Australian Government

MEM14086A Apply mechatronic engineering analysis techniques

Release 1

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MEM14086A Apply mechatronic engineering analysis techniques

Modification History

Release 1 - New unit. Replaces MEM14062A, but not equivalent.

Unit Descriptor

This unit of competency covers the skills needed to undertake a range of mechatronic analyses. The analyses may relate to design or contribution to the design of mechatronic devices or automated plant or be for other purposes, including fitness for purpose evaluations, installation and commissioning, system changes or improvements or other mechatronic engineering-related tasks. It includes application of mechanical, fluid, electrical and controller design and analytical techniques.

Application of the Unit

This unit applies to mechatronic analyses undertaken as part of a mechatronic engineering design or assessment of automated plant or devices for projects, system changes or improvements.
It is suitable for people working as mechatronic or automated system designers and draftspersons and those pursuing careers and qualifications in mechatronic, automation, maintenance or manufacturing engineering. The work may be undertaken individually or as part of a team.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

MEM23004A	Apply technical mathematics
MEM23111A	Select electrical equipment and components for engineering applications
MEM23112A	Investigate electrical and electronic controllers in engineering applications
MEM14090A	Integrate mechatronic fundamentals into an engineering task

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	Investigate mechatronic analysis context and need	1.1	Review the context and negotiate parameters of the engineering design brief in consultation with stakeholders
		1.2	Identify relevant engineering scientific principles and required analysis techniques
		1.3	Investigate life cycle design and sustainability implications of mechatronic design or existing mechatronic systems, devices or equipment
		1.4	Determine specification, documentation and graphical techniques required for analysis
		1.5	Confirm work health and safety (WHS), regulatory requirements, codes of practice, standards, and risk management relevant to mechatronic analysis task
		1.6	Determine available sources for any required technical and professional assistance
2	Apply mechatronic analysis techniques	2.1	Plan, schedule and coordinate the analysis task
		2.2	Create adequate and accurate calculations, preliminary graphics and maintain design process records
		2.3	Evaluate multiple solutions against analysis criteria
		2.4	Integrate mechatronic techniques, hardware and software, including mechanical, fluid, electrical, electronic, controller and networking

		2.5	Apply systems thinking, problem solving and decision making
		2.6	Incorporate professional and technical assistance, as required
		2.7	Apply specification, documentation and graphical techniques modelling, mock-up or prototyping techniques, where required, to achieve or test solution
3	Report results	3.1	Record results of analysis
		3.2	Provide documentation such as calculations, specifications, diagrams, computer-aided design (CAD) files, control circuits and controller programs, mock-ups or prototypes

Required Skills and Knowledge

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

Required skills

Required skills include:

- communicating and negotiating with stakeholders and team
- determining or confirming relevance of mechatronic scientific principles and analysis techniques, including principles of:
  - mechanical
  - fluid power
  - fluid dynamics
  - thermodynamics
  - electrical and electronic fundamentals
  - controller and system control and data acquisition (SCADA) or distributed control systems (DCS) programming
  - engineering materials, properties and processes
  - techniques for integration of mechanical, fluid, electrical, electronic, controller and networking elements
- evaluating relevance of WHS, and regulatory requirements, standards and codes of practice
- evaluating multiple solutions against design criteria, risk, sustainability and cost factors
- applying life cycle design and sustainability parameters to analysis task
- planning, scheduling and coordinating the mechatronic analysis task
- solving problems and making decisions with systems thinking approach for contingencies and constraints, and continuous improvement
- integration of hardware and software and mechatronic techniques, such as mechanical, fluid, electrical, electronic, controller and networking
- specifying, documenting and applying graphical techniques, including modelling
- undertaking or supervising mock-up or prototyping techniques, where required, to achieve solution
- creating and maintaining adequate and accurate calculations and analysis process records
- reporting and documenting, results of investigations, application of principles and techniques, calculations, specifications, diagrams, CAD files, mock-ups or prototypes of designs

Required knowledge

Required knowledge includes:

- implications of life cycle design, fitness for purpose evaluation and sustainability for mechatronic analysis process
- mechatronic analysis processes and techniques to investigate, synthesise and develop proposals, evaluate feasibility against design criteria, and review and revise in consultation with stakeholders, team or support functional group
- common model, mock-up and prototyping techniques relevant to mechatronic engineering
- systems thinking, problem solving and decision making, and continuous improvement methods
- WHS and regulatory requirements, codes of practice, standards, risk management and registration requirements with particular emphasis on automation safety requirements
- sources of professional and technical assistance
- procedures for planning, scheduling and coordination of analysis
- hardware requirements of typical mechatronic or automation applications
- engineering mechatronic scientific principles and techniques required for analysis tasks:
  - mechanical
  - fluid power
  - fluid dynamics
  - thermodynamics
  - electrical and electronic fundamentals
  - controller and SCADA or DCS programming
  - engineering materials, properties and processes
  - techniques for integration of mechanical, fluid, electrical, electronic, controller and networking elements
- mechatronic analysis calculations techniques
- software for product planning and design, such as CAD, circuit design, controller programming and project management
- required documentation prototyping options, including mock-ups, physical and virtual modelling and rapid prototyping

