Australian Government

MEM09156A Prepare mechatronic models for computer-aided engineering (CAE)

Release: 1

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MEM09156A Prepare mechatronic models for computer-aided engineering (CAE)

Modification History

Release 1 - New unit. Replaces MEM09152A, but not equivalent.

Unit Descriptor

This unit of competency covers the application of techniques for mechatronic modelling for computer-aided engineering (CAE) purposes. It includes consideration of the CAE purposes for which the model is required, such as automated mechanisms, robots or system control and data acquisition (SCADA) environments, printed circuit board manufacture and assembly, and as a basis for generating orthogonal drawings.

Application of the Unit

This unit applies to modelling of mechatronic or automation systems and devices for CAE applications. It is suitable for people working in design drafting and those pursuing careers and qualifications in mechatronics, automated systems or systems maintenance at engineering technician level.
Prior or concurrently developed competence in graphics, workshop, electrical and electronic fundamentals, engineering science, mathematics and mechanical components, and manufacturing plant is required.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

MEM23004A	Apply technical mathematics
MEM23109A	Apply engineering mechanics principles
MEM23111A	Select electrical equipment and components for engineering applications
MEM23112A	Investigate electrical and electronic controllers in engineering applications

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	Identify the model parameters	1.1	Investigate applications for modelling in mechatronics
		1.2	Identify work health and safety (WHS) and regulatory requirements related to modelling processes and materials
		1.3	Identify the virtual parameters, form, function and features
		1.4	Identify required model generation processes required, including graphics generation and post-processing
		1.5	Identify licensed technical and professional assistance for advice, as required
2	Develop model	2.1	Generate initial graphical model
		2.2	Undertake initial consultation on model with stakeholders and adjust, as required
		2.3	Prepare and trial model for intended purpose
		2.4	Evaluate model against design criteria in consultation with stakeholders and make adjustments to model, as required
		2.5	Engage appropriate licensed technical and professional assistance for advice, as required

3	Finalise model	3.1	Prepare final model
		3.2	Report and demonstrate results
		3.3	Provide documentation, instructions, models and files, as required
		3.4	Obtain sign-off

Required Skills and Knowledge

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

Required skills

Required skills include:

- investigating the uses of mechatronic models
- reviewing features, functions and context of mechatronic modelling, including imminent future developments
- comparing available software, functions and features
- communicating, participating and negotiating with:
  - stakeholders, team, cross-function support groups and experts
  - appropriate licensed technicians and professionals
- modelling using a comprehensive range of techniques, such as:
  - creating and manipulating 3-D entities
  - using library files and adaptations
  - accessing supplier catalogues and databases
- creating dimensioned orthographic projections from model
- extracting dimensional properties from model
- post-processing model for analysis or physical modelling
- finalising modelling by:
  - completing work
  - gaining approval and commissioning work
  - providing documentation and reports, as required
  - obtaining sign-off

Required knowledge

Required knowledge includes:

- advantages and disadvantages of computer-aided manufacturing (CAM) using modelling compared to traditional manufacturing methods
- implications to be taken into account when modelling (e.g. efficiency of production, generation of waste, life cycle considerations, and accessing supplier catalogues and databases)
- typical mechatronic components, assemblies and layouts suitable for modelling
- software functions and features
- model creation techniques, including:
  - using and manipulating coordinate systems

- creating 3-D entities, ruled and revolved surfaces
- creating solids, editing and combining solids
- manipulating entities and solids
- library files
- manipulations of solids and library files
- 3-D graphics from models, including rotated views and sections
- dimensioned orthographic representations from models

- typical modelling processes, including:
  - computer modelling
  - post-processing
- virtual model options, including automated systems simulation of motions:
  - post-processing to create numeric control (NC) data files to computer numeric control (CNC) circuit board assembly or gantry robot assembly of boards
  - rapid prototyping options
  - finite element analysis (FEA) using software
- WHS and regulatory requirements, codes of practice, risk assessment and registration requirements, relevant to modelling task
- job requirements that may create a need for licensed technical and professional services
- modelling compared to traditional representation methods, including:
  - pen and pencil graphics compared to wire frame, surface and solid models
  - computer animations compared to transparent overlay mobiles to test clearances and motions
  - solid models compared to isometric representations
  - computer library files compared to the use of reference charts and catalogue information

