Australian Government

Assessment Requirements for UEEEL0020 Solve problems in low voltage a.c. circuits

Release: 2

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Modification History

Release 2. This is the second release of this unit of competency in the UEE Electrotechnology Training Package.

Assessor requirements updated in Assessment Conditions.

Release 1. This is the first release of this unit of competency in the UEE Electrotechnology Training Package.

Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions on at least one occasions and include:

- applying relevant work health and safety (WHS)/occupational health and safety (OHS) requirements Including:
  - implementing OHS/WHS workplace procedures and practices, including risk control measures
  - safely measuring the parameters for the whole or any part of a circuit
- measuring:
  - instantaneous, peak, peak-to-peak values and the period of a sinusoidal waveform
  - the phase angle between two or more alternating quantities from a given sinusoidal waveform diagram
  - the fault-loop impedance of typical circuits
  - the branch currents and voltages in a series and parallel resistance inductance capacitance (RLC) circuit and use a phasor diagram to determine the total current and phase angle between circuit voltage and circuit current
- determining:
  - phase relationship between two or more sinusoidal waveforms from a given diagram
  - the impedance, current and voltages and phase angles for a series and parallel resistance capacitance (RC), resistance inductance (RL), and RLC circuit given the resistance, capacitance, inductance and supply voltage
  - comparison of current limiting characteristics of inductors and resistors
  - the relationship between inductive reactance and capacitive reactance and frequency
  - difference between true power, apparent power and reactive power and the units in which these quantities are measured
  - the root-mean-square (rms) value of line and phase, voltage and current given any one of these quantities

  - the effects of a high impedance in the neutral conductor of a three phase four wire system supplying an unbalanced load where multiple earthed neutral (MEN) earthing is employed
  - the value of neutral current in an unbalanced three phase four wire systems given line currents and power factors
  - how the power factor of a three phase installation can be improved
  - fault loop impedance using resistance and reactance values from relevant industry standards
  - voltage, current and resistance from measured or given values of any two of these qualities
  - the phase sequence of a three phase supply
- drawing and labelling the following:
  - the power triangle to show the relationships between true power, apparent power and reactive power
  - the typical combinations of three phase interconnected systems using star and delta connection
  - the impedance triangle for a series RC, RL and RLC circuit
  - the equivalent circuit of a practical inductor
  - phasor diagrams to show:
    - the relationship between two or more alternating current (a.c.) values of voltage and/or current, including ‘in-phase’, ‘out-of-phase’, ‘phase angle’, lead’ and ‘lag’
    - a series and parallel RC, RL, and RLC circuits
- calculating:
  - rms value of voltage generated in each phase given the maximum value
  - terms in relation to a sinusoidal waveform from values of root-mean-square (rms) value, frequency, peak voltage, period and instantaneous value
  - capacitive reactance and inductive reactance for a given capacitor and inductor
  - total impedance for a series and parallel RLC circuit
- connecting a three-phase star and delta load
- setting up and connecting a single-source resistive a.c. circuit and taking voltage and current measurements to determine the resistance
- applying sustainable energy principles and practices
- completing workplace documentation
- voltage, current and reactance of inductive and capacitive reactance by applying Ohm’s law in purely inductive and capacitive a.c. circuits given any two quantities
- altering an existing circuit to comply with specified operating parameters
- developing circuits to comply with a specified function and operating parameters
- determining conditions causing an existing circuit to be unsafe
- dealing with unplanned events.