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 mechatronic design techniques consistent with a design brief information, relevant standards and conventions.
Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate can competently and consistently: • communicate, negotiate and review design brief with stakeholders and team or support functional group • determine or confirm relevant scientific principles and analysis techniques, WHS and regulatory requirements • evaluate multiple solutions • investigate life cycle design and sustainability • plan, schedule and coordinate the design task • integrate mechatronic techniques, hardware and software • solve problems and make decisions with systems thinking for contingencies and constraints, and continuous improvement • define analysis, specify and document and apply graphical techniques, modelling, mock-up or prototyping techniques • create and maintain adequate and accurate calculations and design process records • report and document results and processes.
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.

Mechatronic engineering analysis	Mechatronic engineering analysis may be required for a variety of reasons, including: • design of automated devices and plant • design or evaluation of significant modifications, process changes or improvements • sustainability issues relevant to plant, equipment or processes • fitness for purpose evaluation • installation and commissioning of plant and equipment
Planning processes	Planning processes may include: • establishing design parameters and design criteria • contributing to the negotiation and advice process • preliminary planning, design investigations and costing • identifying design, development, prototyping activities and skills requirements • planning and scheduling design activities • improving, adjusting and rescheduling as required by emergency

	contingencies and constraints
Analysis process	Designing as a systematic process includes: • establish design parameters and criteria • research, measurement, experimentation and investigation • generating ideas • synthesis, problem solving and decision making, and addressing constraints • apply scientific principles, calculation and graphics, prototyping and mock-up techniques • evaluating solutions against design criteria • consultation, adjustments and agreement • finalise design and sign-off
Analysis criteria	Analysis includes relevant technical criteria and may also include criteria relating to: • function • aesthetics • manufacturability and maintainability • marketability • sustainability • cost constraints • ergonomics and anthropometrics and physiology • manufacturability, maintainability • facilities, plant and skills available • safety and risk
Sustainability	Sustainability is used to mean the entire sustainable performance of the organisation/plant, including: • meeting all regulatory requirements • conforming to all industry covenants, protocols and best practice guides • minimising ecological and environmental footprint of process, plant and product • maximising economic benefit of process plant and product to the organisation and the community • minimising the negative WHS impact on employees, community and customer
Life cycle assessment	Life cycle analysis can be used to improve sustainability of products and services. It may be applied to: • all aspects of manufacture of a single product • the entire operations of an organisation • a particular aspect of operations, such as environmental implications

Prototyping	Prototyping may include: • mock-ups, physical and virtual modelling with post-processing for computer numeric control (CNC) and rapid prototyping

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 enterprise procedures	WHS, regulatory requirements and enterprise procedures may include: • WHS Acts and regulations • relevant standards • codes of practice from Australian and overseas engineering and technical associations and societies • risk assessments • registration requirements • safe work practices • state and territory regulatory requirements
Standards and codes	Standards and codes refer to all relevant Australian and international standards and codes applicable to a particular mechatronic analysis task
Systems thinking	Systems thinking refers to the conduct of engineering work in a manner that demonstrates knowledge of how the interaction of different technical systems on equipment, machinery or structures, as well as the skills and techniques of personnel, combine to perform or support engineering-related operations, processes or projects. It embraces determining or establishing how the function of each technical system or component, as well as the skills and techniques of personnel, effects or potentially may effect outcomes. Systems should be interpreted broadly within the context of the organisation and depending on the project or operation can include equipment, related facilities, material, software, internal services and personnel,

	and other organisations in the value chain
Automation safety	Automation safetyrefers to the reliance on emergency stop, failsafe design, redundancy, interlocks and data integrity. Standards apply to general plant design and use as well as the 'functional safety of safety-related electrical, electronic and programmable electronic control systems'
Mechatronic hardware	Mechatronic hardware may include: • mechanical, fluid and electric actuators • power transmission devices • pipes, conduits wires, fittings and connectors • controllers • power interfaces • signal conditioning interfaces
Documentation	Documentation includes: • documented calculations • specifications • CAD files • risk analysis • sustainability and life cycle assessments

Unit Sector(s)

Competency field

Unit sector Planning

Custom Content Section

Not applicable.