



Australian Government

MEM234014 Design a robotic system

Release: 1

MEM234014 Design a robotic system

Modification History

Release 1. Supersedes and is equivalent to MEM234014A Design a robotic system.

Application

This unit of competency defines the skills and knowledge required to design an engineering application that employs a robot and to integrate the robotic application with other equipment and systems. It includes the use and integration of actuators, sensors, end effectors, including tactile effectors, dynamic analysis of strength and stability, programming and protocols for communications and networking, as appropriate.

The client may be internal or external to the designer's organisation.

The unit applies to the design of a robotic system across all forms of manufacturing and engineering, and design activities can also include reverse engineering, design rectification, integration of off-the-shelf components, or modifications of an existing design. It is suitable for robotic system designers or maintenance technologists, and for those pursuing qualifications and careers in engineering design involving robotics and automation.

Individuals completing this work either already have or are developing skills and experience in the application of computing technology, mathematics, scientific principles and techniques, kinematics and kinetics, electrical and fluid power principles, programming of computers and controllers, robotic systems evaluation and mechanical construction techniques.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

Nil

Competency Field

Engineering science

Elements and Performance Criteria

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
1. Clarify client brief or contract requirements	1.1 Consult with client to determine the required features and functions of the application and establish control requirements 1.2 Determine technical, commercial and environmental parameters of

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
	the brief or contract 1.3 Determine stakeholders to be consulted in the design and application process 1.4 Provide initial advice to client on the feasibility of the project
2. Prepare concept proposal	2.1 Investigate and take initial measurements to define robotic system performance parameters 2.2 Carry out required modelling, simulations and calculations using appropriate techniques, software and validation techniques 2.3 Generate robotic system solutions that respond to the brief or contract 2.4 Check feasibility and evaluate solutions against design criteria, ensuring conformity to work health and safety (WHS), regulatory, sustainability and environmental requirements 2.5 Review concept proposals with clients and select preferred solution
3. Design robotic device or system	3.1 Finalise design of robotic system according to preferred solution 3.2 Provide documentation, drawings, specifications and instructions that reflect the design 3.3 Consult and negotiate with clients and stakeholders to obtain sign-off on design 3.4 Monitor installation and commissioning with stakeholders, and make any necessary modifications

Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential to performance.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

Parameters of the design brief includes one or more of the following:	• the design of new equipment or fault analysis, rectification or modification to an existing design • determination of the degree of innovation and creativity expected by the client • design process limits and budgets • product cost limits and budgets • performance specifications • equipment availability, capacities and restrictions • specified administrative, communication and approval procedures • use and integration of off-the-shelf components • other special features and limits in the design brief.
Robotic systems include:	• a self-controlling machine (robot) that can perform functions automatically without human initiation and assistance after initial programming and other components to allow integration with other equipment and systems within the workplace • sensory elements, electrical, hydraulic or pneumatic actuators for linear or rotary motion and components to perform functions including grasping hands, lifting magnets and heating pads • networking capabilities to serve an automated environment • programming capability to perform repetitive tasks or tasks unsuitable for humans. • consideration of: • motions • loads • accuracy • precision and repeatability • kinematics, kinetics and dynamic stability • sensing • control • end effectors • data requirements • hardware requirements • system integration • network topology and communication protocol.
WHS, regulatory, sustainability and environmental issues include:	• WHS acts, regulations and relevant standards • industry codes of practice • risk assessments • registration requirements • safe work practices • 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 • state and territory regulatory requirements.
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Unit Mapping Information

Release 1. Supersedes and is equivalent to MEM234014A Design a robotic system.

Links

Companion Volume Implementation Guides are available on VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b7050d37-5fd0-4740-8f7d-3b7a49c10bb2>

Assessment Requirements for MEM234014 Design a robotic system

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include:

- consulting and negotiating throughout the design process
- establishing required features of the robotic system
- confirming parameters of the brief or contract and providing initial advice based on discipline knowledge, standards, work health and safety (WHS), regulatory and risk assessment requirements
- researching sustainability and current and emerging trends in applications of robots and robot functions, programming options and reverse engineering
- investigating and reviewing robotic concept proposals and performance parameters and options
- investigating faults in existing designs and proposing solutions
- measuring, modelling and calculating using appropriate techniques, software and validation techniques
- applying innovation and creativity to generate solutions
- evaluating solutions against design criteria, ensuring conformity to WHS requirements
- preparing robotic system proposal
- designing a robotic system on at least two occasions
- communicating, negotiating and reviewing with stakeholders and client throughout the process to obtain agreement on proposal and sign-off on design
- documenting design with required drawings, specifications and instructions.

Note: Where a volume and/or frequency is not specified, demonstration must be provided at least once.

Knowledge Evidence

Evidence required to demonstrate the required knowledge for this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include knowledge of:

- contemporary engineering for robot and robotic application design methods
- design brief parameters
- robotic fundamentals including:
 - mechanical
 - electrical

- fluid
- electronic and information technologies
- sensors and transducers
- controllers
- interfacing and signal conditioning
- networking
- software
- data sharing
- control functions
- techniques for:
 - continuous improvement
 - problem-solving and decision-making
 - root cause analysis (RCA) or failure mode and effects analysis (FMEA) or design review based on failure mode (DRBFM), and Pareto analysis
- WHS and regulatory requirements, codes of practice, standards, risk management and registration requirements
- processes for:
 - investigation
 - developing options
 - modelling and calculating
 - generating solutions
 - completing feasibility and evaluation studies
 - preparing proposals
 - designing
- software modelling techniques to analyse robot capability including motions, loads, accuracy, precision and repeatability, kinematics, kinetics and dynamic stability
- validation techniques including use of simple case traditional methods and calculations:
 - robot drive systems
 - manipulators and end effector options
- fundamentals of locomotion for mobile robots including wheels, legs, combined leg and wheels and tracks:
 - object detection and sensor options
- program techniques for robot functions including:
 - pick and place
 - proximity detection (presence and distance)
 - motion control algorithms
- supervisory control and data acquisition (SCADA) or distributed control systems (DCS), communications methods and protocols, and networking requirements
- programs and programming techniques for robot functions, communications and networking as required by design
- documentation, drawings, specifications, programs and instructions.

Assessment Conditions

- Assessors must:
 - have vocational competency in designing a robotic system at least to the level being assessed with relevant industry knowledge and experience
 - satisfy the assessor requirements in the *Standards for Registered Training Organisations 2015 or its replacement* and comply with the *National Vocational Education and Training Regulator Act 2011*, its replacement or equivalent legislation covering VET regulation in a non-referring State as the case requires.
- Where possible assessment must occur in operational workplace situations. Where this is not possible or where personal safety or environmental damage are limiting factors, assessment must occur in a sufficiently rigorous simulated environment that reflects realistic operational workplace conditions that cover all aspects of workplace performance, including environment, task skills, task management skills, contingency management skills and job role environment skills.
- Conditions for assessment must include access to all tools, equipment, materials and documentation required including relevant workplace procedures, product and manufacturing specifications.
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.
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