Australian Government

MEM23007A Apply calculus to engineering tasks

Release 1

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MEM23007A Apply calculus to engineering tasks

Modification History

Release 1 - New unit. Replaces MEM23002A, but not equivalent.

Unit Descriptor

This unit of competency covers the application of calculus, including differentiation and integration techniques to engineering applications. It includes the use and application of standard differentiation and integration rules, finding maximum and minimum values of curves, application to rates of change and slope, finding definite integrals, using method of substitution, using trigonometric identities and finding areas under curves.

Application of the Unit

The unit applies to engineering or related activities requiring the application of mathematical techniques using calculus. It 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.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

MEM23004A	Apply technical mathematics

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.

Elements and Performance Criteria

1	Determine scope of calculus techniques required for an engineering application	1.1	Analyse an engineering application for required calculus tasks
		1.2	Develop systematic methods for layout and solution validation, including any required external sign-off of solution
		1.3	Identify calculus technique and any software required for analysis and resolution of identified engineering application tasks
		1.4	Identify sources for professional and technical assistance, if required
2	Apply differential techniques to engineering applications	2.1	Apply standard differentiation rules to solve engineering problems
		2.2	Check solution is laid out correctly and is error free
		2.3	Review solution to ensure it provides information relevant to resolution of engineering application task
		2.4	Report results and document calculations, graphs and analysis
3	Apply integration techniques to engineering applications	3.1	Apply standard integration rules to solve engineering problems
		3.2	Check solution is laid out correctly 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

Required Skills and Knowledge

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

Required skills

Required skills include:

- analysing engineering applications to determine relevant calculus techniques
- applying relevant differentiation and integration concepts and tools to engineering applications
- using appropriate software and/or scientific calculators to generate solutions to statistical and probability-related engineering problems
- using differentiation to find rates of change
- applying special calculus techniques to solve more complex integrals, such as:
  - method of substitution
  - using trigonometric identities
- identifying and solving simple first and second order differential equations
- identifying key points to find constants of integration
- finding integrals of algebraic, trigonometric and exponential functions
- establishing appropriate procedures for checking and validating solutions
- logical layout and presentation of data developed using calculus
- reporting and effectively communicating the results of calculus-based analysis

Required knowledge

Required knowledge includes:

- identifying appropriate limits and applying to engineering problems being solved with calculus techniques
- differentiation rules and techniques
- partial differentiation
- relationship between differentiation and attributes of mathematical curves and graphs
- optimisation of variables based on maximum and minimum values of mathematical curves and graphs
- integration as the reverse of differentiation
- integration rules and techniques
- the definite integral

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.

Overview of assessment	A person who demonstrates competency in this unit must be able to apply calculus techniques to engineering and related problems within the context of specified engineering applications and solution validation and technical oversight procedures. The candidate may demonstrate competence through either working individually or as part of a team.
Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate can competently and consistently: • solve mathematical problems related to engineering and manufacturing using calculus techniques • validate results of mathematical problems using calculus either analytically and/or graphically • manipulate engineering and manufacturing-related mathematical functions and equations using calculus techniques • analyse mathematical problems by using appropriate calculus techniques to achieve engineering and manufacturing solutions.
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 then a simulated working environment must be used where the range of conditions reflects realistic workplace situations. The competencies 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 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 not only able 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. Bold italicised wording, if used in the performance criteria, is detailed below. 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.

Engineering applications related to calculus techniques in this unit	Most engineering disciplines will have applications supported by the calculus skills described in this unit, including mechanical, manufacturing, maintenance and mechatronics engineering. Examples of engineering or manufacturing applications requiring calculus skills described in this unit may include: • determining the point of maximum bending moment, slope and deflection for a beam • determining the depth of parabolic mirrors • determining moments of inertia of a range of engineering components • solving rectilinear motion problems
Scope of calculus techniques	The scope of calculus techniques required for an engineering or manufacturing application will vary and may include: • identification of appropriate limits • use of standard derivatives and rules • application of second and third derivatives • finding rates of change and slopes of curves • calculating maximum and minimum values of curves • solving first and second order differential equations • use of standard integrals and rules • finding constants of integration • finding areas under and between curves • integrating algebraic, trigonometric and exponential functions • the definite integral

	• identification of appropriate methods to solve more complex integration applications

Unit Sector(s)

Competency field

Unit sector Engineering science

Custom Content Section

Not applicable.