common engineering elements; covers the effects of forces on the condition of machines, structures, and their components when at rest or in motion, particularly the mechanics of rigid structures, machines and components
mental procedures	a domain of knowledge in Marzano's taxonomy, and acted upon by the cognitive, metacognitive and self-systems; sometimes referred to as 'procedural knowledge' there are three distinct phases to the acquisition of mental procedures — the cognitive stage, the associative stage, and the autonomous stage; the two categories of mental procedures are skills (single rules, algorithms and tactics) and processes (macroprocedures)
methodical	performed, disposed or acting in a systematic way; orderly; characterised by method or order; performed or carried out systematically
methodology	a system of methods used in a particular area of study or activity
mind map	a purposeful diagram used to visually organise information; allows the abstract relationships between ideas to be explored and refined; visual representations may include images, words and parts of words; usually a central idea or concept is placed in the middle and associated ideas arranged around it
minimal	least possible; small, the least amount; negligible
model	a representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships in an object, system or idea; can be either a physical model, such as a scale model of a car or house that shows the form of a final production design, and is made with tools, jigs and fixtures; or virtual, such as a simulator program that demonstrates the capabilities of a vending machine through interaction with a computer user
modify	change the form or qualities of; make partial or minor changes to something
multimodal	uses a combination of at least two modes (e.g. spoken, written), delivered at the same time, to communicate ideas and information to a live or virtual audience, for a particular purpose; the selected modes are integrated so that each mode contributes significantly to the response
N	
narrow	limited in range or scope; lacking breadth of view; limited in amount; barely sufficient or adequate; restricted
NASA	National Aeronautics and Space Administration; United States agency responsible for the civilian space, aeronautics and aerospace research program
National Aeronautics and Space Administration	NASA; United States agency responsible for the civilian space, aeronautics and aerospace research program
never exceed speed	Vne; the maximum capacity of the safe operation of the aircraft
Newton's third law	for every action, there is an equal and opposite reaction
normal operating speed	Vno

Term	Explanation
nuanced	showing a subtle difference or distinction in expression, meaning, response, etc.; finely differentiated; characterised by subtle shades of meaning or expression; a subtle distinction, variation or quality; sensibility to, awareness of, or ability to express delicate shadings, as of meaning, feeling, or value
O	
1 in 60 rule	states that if a pilot has travelled sixty miles then an error in track of one mile is approximately a 1° error in heading, and proportionately more for larger errors
OAT	outside air temperature; the current air temperature read directly from a thermometer in degrees Celsius
objectives	see ‘syllabus objectives’, ‘unit objectives’, ‘assessment objectives’
obvious	clearly perceptible or evident; easily seen, recognised or understood
open-ended problems	loosely structured and complex, having no one correct solution or solution path, and requiring students to comprehend and apply a breadth and depth of knowledge during problem-solving
optimal	best, most favourable, under a particular set of circumstances
organise	arrange, order; form as or into a whole consisting of interdependent or coordinated parts, especially for harmonious or united action
organised	systematically ordered and arranged; having a formal organisational structure to arrange, coordinate and carry out activities
output	a result of something (physical or virtual) such as power, energy, action, material or information produced by a person, machine or a system
outside air temperature	OAT; the current air temperature read directly from a thermometer in degrees Celsius
outstanding	exceptionally good; clearly noticeable; prominent; conspicuous; striking
OVC	overcast; in meteorological reporting, complete cloud cover
overcast	OVC; in meteorological reporting, complete cloud cover
P	
partial	not total or general; existing only in part; attempted, but incomplete
particular	distinguished or different from others or from the ordinary; noteworthy
passenger yield	PY; the measure of average fare paid per kilometre, per passenger, calculated by dividing passenger revenue by revenue passenger kilometres
pattern	something that happens in a regular and repeated way
pax	passengers
perceptive	having or showing insight and the ability to perceive or understand; discerning (see also ‘discriminating’)

