



Australian Government

UEENEEG143A Develop engineering solution for synchronous machine and control problems

Release 2

UEENEEG143A Develop engineering solution for synchronous machine and control problems

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor

1) Scope:

1.1) Descriptor

This unit covers developing engineering solutions to resolve problems with synchronous machines and their controls. It encompasses working safely, apply extensive knowledge of synchronous machine operation, construction and their application, gathering and analysing data, applying problem solving techniques, developing and documenting solutions and alternatives.

Note.

Typical machine problems are those encountered in meeting performance requirements and compliance standards, revising a machine operating parameters and dealing with machine malfunctions.

Application of the Unit

Application of the Unit 2)

This unit applies to any recognised development program that leads to the acquisition of a formal award at AQF level 6

Licensing/Regulatory Information

License to practice 3)

The skills and knowledge described in this unit require a license to practice in the workplace for work involving

License to practice

3)

direct access to plant and equipment connected to installation wiring at voltage above 50 V a.c. or 120 V d.c. However other conditions may apply in some jurisdictions subject to regulations related to electrical work. Practice in the workplace and during training is also subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships.

Note:

1. Compliance with permits may be required in various jurisdictions and typically relates to the operation of plant, machinery and equipment such as elevating work platforms, powder operated fixing tools, power operated tools, vehicles, road signage and traffic control and lifting equipment. Permits may also be required for some work environments such as confined spaces, working aloft, near live electrical apparatus and site rehabilitation.

2. Compliance may be required in various jurisdictions relating to currency in First Aid, confined space, lifting and risk safety measures.

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.

UEENEEG1 49A Provide engineering solutions to problems in complex polyphase power circuits

UEENEEE1 25A Provide engineering solutions for problems in complex multiple path circuit

UEENEEE1 26A Provide solutions to basic engineering computational problems

AND

UEENEEE1 Solve electrotechnical engineering

Prerequisite Unit(s)	4)
	29A problems
	OR
	UEENEEE1 Apply Occupational Health and Safety 01A regulations, codes and practices in the workplace
	UEENEEE1 Solve problems in d.c. circuits 04A
	UEENEEG1 Solve problems in electromagnetic devices 01A and related circuits
	OR
	UEENEEH1 Troubleshoot resonance circuits in an 14A electronic apparatus
	UEENEEE1 Apply Occupational Health and Safety 01A regulations, codes and practices in the workplace
	AND
	UEENEEE1 Solve problems in d.c. circuits 04A
	OR
	UEENEEH1 Solve problems in basic electronic circuits 69A

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)

This unit contains Employability Skills

The required outcomes described in this unit of competency contain applicable facets of Employability Skills. The Employability Skills Summary of the 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 develop engineering solution for synchronous machine problems.	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 in preparation for the work are followed.
	1.3	The extent of the machine problem is determined from performance specifications and situation reports and in consultations with relevant persons.
	1.4	Activities are planned to meet scheduled timelines in consultation with others involved in the work.
	1.5	Effective strategies are formed to ensure solution development and implementation is carried out efficiently.

ELEMENT	PERFORMANCE CRITERIA
2 Develop engineering solution for synchronous machine problems.	2.1 OHS risk control measures and procedures for carrying out the work are followed.
	2.2 Knowledge of synchronous machine construction, operation, characteristics and applications are applied to developing solutions to synchronous machine problems.
	2.3 Parameters, specifications and performance requirements in relation to each machine problem are obtained in accordance with established procedures.
	2.4 Approaches to resolving synchronous machine problems are analysed to provide most effective solutions.
	2.5 Unplanned events are dealt with safely and effectively consistent with regulatory requirements and enterprise policy.
	2.6 Quality of work is monitored against personal performance agreement and/or established organizational or professional standards.
3 Test, document and implement engineering solution for synchronous machine problem.	3.1 Solutions to machine problems are tested to determine their effectiveness and modified where necessary.
	3.2 Adopted solutions are documented including instruction for their implementation that incorporates risk control measure to be followed.
	3.3 Appropriately competent and qualified person(s) required to implement solutions to synchronous machine problems are coordinated in accordance with regulatory requirements and enterprise policy. (Note)
	3.4 Justification for solutions used to solve synchronous machine problems is documented for inclusion in work/project development records in accordance with professional standards.

