Australian Government

Department of Education, Employment and Workplace Relations

MEM234008A Design plant using computer simulations

Release: 1

MEM234008A Design plant using computer simulations

Modification History

New unit

Unit Descriptor

This unit of competency covers the use of computer simulations to develop engineering solutions for the design of plant, equipment and manufacturing processes. It includes mathematical models and computer simulation models, sensitivity estimation and optimisation to ensure reliability, validity and robustness of simulations.

Application of the Unit

This unit applies to the use of computer simulation for design of significant plant, equipment or manufacturing processes across all forms of manufacturing and engineering. Design activities may also include reverse engineering, design rectification or modifications of an existing design. It is suitable for plant and process designers and maintenance personnel, and those pursuing engineering or related qualifications and careers.

Prior experience in the evaluation of plant and processes; scientific principles; analysis of loads on machine elements; selection of components; mathematics, including calculus and differential equations, materials, manufacturing processes and computer-aided design (CAD) 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	Clarify the simulation task and elaborate the specification	1.1	Establish, in consultation with client, required features of the computer simulations
		1.2	Determine parameters to the brief or contract
		1.3	Determine stakeholders to be consulted in design process
		1.4	Assess occupational health and safety (OHS), regulatory, sustainability or environmental issues relevant to design task
		1.5	Confirm design brief, including budget and schedule, and provide preliminary advice on feasibility
2	Research and test computer simulation options for a range of applications	2.1	Analyse computer simulations software for reliability, validity and robustness
		2.2	Assess process simulation software for applications in commercial plant and processes
		2.3	Test computer simulation software with known solutions
		2.4	Select the most appropriate simulation option for the application
3	Prepare concept proposal	3.1	computer simulation design
		3.2	Complete required modelling, optimisation and sensitivity analysis
		3.3	Generate a range of design solutions, if required
		3.4	Check feasibility and evaluate solutions against design

			criteria, standards and codes ensuring conformity to OHS requirements
		3.5	Prepare a proposal that includes results of feasibility study, consideration of expert opinion, initial calculations, modelling and the use of judgment and discretion
		3.6	Review concept proposal with client to improve outcomes and overcome possible problems
		3.7	Negotiate adjustments to brief or contract parameters if required
4	Design plant, equipment or manufacturing process	4.1	Design plant, equipment or process using chosen simulation methods
		4.2	Optimise simulation and analyse sensitivity
		4.3	Provide documentation, graphics, specifications and instructions
		4.4	Consult with client and stakeholders
		4.5	Obtain sign-off on design simulation

Required Skills and Knowledge

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

Required skills

Required skills include:

- determining design parameters, performance targets and system variables of plant, equipment or process to be simulated, including OHS, regulatory and risk management requirements
- interpreting parameters to the brief or contract
- researching latest trends and techniques in:
  - computer simulation models, methods for sensitivity estimation and optimisation to ensure reliability, validity and robustness of simulation, simulation software, and programming and validation techniques
  - reverse engineering
  - sustainability implications and implications for computer simulation design applications
  - selecting appropriate simulation model
  - modelling, optimising and analysing model sensitivity
- generating and evaluating a range of solutions using appropriate innovation and creativity for feasibility against design criteria
- investigating faults in existing designs and arriving at solutions
- designing simulated plant
- communicating, negotiating and reviewing with stakeholders and client throughout process to obtain agreement on proposal and sign-off on simulated design
- documenting design with files, drawings, specifications and instructions

Required knowledge

Required knowledge includes:

- design methods, research and investigations methods
- 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
- computer simulation packages
- advantages of design simulation, such as development time, low cost and minimum resources

- disadvantages of design simulations, such as level of uncertainty, and cost of making decisions based on invalid simulations
- simulation applications:
  - physical simulation using physical objects as analogues of another reality
  - interactive simulation or 'human in the loop' simulations (e.g. space experiences, flight and driving simulation, medical procedure training etc.)
  - computer architecture simulation
  - training simulation
  - business performance
  - plant or process design
- mathematical models:
  - linear and non-linear
  - deterministic and stochastic
  - steady-state and dynamic
  - lumped and distributed parameter models
- computer simulation types:
  - continuous and discrete
  - deterministic and stochastic
  - local or distributed simulations
  - object-oriented physical modelling (OOPM) simulation
- model variable types:
  - state variables, constants and random variables
  - inputs, outputs and decisions variables
- sensitivity estimation and optimisation
- graphical techniques for visual model building

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: • interpret design parameters, performance targets and system variables of plant, equipment or process to be simulated • advise client based on discipline knowledge, OHS and regulatory standards • research sustainability implications, computer simulation design applications, mathematical and computer simulation models, methods for sensitivity estimation and optimisation to ensure reliability, validity and robustness of simulation, simulation software, programming and validation techniques • determine OHS, regulatory and risk management requirements related to plant • investigate and measure to confirm the parameters for required design • select appropriate simulation model • model, optimise and analyse model sensitivity • generate and evaluate a range of solutions using appropriate innovation and creativity for feasibility against design criteria • design simulated plant • communicate, negotiate and review with stakeholders and client throughout process to obtain agreement on proposal and sign-off on simulated design • document design with files, drawings, specifications and instructions.
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 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 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. 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.

Client	Client may be: • internal or external to the designer's organisation
Computer simulations	A computer simulation is a computer programme or network of computers that attempts to simulate an abstract model of a particular system in order to gain insight into the operation of the system or operator characteristics Typical applications include: • process simulations • performance analysis and optimisation • fault simulations • machine simulations, stress, deflection and heating • environmental modelling • mathematical design modelling

	• hydraulic system modelling • virtual engineering
Parameters to the design brief	The design brief may include the design of new equipment or fault analysis, rectification or modification to an existing design. Parameters to the design brief may include: • 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 • other special features and limits in the design brief
OHS, regulatory, sustainability and environmental issues	OHS, regulatory, sustainability and environmental issues may include: • OHS Acts and regulations • 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 OHS impact on employees, community and customer • state and territory regulatory requirements
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 OHS impact on employees, community and customer
Standards and codes	Standards and codes refer to all relevant Australian and

	international standards and codes applicable to a particular design task

Sensitivity estimation, optimisation and validation	• Software may be employed for estimation, optimisation and validation.
	• Sensitivity is a measure of impacts of changes to parameter values and assumptions on the output or conclusions from the model. Sensitivity analysis can be used as a measure of robustness and validity.
	• Optimisation is the process of adjustment of variables and parameters to fine-tune the output to closer match expected real system outputs.
	• Validation techniques include:
	  • comparison of traditional solutions for simple design problems with software solutions to the same design problems
	  • review of previously implemented design challenges which were completed using the software
	  • robustness relates to the ability of a simulation model to respond to inputs in a stable manner

Unit Sector(s)

Engineering practice

Custom Content Section

Not applicable.