Term	Explanation
performance	an assessment technique that requires students to demonstrate a range of cognitive, technical, creative and/or expressive skills and to apply theoretical and conceptual understandings, through the psychomotor domain; it involves student application of identified skills when responding to a task that involves solving a problem, providing a solution or conveying meaning or intent; a performance is developed over an extended and defined period of time
persuasive	capable of changing someone's ideas, opinions or beliefs; appearing worthy of approval or acceptance; (of an argument or statement) communicating reasonably or credibly (see also 'convincing')
perusal time	time allocated in an assessment to reading items and tasks and associated assessment materials; no writing is allowed; students may not make notes and may not commence responding to the assessment in the response space/book
phonetic alphabet	system of code words for identifying letters in radio communication
planning time	time allocated in an assessment to planning how to respond to items and tasks and associated assessment materials; students may make notes but may not commence responding to the assessment in the response space/book; notes made during planning are not collected, nor are they graded or used as evidence of achievement
polished	flawless or excellent; performed with skilful ease
precise	definite or exact; definitely or strictly stated, defined or fixed; characterised by definite or exact expression or execution
precision	accuracy; exactness; exact observance of forms in conduct or actions
predict	give an expected result of an upcoming action or event; suggest what may happen based on available information
principles	specific types of generalisations that deal with relationships; a proposition that serves as the foundation for a system of belief or behaviour or for a chain of reasoning
problem-solving process	consists of subject specific problem-solving processes (explore, develop, generate and evaluate) used to iteratively find solutions to difficult or complex problems or situations
product	an assessment technique that focuses on the output or result of a process requiring the application of a range of cognitive, physical, technical, creative and/or expressive skills, and theoretical and conceptual understandings; a product is developed over an extended and defined period of time; in Technologies, a designed solution; a tangible end result of a human, construction, mechanical, manufacturing or digital process; created by practical application of knowledge and skills
proficient	well advanced or expert in any art, science or subject; competent, skilled or adept in doing or using something

Term	Explanation
project	an assessment technique that focuses on a problem-solving process requiring the application of a range of cognitive, technical and creative skills and theoretical understandings; the response is a coherent work that documents the iterative process undertaken to develop a solution and includes written paragraphs and annotations, diagrams, sketches, drawings, photographs, video, spoken presentations, physical prototypes and/or models; a project is developed over an extended and defined period of time
propose	put forward (e.g. a point of view, idea, argument, suggestion) for consideration or action
prototype	a trial solution to test an idea to inform further development; demonstrates the interaction of the components of a product, service or environment; its purpose is to identify if and how well a solution functions and can be tested by stakeholders
prove	use a sequence of steps to obtain the required result in a formal way
psychomotor procedures	a domain of knowledge in Marzano's taxonomy, and acted upon by the cognitive, metacognitive and self-systems; these are physical procedures used to negotiate daily life and to engage in complex physical activities; the two categories of psychomotor procedures are skills (foundational procedures and simple combination procedures) and processes (complex combination procedures)
purposeful	having an intended or desired result; having a useful purpose; determined; resolute; full of meaning; significant; intentional
PY	passenger yield; the measure of average fare paid per kilometre, per passenger, calculated by dividing passenger revenue by revenue passenger kilometres
Q	
QCE	Queensland Certificate of Education
QNH	pressure setting used in aviation to refer to barometric settings for altimeters
qualitative data	information that is not numerical in nature
quantitative data	numerical information
R	
radio communications phraseology	systematic way to communicate between the pilot and air traffic controller (ATC unit) for the purpose of ensuring uniformity in radiotelephony (RTF) communications
RASK	revenue available seat kilometres; a commonly used measure of unit revenue for airlines, expressed in cents received for each available seat kilometre
realise	create or make (e.g. a musical, artistic or dramatic work); actualise; make real or concrete; give reality or substance to
reasonable	endowed with reason; having sound judgment; fair and sensible; based on good sense; average; appropriate, moderate
reasoned	logical and sound; based on logic or good sense; logically thought out and presented with justification; guided by reason; well-grounded; considered