ELEMENT

PERFORMANCE CRITERIA

Note:

A license to practice in the workplace is required for work involving direct access to plant and equipment connected to installation wiring at voltages above 50 V a.c. or 120 V d.c.

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 developing engineering solution for synchronous machine problems.

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

KS01-EG143A

Synchronous machine diagnostics

Evidence shall show an understanding of developing engineering solutions for synchronous machine problems to an extent indicated by the following aspects:

T1 a.c. generators – construction, types and cooling encompassing:

- construction of stator and rotor windings
- rotor construction (cylindrical and salient pole)
- advantages of rotating field construction
- excitation methods
- cooling methods
- prime movers

T2 a.c. generators – operating principles and characteristics encompassing:

- a.c. generator equivalent circuits (synchronous reactance and resistance components)
- tests – open circuit, short circuit, stator impedance
- voltage regulation, island generator's terminal voltage load power factor
- determination of excitation voltage and load angle

T3 Synchronising a.c. generators encompassing:

- conditions for synchronising (infinite bus)
- methods for synchronising (lamp methods, synchroscope)
- alternator load sharing, parallel operation

T4 a.c. generators power, torque and efficiency encompassing:

- power input, input torque, speed
- power losses
- output power, load power factor, rotor angle, pu power
- efficiency
- performance chart interpretation

T5 Voltage regulation (AVR) encompassing:

- need for AVR's
- features of AVR's
- effects of rotor inductance

REQUIRED SKILLS AND KNOWLEDGE

- connections of AVRs
- operation of AVRs

T6 a.c. generator operational stability encompassing:

- power output, VAR effects, rotor angle, excitation
- control of VAR (OLTC transformers)
- voltage dependant nature of stability
- critical clearance angle of a.c. generator
- stability limits

T7 a.c. generator protection encompassing:

- restricted, unrestricted primary, back up and duplicated protection
- overcurrent, short circuit, differential, reverse power, load unbalance, rotor overload, loss-of-field, rotor earth fault, station earth fault, under frequency protection
- external fault protection

T8 Induction generator encompassing:

- types operating principles, characteristics
- excitation methods
- losses and efficiency
- synchronising and paralleling

T9 Three phase synchronous motors encompassing:

- construction – rotor, stator, windings
- excitation methods
- operating principles (equivalent circuits, synchronous impedance)
- hunting and stability limits
- power factor correction
- paralleling and synchronisation techniques
- starting methods
- braking methods

Evidence Guide

EVIDENCE GUIDE

9) The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

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's 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 every day 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, policies and workplace procedures
- Demonstrated consistent performance across a representative range of contexts from the prescribed items below:
 - Develop engineering solution for synchronous machine problems as described in 8) and including:
 - A Understanding the extent of the machine problem.
 - B Forming effective strategies for solution development and implementation.
 - C Obtaining machine parameters, specifications and performance requirements appropriate to each

- problem.
- D Testing and solutions to machine problems.
 - E Documenting instruction for implementation of solutions that incorporate risk control measure to be followed.
 - F Documenting justification of solutions implemented in accordance with professional standards.
 - G Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions incorporated in the 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 by this unit.

These should be part of the formal learning/assessment environment.

Note:

Where simulation is considered a suitable strategy for assessment, conditions 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 developing engineering solution for

synchronous machine problems.

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)

For optimisation of training and assessment effort, competency development in this unit may be arranged concurrently with unit:

UEENEEG14 Provide engineering solutions to problems in
9A complex polyphase power circuits

The critical aspects of occupational health and safety covered in unit UEENEEE101A and other discipline specific occupational health and safety units shall be incorporated in relation to this unit.

Range Statement

RANGE STATEMENT

10) 8) 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 developing engineering solution for at least four synchronous machine problems.

Note.

Typical machine problems are those encountered in meeting performance requirements and compliance standards, revising a machine operating parameters and dealing with machine malfunctions

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)
	Electrical