Australian Government

Department of Education, Employment and Workplace Relations

UEENEEE129A Solve electrotechnical engineering problems

Release: 1

UEENEEE129A Solve electrotechnical engineering problems

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor **1) Scope:**

1.1) Descriptor

This unit covers the application of calculations required to solve electrotechnical engineering problems. It encompasses working safely, applying problem solving techniques, using a range of mathematical processes and techniques to providing solutions to electrotechnical problems, and justifying such solutions.

Note.

Typical electrotechnical problems are those encountered in meeting requirements in meeting performance requirements and compliance standards, revising systems operating parameters and dealing with system malfunctions

Application of the Unit

Application of the Unit **2)**

This unit is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 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

License to practice **3)**

applicable contracts of training such as apprenticeships.

Pre-Requisites

Prerequisite Unit(s) **4)**

Competencies **4.1)**

There are no prerequisite competencies for this unit.

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 Provide calculated solutions to electrotechnical engineering problems.	1.1 OHS procedures for a given work area are obtained and understood
	1.2 The nature of the problems are obtained from documentation or from work supervisor to establish the scope of work to be undertaken
	1.3 Problems are clearly stated in writing and/or diagrammatic form to ensure they are understood and appropriate methods used to resolve them.
	1.4 Known constants and variable related to the problem are obtained from measured values or problem documentation.
	1.5 Alternative methods for resolving the problem are considered and where necessary discussed with appropriate person(s).
	1.6 Problems are solved using appropriate mathematical processes and techniques and within the realistic accuracy.
2 Complete work and document calculated solutions to electrotechnical activities	2.1 Justification for solutions used to solve electrotechnical engineering problems is documented for inclusion in work/project development records in accordance with professional standards.
	2.2 Work completion is documented and appropriate person(s) notified.

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 solve electrotechnical engineering problems.

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

KS01-EE129A Electrotechnical engineering principles

Evidence shall show an understanding of electrotechnical principles to an extent indicated by the following aspects:

T1 Resistance encompassing:

- relationship between voltage, current and resistance and the power dissipated in a circuit
- value of voltage, current and resistance in a circuit given any two of these quantities
- the factors of length, cross-sectional area and material effect the resistance of conductors
- effects of temperature change on the resistance of various conducting materials
- features of fixed and variable resistor types and typical applications
- characteristics of temperature, voltage and light dependent resistors and typical applications of each

T2 Series circuits encompassing:

- measurement of resistance, voltage and current values in a single source series circuit
- the voltage, current, resistances or power dissipated from measured or given values of any two of these quantities
- relationship between the voltage drops around a circuit and the applied voltage

T3 Parallel circuits encompassing:

- measurement of resistance, voltage and current values in a single-source parallel circuit
- the voltage, current, resistance or power dissipated from measured or given values of any of these quantities
- relationship between currents entering a junction and currents leaving a junction

T4 Series/parallel circuits encompassing:

- measurement of resistance, voltage and current values in a single-source series / parallel circuit
- the voltage, current, resistances or power dissipated from measured or given values of any two of these quantities

REQUIRED SKILLS AND KNOWLEDGE

T5 Measurement of electrical quantities encompassing:

- operating characteristics of analogue and digital meters
- selecting an appropriate meter in terms of units to be measured, range, loading effect and accuracy for a given application

T6 Capacitance/Capacitors encompassing:

- definition of capacitance and explain how a capacitor is charged
- the units by which capacitance is measured
- relationship between capacitance, voltage and charge
- behaviour of a series d.c. circuit containing resistance and capacitance components
- factors which determine the capacitance of a capacitor and explain how these factors are present in all circuits to some extent

T7 Magnetism and electromagnetism encompassing:

- field patterns around given permanent magnets
- magnetic field patterns around a straight current carrying conductor and a solenoid
- direction in which the magnetic field around a straight current carrying conductor

T8 Electromagnetic induction encompassing:

- factors required to induce an emf in a conductor

T9 Sinusoidal alternating voltage and current encompassing:

- how a sinusoidal voltage is generated in a single turn coil rotated in a uniform magnetic field
- definition of the terms ‘period’, ‘maximum value’, ‘peak-to-peak value’, ‘instantaneous value’, ‘average value’ and ‘root-mean-square (r.m.s.) value’ in relation to a sinusoidal waveform
- instantaneous value of induced voltage of a generated sinusoidal waveform
- root-mean-square (r.m.s.) value and frequency of a sinusoidal waveform from values of peak voltage and period

T10 Test equipment encompassing:

- operating principles of a CRO including block diagram of functional areas
- set up, calibration and use of an oscilloscope to measure d.c and a.c. voltages and frequency
- measurement of the instantaneous, peak, peak-to-peak values and the period of sinusoidal and other common waveforms provided by a signal generator
- calibration and limitation of CRO probes
- use of signal generator as a voltage source

T11 Phase relationships in a.c. circuits encompassing:

- phasor representation of graphical waveforms
- ‘in-phase’, ‘out-of-phase’, ‘phase angle’, ‘lead’, and ‘lag’
- convention for representing voltage, current and the reference quantity in a phasor

REQUIRED SKILLS AND KNOWLEDGE

diagram

- phasor diagrams to show the relationship between two or more a.c. values of voltage and/or current

T12 Single-source resistive a.c. circuits of various frequencies encompassing:

- single-source a.c. circuit and taking resistance, voltage and current measurements
- voltage, current, resistances or power dissipated from measured or given values of any two of these quantities

T13 Inductance in a.c. circuits encompassing:

- concept of inductance, self-inductance and mutual inductance. (in terms of storage of magnetic energy)
- factors affecting inductance and how the unit of inductance is derived
- value of induced voltage in a given circuit
- how a series d.c. circuit containing resistance and inductance behaves
- 'inductive reactance'
- inductive reactance of a given inductor and show the relationship between inductive reactance and frequency
- applying Ohm's law to determine voltage, current or inductive reactance in a purely inductive a.c. circuit given any two of these quantities
- examples of inductive components in circuits and systems and describe their effect on the phase relationship between voltage and current

T14 Capacitance in a.c. circuits encompassing:

- capacitive reactance of a given capacitor and the relationship between capacitive reactance and frequency
- applying Ohm's law to determine voltage, current or capacitive reactance in a purely capacitive a.c. circuit given any two of these quantities
- examples of capacitive components in electronic circuits and systems and describe their effect on the phase relationship between voltage and current

T15 Impedance in a.c. circuits encompassing:

- definition of 'impedance'
- impedance of series, parallel and series-parallel circuits and draw diagrams showing the relationship between resistive, inductive and capacitive components
- single-source a.c. circuit with resistance, voltage and current measurements
- determination of the voltage, current or impedance from measured or given values of any two of these quantities
- using phasor diagrams to solve problems and show the relationship between voltages and currents in a.c. circuits

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 the 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 must 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:
  - Apply calculations required to solve electrotechnical problems as described in 8) and including:

A Clearly stating problems in written and diagrammatic form.

B Obtaining known constants and variable from an appropriate source.

C Solving problems using appropriate calculations

D	Documenting justification of solutions provided in accordance with professional standards.
E	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.

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 applying calculations required to solve electrotechnical 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 that the specified essential knowledge and associated skills are assessed 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)**

There are no concurrent assessment recommendations for this unit.

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 solve electrotechnical engineering problems that apply to electrotechnical diagnostic and systems processes in the development of work functions in any of the following disciplines:

- Computer systems
- Electrical/Electronics
- Refrigeration and Air Conditioning
- Renewable Energy

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)**

Electrotechnology