Term	Explanation
recall	remember; present remembered ideas, facts or experiences; bring something back into thought, attention or into one's mind
recognise	identify or recall particular features of information from knowledge; identify that an item, characteristic or quality exists; perceive as existing or true; be aware of or acknowledge
refine	to make partial or minor changes to something in order to improve it; modify in relation to selected criteria
refined	developed or improved so as to be precise, exact or subtle
reflect on	think about deeply and carefully
rehearsed	practised; previously experienced; practised extensively
related	associated with or linked to
relationships	the way in which two or more things are connected, or the state of being connected
relevance	being related to the matter at hand
relevant	bearing upon or connected with the matter in hand; to the purpose; applicable and pertinent; having a direct bearing on
reliability	ability to be trusted to be accurate or correct or to provide a correct result
reliable	constant and dependable or consistent and repeatable
remotely piloted aircraft system	RPAS; a powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a payload; also known as a drone
repetitive	containing or characterised by repetition, especially when unnecessary or tiresome
reporting	providing information that succinctly describes student performance at different junctures throughout a course of study
resolve	in the Arts, consolidate and communicate intent through a synthesis of ideas and application of media to express meaning
revenue available seat kilometres	RASK; a commonly used measure of unit revenue for airlines, expressed in cents received for each available seat kilometre
revenue passenger kilometres	RPK; measures of traffic for an airline flight, bus, or train calculated by multiplying the number of revenue-paying passengers aboard the vehicle by the distance travelled
risk assessment	evaluations performed to identify, assess and control hazards in a systematic way
routine	often encountered, previously experienced; commonplace; customary and regular; well-practiced; performed as part of a regular procedure, rather than for a special reason

Term	Explanation
RPAS	remotely piloted aircraft system; a powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a payload; also known as a drone
RPK	revenue passenger kilometres; measures of traffic for an airline flight, bus, or train calculated by multiplying the number of revenue-paying passengers aboard the vehicle by the distance travelled
rudimentary	relating to rudiments or first principles; elementary; undeveloped; involving or limited to basic principles; relating to an immature, undeveloped or basic form
S	
safe	secure; not risky
SAR	search and rescue
scattered	SCT; in meteorological reporting, cloud cover in 3/8 to 4/8 of sky
school-based assessment	assessment developed, administered and marked by teachers as part of the school curriculum; (see also 'internal assessment')
SCT	scattered; in meteorological reporting, cloud cover in 3/8 to 4/8 of sky
search and rescue	SAR
secure	sure; certain; able to be counted on; self-confident; poised; dependable; confident; assured; not liable to fail
select	choose in preference to another or others; pick out
sensitive	capable of perceiving with a sense or senses; aware of the attitudes, feelings or circumstances of others; having acute mental or emotional sensibility; relating to or connected with the senses or sensation
sequence	place in a continuous or connected series; arrange in a particular order
SHELL model	software, hardware, environment, liveware; a conceptual model of the relationships between aviation system resources/environment (the flying subsystem) and the human component in the aviation system (the human subsystem)
show	provide the relevant reasoning to support a response
significant	important; of consequence; expressing a meaning; indicative; includes all that is important; sufficiently great or important to be worthy of attention; noteworthy; having a particular meaning; indicative of something
simple	easy to understand, deal with and use; not complex or complicated; plain; not elaborate or artificial; may concern a single or basic aspect; involving few elements, components or steps
simplistic	characterised by extreme simplification, especially if misleading; oversimplified

Term	Explanation
simulation	a representation of a process, event or system that imitates a real or idealised situation
SKC	sky clear; in meteorological reporting, no cloud cover
sketches	drawings or paintings in simple form, giving essential features but not necessarily with detail or accuracy; in mathematics, represent by means of a diagram or graph; the sketch should give a general idea of the required shape or relationship and should include features; in Technologies, a two-dimensional informal visualisation method completed freehand, often instantly capturing an idea for later use and therefore lacking in presentation quality; sketches are usually produced manually, using pencil, ink and paper, but may be software-assisted
skilful	having technical facility or practical ability; possessing, showing, involving or requiring skill; expert, dexterous; demonstrating the knowledge, ability or training to perform a certain activity or task well; trained, practised or experienced
skilled	having or showing the knowledge, ability or training to perform a certain activity or task well; having skill; trained or experienced; showing, involving or requiring skill
slats	a moving auxiliary aerofoil on the leading edge of an aerofoil used to enhance lift
slots	a fixed opening in an aerofoil that redirects airflow to enhance lift
solutions	ideas, concepts, products, systems, components or processes that have been developed through a problem-solving process
solve	find an answer to, explanation for, or means of dealing with (e.g. a problem); work out the answer or solution to (e.g. a mathematical problem); obtain the answer/s using algebraic, numerical and/or graphical methods
sophisticated	of intellectual complexity; reflecting a high degree of skill, intelligence, etc.; employing advanced or refined methods or concepts; highly developed or complicated
specific	clearly defined or identified; precise and clear in making statements or issuing instructions; having a special application or reference; explicit, or definite; peculiar or proper to something, as qualities, characteristics, effects, etc.
spoilers	devices used to spoil/dump lift by disrupting airflow over an aerofoil
sporadic	happening now and again or at intervals; irregular or occasional; appearing in scattered or isolated instances
stall speed	Vs; minimum steady flight speed for which the aircraft is still controllable
static stability	the initial tendency of an aircraft to return to its original position when it is disturbed
straightforward	without difficulty; uncomplicated; direct; easy to do or understand
structure	give a pattern, organisation or arrangement to; construct or arrange according to a plan; an ordered assembly of elements, components and features that form an organised pattern or system