Knowledge Evidence

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

- a.c. quantities, including:
  - Pythagoras theorem to a right-angle triangle
  - sine, cosine and tangent ratios of a right-angle triangle
  - sinusoidal voltage generated by a single turn coil rotated in a uniform magnetic field and resulting current
  - terms in relation to a sinusoidal waveform involving:
    - period
    - maximum value
    - peak-to-peak value
    - instantaneous value
    - average value
    - rms value
  - use of a cathode-ray oscilloscope (CRO) to measure d.c. and a.c. voltage levels
- phasor diagrams, including:
  - convention for representing voltage, current and the reference quantity in a phasor diagram
  - purpose of phasor diagrams
- single element a.c. circuits, including:
  - applications of capacitive, inductive and resistive a.c circuits
  - defining inductive and capacitive reactance
  - relationship between voltage drops and current in resistive a.c. circuit
  - arrangement, characteristics of single item inductive and capacitive circuits
- RC and RL series a.c. circuits, including:
  - capacitive and inductive components in power circuits and systems and the effect on the phase relationship between voltage and current
  - impedance and impedance triangle
  - voltage triangle
  - arrangement, characteristics, and relationship between resistance, capacitance and inductance in RL, RC, and LC series circuits
- RLC series and parallel a.c. circuits, including:
  - practical examples of RLC series and parallel circuits
  - voltage and current triangle
  - relationship between resistance, capacitance and inductance in RLC parallel circuits
- power in an a.c. circuit, including:
  - definition of power factor and phase angle
  - methods used to measure single phase power, energy and demand

    - effects of low power factor
- power factor improvement, including:
    - requirements for power factor improvement
    - methods used to improve low power factor of an installation
    - local supply authority and AS/NZS 3000 requirements regarding the power factor of an installation and power factor improvement equipment
    - local supply authority and AS/NZS 3000 requirements for installation of capacitors including safety considerations
    - using manufacturer catalogues to select power factor equipment for a particular installation
- harmonics and resonance effect in a.c. systems, including:
    - conditions in a series and parallel a.c. circuit that produce resonance
    - dangers of series and parallel resonance circuits
    - methods and test equipment used to test for harmonics
    - methods used to reduce harmonics in a.c. power system
    - problems that may arise in a.c. circuits as a result of harmonics and how these are overcome
    - sources in a.c. systems that produce harmonics
    - term harmonic in relation to the sinusoidal waveform of an a.c. power system
- three phase systems, including:
    - features of a multi-phase system
    - comparison of voltages generated by single and multi-phase alternators
    - how three phase is generated in a single alternator
    - advantages of three phase for power systems
    - relationship between the phase voltages generated in a three phase alternator and the conventions for identifying each
    - method of determining the phase sequence or phase rotation of a three-phase supply
- three phase star connections, including:
    - arrangement and characteristics of a three phase star connection
    - effect of a reversed phase winding of a star connected alternator
    - examples of balanced and unbalanced loads in typical power systems
    - terms balanced load and unbalanced load
- three phase four wire systems, including:
    - purpose of the neutral conductor in three phase four wire systems
    - AS/NZS 3000 requirements regarding neutral conductors
    - AS/NZS 3008.1.1 Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions method for determining voltage drop in unbalanced three phase circuits
- three phase delta connections and interconnected systems, including:
    - arrangement and characteristics of a three phase delta connection
    - effect of a reversed phase winding of a delta connected transformer

  - examples of loads in typical power systems
  - limitations and uses of open delta connections
- energy and power requirements of ac systems, including:
  - purposes for measuring power, energy, power factor and maximum demand of a.c. power systems and loads
  - difference between true power, apparent power and reactive power and the units in which these quantities are measured in a three phase system
  - methods used to measure three phase power, energy, power factor and demand
  - using manufacturers catalogues to select measurement equipment for a particular installation
- fault-loop impedance, including:
  - procedures for testing fault-loop impedance
  - term fault-loop impedance of an a.c. power system
- local requirements and relevant industry standards relating to:
  - the installation of capacitors
  - the power factor of an installation and power factor improvement equipment
  - harmonics and resonance effect in a.c. power systems
  - neutral conductors
- phase relationship between line and phase voltages and line and phase currents of star, delta, and typical interconnected systems using star connections and delta connections
- relevant manufacturers' specifications

Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessors must also hold the occupational licence for the jurisdiction the assessment is occurring where the activity being assessed requires a licence to practice.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must occur in workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated workplace operational situations that replicate workplace conditions.

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.

Resources for assessment must include access to:

- a range of relevant exercises, case studies and/or other simulations
- relevant and appropriate materials, tools, facilities, equipment and personal protective equipment (PPE) currently used in industry
- applicable documentation, including workplace procedures, equipment specifications,

regulations, relevant industry standards, codes of practice and operation manuals.

Links

Companion Volume Implementation Guides are found in VETNet - https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6