Australian Government

Department of Education, Employment and Workplace Relations

MEM234022A Apply advanced calculus to technology problems

Release: 1

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Modification History

New unit

Unit Descriptor

This unit of competency covers the application of advanced calculus in an engineering or related application. It includes differential and integral calculus 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 calculus, 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 covering calculus and differentials 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

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

1	Identify a need for the application of calculus	1.1	Identify a problem requiring application of calculus
		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 calculus	2.1	Determine appropriate calculus 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 calculus	3.1	Apply appropriate technique 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:

- differential calculus:
  - introduction - review of standard derivatives and rules:
    - power rule
    - product rule
    - quotient rule
    - chain or function of a function rule
    - standard derivatives for a variety of common functions
  - higher order derivatives
  - graph sketching
  - maxima and minima (optimisation)
  - rates of change
  - small increments (errors and approximations)
  - implicit differentiation
  - logarithmic differentiation
  - partial differentiation
  - directional derivatives
- integral calculus
  - revision-integration techniques (areas and volumes)
  - partial fractions
  - integration by parts
  - trigonometric and hyperbolic substitution methods
  - improper integrals
  - integration of partial derivatives

- evaluation of arc lengths
- evaluation of surface areas
- mean and RMS values
- approximate integration (the trapezoidal and Simpson's rules)
- evaluation of centre of mass
- evaluation of centroidal positions in plane regions
- evaluation of moments of inertia and second moments of area
- evaluation of work and energy
- evaluation of centres of pressure on submerged plates

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.

Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate can competently and consistently: • identify appropriate calculus technique for engineering or related problems • apply the appropriate technique to the problem • check answer has addressed problem • 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. • Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate ethnicity, age, gender, demographics and disability. • 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. • 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. • Assessment methods must be by direct observation of tasks and include questioning on underpinning knowledge to ensure its correct interpretation and application. • Assessment may be applied under project-related conditions (real or simulated) and require evidence of process. • 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. • 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.

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

	• web-based • electronic or hard copy
Check outcome	Check outcome includes: • ensuring that the result of the analysis does assist in the resolution of the problem

Unit Sector(s)

Not applicable.

Custom Content Section

Not applicable.