UEENEED152A Design embedded controller control systems

Release: 1

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Modification History

Not applicable.

Unit Descriptor

Unit Descriptor	**1) Scope:**
	1.1) Descriptor
	This unit covers designing control systems using microcontrollers, or PCs or embedded signal processors (DSPs). It encompasses working safely, following design briefs and applying knowledge of embedded system devices, interpreting device specifications, constructing prototypes, using appropriate development software, applying programming techniques, testing developed system prototype operation, verifying compliance of the design against the final brief and documenting design and development work.
	Note:
	This unit applies to all aspects of Electrotechnology – engineering applications only. For general competencies related to Information Technologies refer to the latest endorsed IT Training Package.

Application of the Unit

Application of the Unit	**2)**
	This unit is intended for competency development entry-level employment-based programs incorporated in approved contracts of training. It applies to any formal recognition for this standard at the aligned AQF 5 level or higher.

Licensing/Regulatory Information

License to practice   **3)**

The skills and knowledge described in this unit do not require a license to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships.

Pre-Requisites

Prerequisite Unit(s)   **4)**

Competencies   **4.1)**

Granting competency in this unit shall be made only after competency in the following unit(s) has/have been confirmed.

UEENEEE1 01A	Apply Occupational Health Safety regulations, codes and practices in the workplace

Literacy and numeracy skills   **4.2)**

Participants are best equipped to achieve competency in this unit if they have reading, writing and numeracy skills indicated by the following scales. Description of each scale is given in Volume 2, Part 3 'Literacy and Numeracy'

Reading   5   Writing   5   Numeracy   5

Employability Skills Information

Employability Skills   **5)**

The required outcomes described in this unit of competency contain applicable facets of Employability Skills. The Employability Skills Summary of the

Employability Skills	**5)**
	qualification in which this unit of competency is packaged will assist in identifying Employability Skill requirements.

Elements and Performance Criteria Pre-Content

6) Elements describe the essential outcomes of a competency standard unit

Performance Criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the Evidence Guide.

Elements and Performance Criteria

ELEMENT		**PERFORMANCE CRITERIA**	
1	Prepare to design and develop advance embedded systems.	1.1	OHS processes and procedures for a given work area are identified, obtained and understood.
		1.2	Established OHS risk control measures and procedures are followed in preparation for the work.
		1.3	The extent of the proposed embedded system development is determined from the design brief or in consultation with appropriate person(s).
		1.4	Design development work is planned to meet scheduled timelines in consultation with others involved on the work site.
		1.5	Materials and devices/components required for the work are selected on compatibility of their specifications with embedded system requirements and project budget constraints.
		1.6	Tools, equipment and testing devices needed to carry out the work are obtained and checked for correct operation and safety.

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ELEMENT	PERFORMANCE CRITERIA	
2 Design and develop advance embedded systems.	2.1	OHS risk control work measures and procedures are followed.
	2.2	Knowledge of embedded devices and systems and compliance standards are applied to the design.
	2.3	Alternative arrangements for the design are considered based on the requirements outlined in the design brief.
	2.4	Safety, functional and budget considerations are incorporated in the design.
	2.5	Prototype devices and circuits are constructed and tested for compliance with the design brief and regulatory requirements.
	2.6	Prototype malfunctions are rectified and retested to ensure effective operation of design.
	2.7	Embedded system design is documented for submission to appropriate person(s) for approval.
	2.8	Solutions to unplanned situation are provided consistent with organisation policy.
3 Obtain approval for embedded systems design.	3.1	Embedded system design is presented and explained to client representative and/or other relevant person(s).
	3.2	Requests for design modifications are negotiated with relevant person(s) within the constraints of organisation policy.
	3.3	Final design is documented and approval obtained from appropriate person(s).
	3.4	Quality of work is monitored against personal performance agreement and/or established organisational or professional standards.

Note.
Prototype construction includes programming some devices.

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

8) This describes the essential skills and knowledge and their level, required for this unit.

Evidence shall show that knowledge has been acquired of safe working practices and designing embedded controller systems.

All knowledge and skills detailed in this unit should be contextualised to current industry practices and technologies.

KS01-ED152A   Embedded microcontroller programming

Evidence shall show an understanding of microprocessor assembly language and high-level language programming as it is applied to engineering applications to an extent indicated by the following aspects:

T1   CPU Architecture

- registers.
- instruction set considerations, common and advanced instructions.
- addressing modes supported: direct, indirect, indexed etc.
- software interrupts and system calls.

T2   Processor And System Support

- instruction pre-fetch pipeline.
- system timer chip, function and programming.
- hardware interrupts programming considerations.
- DMA devices and support.
- co-processors and bus interface.

T3   Modular Programming

- separately compiled and linked assembly language modules.
- library modules.
- macros.