Term	Explanation
structured	organised or arranged so as to produce a desired result
subject	a branch or area of knowledge or learning defined by a syllabus; school subjects are usually based in a discipline or field of study (see also 'course')
subject matter	the subject-specific body of information, mental procedures and psychomotor procedures that are necessary for students' learning and engagement within that subject
substantial	of ample or considerable amount, quantity, size, etc.; of real worth or value; firmly or solidly established; of real significance; reliable; important, worthwhile
substantiated	established by proof or competent evidence
subtle	fine or delicate in meaning or intent; making use of indirect methods; not straightforward or obvious
success criteria	a descriptive list of essential features against which success can be measured; the compilation of criteria involves literacy skills to select and use appropriate terminology
successful	achieving or having achieved success; accomplishing a desired aim or result
succinct	expressed in few words; concise; terse; characterised by conciseness or brevity; brief and clear
sufficient	enough or adequate for the purpose
suitable	appropriate; fitting; conforming or agreeing in nature, condition, or action
summarise	give a brief statement of a general theme or major point/s; present ideas and information in fewer words and in sequence
summary report	provides a client with a concise account of the preferred solution including the key features and any recommendations made to inform future solution development; includes key pictures, tables, graphs, sketches and drawings
summative assessment	assessment whose major purpose is to indicate student achievement; summative assessments contribute towards a student's subject result
superficial	concerned with or comprehending only what is on the surface or obvious; shallow; not profound, thorough, deep or complete; existing or occurring at or on the surface; cursory; lacking depth of character or understanding; apparent and sometimes trivial
supersonic flight	flight exceeding the speed of sound
supported	corroborated; given greater credibility by providing evidence
sustainable	supporting the needs of the present without compromising the ability of future generations to support their needs
sustained	carried on continuously, without interruption, or without any diminishing of intensity or extent

Term	Explanation
Swiss cheese model	(of accident causation) a model used in risk analysis and risk management; likens human systems to multiple slices of Swiss cheese, stacked side by side, in which the risk of a threat becoming a reality (a hole) is mitigated by the types of defences that are layered behind each other
syllabus	a document that prescribes the curriculum for a course of study
syllabus objectives	outline what the school is required to teach and what students have the opportunity to learn; described in terms of actions that operate on the subject matter; the overarching objectives for a course of study (see also 'unit objectives', 'assessment objectives')
symbolise	represent or identify by a symbol or symbols
synoptic weather charts	a weather map commonly used to show current weather patterns
synthesise	combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding
systems	a group of interacting objects, materials or processes that form an integrated whole; systems can be open or closed; a system has properties and/or function that can be described differently from its component parts; systems can be identified as four types: • natural systems, e.g. an ecosystem including plants and animals • designed physical systems, e.g. buildings, road networks, aircraft, airports • designed abstract systems, e.g. mathematic equations, computer algorithms • human activity systems, e.g. a team task, flight crew, human machine interface
systematic	done or acting according to a fixed plan or system; methodical; organised and logical; having, showing, or involving a system, method, or plan; characterised by system or method; methodical; arranged in, or comprising an ordered system
systems engineering	an interdisciplinary field of engineering that focuses on how to design and manage complex engineering systems over their life cycles
systems thinking	a perspective in which people see and comprehend systems as wholes rather than as a collection of parts; a whole is a collection of connections that creates emerging patterns of relationships; systems thinkers use a range of habits, strategies and tools to understand and interpret the dynamic complexity of systems

