Australian Government

Department of Education, Employment and Workplace Relations

# MEM234024A Apply advanced mathematics in technology problems

**Release: 1**

# MEM234024A Apply advanced mathematics in technology problems

## Modification History

New unit

## Unit Descriptor

This unit of competency covers the application of advanced mathematics in an engineering or related application. It includes a range of mathematical techniques and covers both the application of theory in simple calculations and the use of relevant software packages for more complex situations.

## Application of the Unit

This unit applies to projects or tasks requiring advanced mathematics, either manually or through use of an appropriate software package. It is suitable for paraprofessionals and technologists required to solve advanced mathematical problems in an engineering or related field, or those pursuing technologist careers and qualifications.

Prior or concurrent experience in mathematics is required.

## Licensing/Regulatory Information

Not applicable.

## Pre-Requisites

Not applicable.

## Employability Skills Information

This unit contains employability skills.

## Elements and Performance Criteria Pre-Content

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| Elements describe the essential outcomes of a unit of competency. | Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide. |

# Elements and Performance Criteria

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| 1 | Identify a need for the application of advanced mathematics | 1.1 | Identify a problem requiring application of mathematics |
| | | 1.2 | Define the problem |
| | | 1.3 | Determine data currently available for analysis |
| | | 1.4 | Identify ways of obtaining other required data |
| | | 1.5 | Determine information required from outcome |
| 2 | Prepare to solve problem by advanced mathematics | 2.1 | Determine appropriate mathematics to be applied |
| | | 2.2 | Identify and gain access to appropriate computational devices |
| | | 2.3 | Collect required input data |
| | | 2.4 | Analyse collected data for suitability and completeness |
| | | 2.5 | Take appropriate action to address any deficiencies found |
| 3 | Solve problem using advanced mathematics | 3.1 | Apply appropriate techniques to collected data |
| | | 3.2 | Check answer by appropriate means |
| | | 3.3 | Interpret answer to determine information required by problem definition |
| 4 | Communicate outcomes | 4.1 | Communicate outcome to relevant stakeholders by appropriate means |
| | | 4.2 | Explain outcome to stakeholders as appropriate |
| | | 4.3 | Check outcome has addressed problem |

# Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

### Required skills

Required skills include:

- identifying and defining problems
- collecting and analysing data
- reporting and presenting data and quantitative information
- communicating effectively with stakeholders on problem resolution

### Required knowledge

Required knowledge includes:

- exponential, trigonometric and hyperbolic functions
  - revision - functionality and inverse functions
  - exponential and logarithmic functions;
  - trigonometric and inverse trigonometric functions
  - hyperbolic and inverse hyperbolic functions
- series:
  - revision of arithmetic and geometric progressions
  - limits
  - linear and quadratic approximations (Taylor polynomials)
  - partial sums
  - geometric series
  - power series
  - Maclaurin series
- vectors:
  - vectors in 3-dimensions
  - i j k notation
  - magnitude (or modulus) 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:

        - Newton's Laws of Motion
        - energy, work and power
        - the work-energy theorem
        - moment of a force
- analytical geometry:
    - equation of a plane
    - the angle between two planes
    - the distance from a point to a plane
    - lines in 3-dimensional space
- graphing techniques:
    - 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:
    - introduction to complex numbers:
        - Cartesian form
        - the Argand plane
        - trigonometric and polar form
        - subsets of the complex plane
        - De Moivre's Theorem
    - exponential form of complex numbers
    - applications to mesh current network analysis
- linear algebra:
    - matrix algebra:
        - basic operations
        - applications
        - transformations
    - determinants
    - systems of equations I:
        - solutions and inverses
        - applications
    - systems of equations II (numerical techniques)
    - systems of equations III (other systems)

# Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.

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| Critical aspects for assessment and evidence required to demonstrate competency in this unit | Assessors must be satisfied that the candidate can competently and consistently:<br>• identify appropriate mathematical techniques for engineering or related problems<br>• apply the appropriate technique to the problem<br>• check answer has addressed problem<br>• communicate the outcome of the analysis in an appropriate way. |
| Context of and specific resources for assessment | • This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is, the candidate is not in productive work, then a simulated working environment must be used where the range of conditions reflects realistic workplace situations. The competency covered by this unit would be demonstrated by an individual working alone or as part of a team.<br>• Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate ethnicity, age, gender, demographics and disability.<br>• Access must be provided to appropriate learning and/or assessment support when required. Where applicable, physical resources should include equipment modified for people with disabilities. |
| Method of assessment | • Assessment must satisfy the endorsed Assessment Guidelines of the MEM05 Metal and Engineering Training Package.<br>• Assessment methods must confirm consistency and accuracy of performance (over time and in a range of workplace relevant contexts) together with application of underpinning knowledge.<br>• Assessment methods must be by direct observation of tasks and include questioning on underpinning knowledge to ensure its correct interpretation and application.<br>• Assessment may be applied under project-related conditions (real or simulated) and require evidence of process.<br>• Assessment must confirm a reasonable inference that competency is able not only to be satisfied under the particular circumstance, but is able to be transferred to other circumstances.<br>• Assessment may be in conjunction with assessment of other units of competency where required. |
| Guidance information for assessment | Assessment processes and techniques must be culturally appropriate and appropriate to the language and literacy capacity of the candidate and the work being performed. |

# Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

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| **Data available** | Data currently available includes:<br>• all relevant data which is currently available within the organisation or could be readily obtained |
| **Information required** | Information required is the outcome which needs to be produced in order to solve/assist in resolving the defined problem |
| **Mathematics** | Mathematics may include:<br>• one or more or any of the techniques listed under 'required knowledge'<br>• a related technique |
| **Computational device** | Computational devices include:<br>• calculators with appropriate mathematical functions<br>• computer software packages |
| **Appropriate action** | Appropriate action may include:<br>• taking necessary steps to obtain required data<br>• obtaining some relevant proxy for the desired data<br>• choosing a different mathematical/computational device which will function with available data |
| **Appropriate technique** | Appropriate technique includes:<br>• selected mathematical technique which will yield required outcome<br>• a technique which is appropriate for the available data and which is relevant to the problem |
| **Check answer** | Checking answer means examining the answer to ensure it is within the range of expected logical results |
| **Interpret answer** | Interpret answer means translating the result of the mathematical solution into a form which is useable by the relevant stakeholders |
| **Appropriate communication** | Appropriate communication may include:<br>• report<br>• presentation |

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| | • verbal communication<br>• web-based<br>• electronic or hard copy |
| **Check outcome** | Check outcome includes:<br>• ensuring that the result of the analysis does assist in the resolution of the problem |

# Unit Sector(s)

Engineering practice

# Custom Content Section

Not applicable.