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 produce a variety of mechatronic-related models that are consistent with design information and relevant standards and conventions.
Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate competently and consistently: • review features, functions and context of mechatronic modelling • compare available software, functions and features • communicate, participate and negotiate with stakeholders, team, cross-function support groups and experts, appropriate licensed technicians and professionals • model using a comprehensive range of techniques • create dimensioned orthographic projections from model • extract dimensional properties from model • post-process model for analysis or physical modelling • complete work, commission and gain approval, document and report, and obtain sign-off • identify future developments in modelling.
Context of and specific resources for assessment	• Assessment may occur on the job or in an appropriately simulated environment. Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and WHS practices. • 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.

Models	Models may be: • virtual, such as computer generated solids models • physical models developed from the virtual model data
Model purpose	Models covered by this unit include mechanical, maintenance and manufacturing engineering products, plant and system models. Examples of models include: • virtual robot model for motion simulation • automated process simulation • printed circuit board model for component fit or robot assembly
Features, functions and context of engineering	Features, functions and context of mechanical modelling include:

modelling	• techniques used for mechanical modelling • sustainability implications of modelling • WHS and regulatory requirements related to modelling processes and materials • model parameters, form, function and features, virtual or physical • processes required which may include those for generating graphics, post-processing and physical modelling • required licensed technical and professional assistance
Post-processor	A post-processor or code generator converts programmed instructions generated by CAM software or computer-aided design (CAD) package into CNC program code to control a machine tool
Post-processing model for analysis or physical modelling	Examples of post-processing model for analysis or physical modelling include: • setting up robotic model for motion analysis • processing dimensional data to create 2-D or 3-D code for CAM operations, such as printed circuit board manufacture • post-processing to create NC data files to control NC devices, including mills, lathes, machining centres, lasers, ultrasonic cutters and routers • modelling for rapid prototyping
Rapid prototyping	A variety of rapid prototyping processes are available, including: • selective laser sintering (SLS) which uses thermoplastics and metal powders • fused deposition modelling (FDM) which uses thermoplastics and eutectic metals • steriolithography (SLS) which uses a photopolymer • laminated paper manufacturing (LPM) which uses paper • electron beam melting (EBM) which uses titanium alloys • 3-D printing (3-DP) which uses a variety of materials
Criteria for mechatronic designs	Criteria for mechatronic designs may include: • safety and risk • function

	• aesthetics • manufacturability and maintainability • marketability • sustainability • cost constraints • ergonomics, anthropometrics and physiology • facilities, plant and skills available
Mechatronic components, assemblies and layouts	Mechatronic assemblies may include: • electrical motors and fluid power actuators • printed circuit boards • electrical, electronic and electro fluid controls • chain drives, gear sets, pulley and belt drives • structural sections • mechatronic assembly models, including robots,automated mechanisms and machines • materials handling equipment, including belt conveyors, augers and pneumatic conveyors • manufacturing plant and process layouts • manufactured product with embedded controller

Appropriate licensed technical and professional assistance	Appropriate licensed technical and professional assistance may include:
	• technical support and advice relating to elements which have intrinsic dangers, such as:
	  • high pressure
	  • energised fluid vessels
	  • high temperatures and heat energy capacity
	  • wiring with high current control voltages above extra low voltage
	• professional support for technologies, such as:
	  • specialist electric motor drives and controllers
	  • specialist materials, plastics, metal alloys and nano materials
	  • special processes, foundry, alloy welding, heat treatment, sealing and fastening

WHS, regulatory requirements and	WHS, regulatory requirements and enterprise procedures may include:

enterprise procedures	• WHS Acts and regulations • other relevant regulations and standards • industry codes of practice • risk assessments • registration requirements • safe work practices
Standards and codes	Standards and codes refer to all relevant Australian and international standards and codes applicable to a particular design task
Modelling and related software	Modelling and related software may include: • lumped parameter model • empirical, random data tested model • FEA software • model-based design

Unit Sector(s)

Competency field

Unit sector Drawing, drafting and design

Custom Content Section

Not applicable.