Term	Explanation
systems thinking habits	range of perspectives used by systems thinkers to understand and interpret the dynamic complexity of systems; habits include looking at: • big picture — examines the dynamics of a system and the relationships between its parts or components, e.g. sees the forest rather than the details of any one tree; • change over time — dynamic systems are made up of individual elements that change over time; systems thinkers interpret the trends and patterns that lead to these changes; • system structure — focuses on the inherent structure of the system to understand system outcomes; • interdependencies — systems exist as a series of interdependent elements that have complex circular causal relationships that are goal orientated; • connections — makes meaning by taking new systems knowledge and integrating with current understandings to create a deeper understanding of the connections in and between systems; • changes in perspectives — looking at a system from a number of different viewpoints to understand how it operates; • assumptions — are examined to gain insight into the function and elements of a system with the aim to improve system performance; • considering issues fully — quick fixes often lead to long-term problems; time and patience is required to develop a deeper understanding of the structure and operation of a system before making decisions to implement changes; • mental models — people's assumptions, generalisations, mental pictures or images that influence how they understand and relate to the world around them; • leverage — where actions and changes in systems structures can lead to significant and enduring improvements in system performance; • consequences — analysing the long- and short-term implications of a decision to minimise the risk of unintended outcomes of an action; • accumulations — systems incorporate elements or accumulations that increase and/or decrease over time, e.g. the amount of aircraft spare parts kept in store depends on consumption, cost and convenience, and interrelationships exist between various systems that supply, replace and use aircraft spare parts; • time delays — implemented actions to change complex dynamic systems may not see immediate results; instead, performance may improve over time • successive approximation — checking results and changing actions if needed to move the system closer to a desired solution or goal
systems thinking strategies	strategies used by system thinkers to visualise the dynamic complexity of systems and aid understanding and analysis; strategies include: • causal loop diagram — shows feedback within a system; feedback refers to circular causal relationships within a system; causal loop diagrams facilitate the understanding and communication of the interactions that represent the dynamics of a system; • balancing feedback — operates to reduce a gap between what is desired and what exists; • reinforcing feedback — a small change builds on itself creating amplification in the same direction; • iceberg visual framework — used to examine a system beyond individual events to investigate patterns of behaviour (changes over time), underlying structures (organisation and relationship between system elements) and mental models

Term	Explanation
T	
technical	requiring special knowledge to be understood
technologies	materials, data, systems, components, tools and equipment used to create solutions for identified needs and opportunities, and the knowledge, understanding and skills used by people involved in the selection and use of these
technology	the development of products, services and environments, using various types of knowledge, including computational, design, systems, social, ethical, economic, environmental, legal and sustainability knowledge to meet human needs and wants; *'the know-how and creative process that may use tools, systems and resources to solve problems and enhance control over the natural and man-made environment in an endeavour to improve the human condition'* (UNESCO 1985 cited in Ferguson 2009, p.7)
test	take measures to check the quality, performance or reliability of something
thorough	carried out through, or applied to the whole of something; carried out completely and carefully; including all that is required; complete with attention to every detail; not superficial or partial; performed or written with care and completeness; taking pains to do something carefully and completely
thoughtful	occupied with, or given to thought; contemplative; meditative; reflective; characterised by or manifesting thought
thrust	a force that moves an aircraft in the direction of the motion
topic	a division of, or sub-section within a unit; all topics/sub-topics within a unit are interrelated
transonic	refers to the condition of flight in which a range of velocities of airflow exist, surrounding and flowing past an air vehicle or an aerofoil that are concurrently below, at, and above the speed of sound in the range of Mach 0.8 to 1.2
turbulence penetration speed	Vb; also known as rough air speed (Vra); maximum speed at which a gust of air turbulence will not damage the aircraft
U	
UTC	Universal Coordinated Time
unclear	not clear or distinct; not easy to understand; obscure
understand	perceive what is meant by something; grasp; be familiar with (e.g. an idea); construct meaning from messages, including oral, written and graphic communication
uneven	unequal; not properly corresponding or agreeing; irregular; varying; not uniform; not equally balanced
unfamiliar	not previously encountered; situations or materials that have not been the focus of prior learning experiences or activities
Universal Coordinated Time	the world's time standard; usually expressed in terms of a 24-hour clock