T4   Documentation And Debugging

- system specification and documentation
- debugging and tracing program execution

T5   Complex data types and structures encompassing:

- Pointers/references
- arrays and strings
- user-defined data types

T6   Interfacing high-level languages to assembler encompassing:

- in-line assembly.
- bit manipulation

REQUIRED SKILLS AND KNOWLEDGE

- IO port addressing

T7   Interrupt Service Routines

Evidence Guide

EVIDENCE GUIDE

9) This provides essential advice for assessment of the unit and must be read in conjunction with the performance criteria and the range statement of the unit and the Training Package Assessment Guidelines.

The Evidence Guide forms an integral part of this unit. It must be used in conjunction with all parts of this unit and performed in accordance with the Assessment Guidelines of this Training Package.

Overview of Assessment	**9.1)**
	Longitudinal competency development approaches to assessment, such as Profiling, require data to be reliably gathered in a form that can be consistently interpreted over time. This approach is best utilised in Apprenticeship programs and reduces assessment intervention. It is the industry-preferred model for apprenticeships. However, where summative (or final) assessment is used it is to include the application of the competency in the normal work environment or, at a minimum, the application of the competency in a realistically simulated work environment. It is recognised that, in some circumstances, assessment in part or full can occur outside the workplace. However, it must be in accordance with industry and regulatory policy.
	Methods chosen for a particular assessment will be influenced by various factors. These include the extent of the assessment, the most effective locations for the assessment activities to take place, access to physical resources, additional safety measures that may be required and the critical nature of the competencies being assessed.
	The critical safety nature of working with electricity, electrical equipment, gas or any other hazardous substance/material carries risk in deeming a person competent. Sources of evidence need to be 'rich' in nature to minimise error in judgment.
	Activities associated with normal everyday work have a bearing

on the decision as to how much and how detailed the data gathered will contribute to its 'richness'. Some skills are more critical to safety and operational requirements while the same skills may be more or less frequently practised. These points are raised for the assessors to consider when choosing an assessment method and developing assessment instruments. Sample assessment instruments are included for Assessors in the Assessment Guidelines of this Training Package.

Critical aspects of evidence required to demonstrate competency in this unit	**9.2)**

Before the critical aspects of evidence are considered all prerequisites shall be met.

Evidence for competence in this unit shall be considered holistically. Each element and associated performance criteria shall be demonstrated on at least two occasions in accordance with the 'Assessment Guidelines – UEE11'. Evidence shall also comprise:

- A representative body of work performance demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this shall incorporate evidence that shows a candidate is able to:
    - Implement Occupational Health and Safety workplace procedures and practices, including the use of risk control measures as specified in the performance criteria and range statement
    - Apply sustainable energy principles and practices as specified in the performance criteria and range statement
    - Demonstrate an understanding of the essential knowledge and associated skills as described in this unit. It may be required by some jurisdictions that RTOs provide a percentile graded result for the purpose of regulatory or licensing requirements.
    - Demonstrate an appropriate level of skills enabling employment
    - Conduct work observing the relevant Anti Discrimination legislation, regulations, polices and workplace procedures
- Demonstrated consistent performance across a representative range of contexts from the prescribed items below:
    - Design embedded controller systems as described in 8) and

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including:

A	Developing outlines of alternative designs.
B	Developing the design within the safety and functional requirements and budget limitations.
C	Constructing and testing prototype devices and circuits according to design brief and regulatory requirements.
D	Documenting and presenting design effectively.
E	Successfully negotiating design alteration requests.
F	Obtaining approval for final design.
G	Verifying compliance of the design against the final brief.
H	Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions incorporated in a holistic assessment with the above listed items.

Note:

Successful completion of relevant vendor training may be used to contribute to evidence on which competency is deemed. In these cases the alignment of outcomes of vendor training with performance criteria and critical aspects of evidence shall be clearly identified.

Context of and specific resources for assessment

9.3)

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OHS policy and work procedures and instructions.
- Suitable work environment, facilities, equipment and materials to undertake actual work as prescribed in this unit.

These should be used in the formal learning/assessment environment.

Note:

Where simulation is considered a suitable strategy for assessment, conditions for assessment must be authentic and as far as possible reproduce and replicate the workplace and be consistent with the approved industry simulation policy.

The resources used for assessment should reflect current industry practices in relation to designing embedded controller systems

Method of assessment   **9.4)**

This unit shall be assessed by methods given in Volume 1, Part 3 'Assessment Guidelines'.

Note:

Competent performance with inherent safe working practices is expected in the Industry to which this unit applies. This requires assessment in a structured environment which is primarily intended for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and skills described in this unit.

Concurrent assessment and relationship with other units   **9.5)**

Nil

Range Statement

RANGE STATEMENT

10) This relates to the unit as a whole providing the range of contexts and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

This unit shall be demonstrated in relation to designing and developing an embedded system, which controls at least three I/O devices or functions.

Note:

Examples include: keyboard and/or LCD interfacing, driving motors, reading, logging and analysing sensor devices.

Generic terms used throughout this Vocational Standard shall be regarded as part of the Range Statement in which competency is demonstrated. The definition of these and other terms that apply are given in Volume 2, Part 2.1.

Unit Sector(s)

Not applicable.

Competency Field

Competency Field   11)

Computer Systems