



Australian Government

MEM23008 Apply advanced algebra and numerical methods to engineering tasks

Release: 1

MEM23008 Apply advanced algebra and numerical methods to engineering tasks

Modification History

Release 1. Supersedes and is equivalent to MEM23008A Apply advanced algebra and numerical methods to engineering tasks.

Application

This unit of competency defines the skills and knowledge required to apply advanced mathematical and numerical method techniques to engineering situations.

Engineering applications requiring advanced mathematics and numerical methods may include those related to assisting decision making by analysis of data, assisting in presentation of data by use of advanced graphical techniques, solution of problems involving rectilinear and rotation motion, solution of problems involving work, energy and power and solution of problems in electrostatics and wave propagation.

The unit applies to engineering or related activities and is suitable for people giving technical support to design, operations or maintenance activities and those pursuing technical qualifications and careers at paraprofessional or technician level.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

MEM23004 Apply technical mathematics

Competency Field

Engineering science

Elements and Performance Criteria

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
1. Determine scope of advanced mathematics and numerical methods required for an engineering application	1.1 Analyse an engineering application for required advanced mathematics or numerical methods tasks 1.2 Develop systematic methods for layout and solution validation, including any required sign-off of solution 1.3 Identify advanced mathematics or numerical methods and any software required for analysis and resolution of identified engineering

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
	application tasks
2. Apply advanced mathematics techniques to engineering applications	2.1 Apply advanced mathematics concepts and models to solve engineering or manufacturing problems 2.2 Check answer by appropriate means 2.3 Interpret answer to determine information required by problem definition 2.4 Report results and document calculations, graphs and analysis
3. Apply numerical methods to engineering applications	3.1 Apply numerical methods concepts and models to solve engineering problems 3.2 Check solution is laid out in a correct manner and is error free 3.3 Review solution to ensure it provides information relevant to resolution of engineering application task 3.4 Report results and document calculations, graphs and analysis

Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential to performance.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

Advanced mathematics and numerical methods techniques include one or more of the following:	- vectors in 3D including i, j, k notation, scalar and vector products - dynamics, including Newton's Laws of Motion, energy, work and power and work-energy theorem - analytical geometry - graphing techniques, including coordinate geometry, polar coordinates and polar graphs - complex numbers, including Cartesian, trigonometric and polar
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	form • linear algebra, including matrix algebra • numerical solutions, including finite difference techniques • errors and propagation of errors • interpolation and approximation.
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Unit Mapping Information

Release 1. Supersedes and is equivalent to MEM23008A Apply advanced algebra and numerical methods to engineering tasks.

Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b7050d37-5fd0-4740-8f7d-3b7a49c10bb2>

Assessment Requirements for MEM23008 Apply advanced algebra and numerical methods to engineering tasks

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include:

- determining relevant algebra and numerical methods to apply to engineering applications
- solving engineering problems using advanced mathematics and numerical methods on at least two occasions
- using appropriate software and/or scientific calculators to generate solutions to algebra and numerical methods problems
- validating results of simple examples using advanced mathematics and numerical methods either analytically and/or graphically using appropriate software or scientific calculators
- assisting decision-making processes in industry by analysing data using advanced mathematics and numerical methods concepts and tools on at least two occasions
- communicating the results of advanced mathematics and numerical methods-based analysis.

Note: Where a volume and/or frequency is not specified, demonstration must be provided at least once.

Knowledge Evidence

Evidence required to demonstrate the required knowledge for this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include knowledge of:

- vectors including:
 - vectors in 3D
 - i, j and k notation
 - magnitude of a vector
 - unit vectors and direction angles
 - scalar or 'dot' product of two vectors
 - vector or 'cross' product of two vectors
 - resolution of vectors
 - differentiation and integration of vectors
- dynamics including:
 - Newton's Laws of Motion
 - energy, work and power

- work-energy theorem
- moment of a force
- analytical geometry including:
 - equation of a plane
 - angle between two planes
 - distance from a point to a plane
 - lines in 3D space
- graphing techniques including:
 - coordinate geometry
 - graphs of exponential growth and decay
 - graphs with logarithmic scales
 - method of least squares
 - polar coordinates and polar graphs
 - graphs of functions of two variables
 - quadric surfaces
- complex numbers including:
 - introduction to complex numbers
 - Cartesian form
 - the Argand plane
 - trigonometric and polar form
- linear algebra including:
 - matrix algebra
 - transformations
 - determinants
- numerical solutions including finite difference techniques
- errors including:
 - computer arithmetic
 - propagation of errors
- interpolation and approximation including:
 - polynomial interpolation
 - Lagrange form
 - Newton's divide formula
 - error bound.
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Assessment Conditions

- Assessors must:
 - have vocational competency in applying advanced algebra and numerical methods to engineering tasks at least to the level being assessed with relevant industry knowledge and experience

- satisfy the assessor requirements in the *Standards for Registered Training Organisations 2015 or its replacement* and comply with the *National Vocational Education and Training Regulator Act 2011*, its replacement or equivalent legislation covering VET regulation in a non-referring state/territory as the case requires.
- Where possible assessment must occur in operational workplace situations. Where this is not possible or where personal safety or environmental damage are limiting factors, assessment must occur in a sufficiently rigorous simulated environment that reflects realistic operational workplace conditions that cover all aspects of workplace performance, including environment, task skills, task management skills, contingency management skills and job role environment skills.
- Conditions for assessment must include access to all tools, equipment, materials and documentation required including relevant workplace procedures, product and manufacturing specifications.
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate
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