Term	Explanation
unit	a defined amount of subject matter delivered in a specific context or with a particular focus; it includes unit objectives particular to the unit, subject matter and assessment direction
unit objectives	drawn from the syllabus objectives and contextualised for the subject matter and requirements of a particular unit; they are assessed at least once in the unit (see also 'syllabus objectives', 'assessment objectives')
unrelated	having no relationship; unconnected
use	operate or put into effect; apply knowledge or rules to put theory into practice
V	
Va	maximum manoeuvring speed; the speed above which any full application of a single flight control may exceed the aircraft's structural limitations
vague	not definite in statement or meaning; not explicit or precise; not definitely fixed, determined or known; of uncertain, indefinite or unclear character or meaning; not clear in thought or understanding; couched in general or indefinite terms; not definitely or precisely expressed; deficient in details or particulars; thinking or communicating in an unfocused or imprecise way
valid	sound, just or well-founded; authoritative; having a sound basis in logic or fact (of an argument or point); reasonable or cogent; able to be supported; legitimate and defensible; applicable
variable	*adjective* apt or liable to vary or change; changeable; inconsistent; (readily) susceptible or capable of variation; fluctuating, uncertain; *noun* in mathematics, a symbol, or the quantity it signifies, that may represent any one of a given set of number and other objects
variety	a number or range of things of different kinds, or the same general class, that are distinct in character or quality; (of sources) a number of different modes or references
Vb	turbulence penetration speed; also known as rough air speed (Vra); maximum speed at which a gust of air turbulence will not damage the aircraft
Vfe	maximum velocity (V) with flaps (f) extended (e); flap extension speed
Vfo	flap operating speed; maximum velocity (V) where flaps (f) can be operated (o)
VFR	visual flight rules; a set of regulations under which a pilot operates an aircraft in weather conditions clear enough to allow the pilot to see where the aircraft is going
visual flight rules	VFR; a set of regulations under which a pilot operates an aircraft in weather conditions clear enough to allow the pilot to see where the aircraft is going

Term	Explanation
visual navigation chart	VNC; used for visual navigation in controlled airspace, transition from the world aeronautical chart (WAC) to the visual terminal chart (VTC) when operating around terminal areas, and navigate when nearing controlled airspace or restricted and danger areas; topographical information at a scale of 1:500,000
visual terminal chart	VTC; for visual flight rules (VFR) operations in the vicinity of major aerodromes; in some cases, these charts show detail of tracks to be flown and significant landmarks, which are used by pilots of VFR aircraft to avoid inadvertent penetration of controlled airspace; provides both aeronautical and topographical information at a scale of 1:250,000
VNC	visual navigation chart; used for visual navigation in controlled airspace, transition from the world aeronautical chart (WAC) to the visual terminal chart (VTC) when operating around terminal areas, and navigate when nearing controlled airspace or restricted and danger areas; topographical information at a scale of 1:500,000
Vne	velocity (V) never (n) to exceed (e); never exceed speed, the maximum capacity of the safe operation of the aircraft
Vno	velocity (V) for normal (n) operations (o); normal operating speed
Vs	velocity (V) of the stall (s); stall speed or the minimum steady flight speed for which the aircraft is still controllable
VTC	visual terminal chart; for visual flight rules (VFR) operations in the vicinity of major aerodromes; in some cases, these charts show detail of tracks to be flown and significant landmarks, which are used by pilots of VFR aircraft to avoid inadvertent penetration of controlled airspace; provides both aeronautical and topographical information at a scale of 1:250,000
W	
WAC	world aeronautical chart; used for navigation by pilots of moderate speed aircraft and aircraft at high altitudes; they are at a scale of 1:1,000,000
weight	the weight of an object is the force on the object due to gravity measured in newtons, e.g. an object with a mass of one kilogram has a weight of approximately 9.8 newtons on the surface of the Earth
wide	of great range or scope; embracing a great number or variety of subjects, cases, etc.; of full extent
with expression	in words, art, music or movement, conveying or indicating feeling, spirit, character, etc.; a way of expressing or representing something; vivid, effective or persuasive communication
world aeronautical chart	WAC; used for navigation by pilots of moderate speed aircraft and aircraft at high altitudes; they are at a scale of 1:1,000,000
Z	
zulu time	used in the military and in navigation generally as a term for Universal Coordinated Time (UCT); usually expressed in terms of a 24-hour clock

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8 Version history

Version	Date of change	Update
1.1	May 2018	Editorial edits
		Subject matter amendments
		IA1: Project — folio • Description paragraph amendment
		IA2: Examination • Specification amendment — structure • Removal of objective 8
		IA3: Project — folio • Description paragraph amendment
		EA: Examination • Specification amendment — structure • Removal of objective 8
		Reporting standards • Amendments to standard C and E to align with subjects in the Technologies learning area
		Amendment to ISMGs — IA1, IA2 and IA3
		Glossary updated

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