Course outline: 231 AC Machines G006A
UEENEEG006A - Solve problems in single and three phase low voltage machines

Qualification:	Certificate III in Electrotechnology Electrician - UEE30811
Applicable to:	Learners, industry/employers, governments, community and Global Energy Training Solutions as the provider
Unit of competency:	Accessible from:
Related policies:	Policy & Procedure 1 – Enrolment Policy Policy & Procedure 2 – Credit Transfer & Recognition of Prior Learning Policy & Procedure 3 – Learner Support Policy & Procedure 4 – Assessment Policy & Procedure 5 – Academic Misconduct Policy & Procedure 6 – Alcohol & Other Drugs Policy & Procedure 7 – Access, Equity & Diversity Policy & Procedure 8 – Vulnerable People Policy & Procedure 9 – Work, Health & Safety Policy & Procedure 10 – Incident, Injury & Rehabilitation Policy & Procedure 11 – Competency, & Qualification Assessment Decisions Policy & Procedure 12 – Complaints & Appeals Policy & Procedure 13 – Privacy Policy & Procedure 14 – Fees Policy & Procedure 15 – Industry & Employer Engagement Policy & Procedure 16 – Trainers & Assessors Policy & Procedure 17 – Administration & Other Staff Policy & Procedure 18 – Quality Assurance Policy & Procedure 19 – Business & Financial Risk Management Policy & Procedure 20 – Changes to Qualifications or Business Policy & Procedure 21 – Conflict of Interest Policy & Procedure 22 – Records Management Policy & Procedure 23 – Marketing & Advertising
Monitor and review:	Policy & Procedure 18 – Quality Assurance
Responsibility:	Ben Murphy – as Proprietor
Questions/queries:	Feedback and suggestions welcomed: office@gets.com.au (+61) 02 6262 0077

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1. Material requirements

- AS/NZS 3000:2007 incorporating amendment 1 and 2
- Scientific calculator, ruler, pens and pencils
- Note book
- Hand tools
- Covered footwear
- Internet access (provided)

2. Session summaries

Day 1	
Required Skills and Knowledge	Single and three-phase transformers T1 Transformer construction encompassing: • types of lamination style and core construction used in single-phase, three phase, double wound, auto transformers and instrument transformers. • identification of different winding styles/types used in transformers. • methods used to insulate low and high voltage transformers. • construction of transformer tanks for distribution transformers. • transformer auxiliary equipment. (Bushings, surge-diverters, tap-changers, hot oil & winding indicators, breather, Buchholz relay and conservator). • function of transformer auxiliary equipment. • types of information stated on transformer nameplates. • application of transformers. • performing basic insulation resistance, continuity and winding identification tests. T2 Transformer operation encompassing: • principles of mutual induction of a transformer. • factors that determine the induced voltage in a transformer winding. • determining the value of a transformers secondary voltage and current given one winding's electrical details and turns ratio. • identification of voltage and current components of a phasor diagram for a transformer on no-load. • principles of power transferred from the primary to secondary when a load is connected using

	a phasor diagram neglecting impedance drops. • selecting transformers for specific application/s. • safety features specified in AS/NZS3000 with respect to transformers and isolating transformers.

Day 2	
Required Skills and Knowledge	T3 Transformer losses, efficiency and cooling encompassing: • power losses which occur in a transformer. • tests which allow the power losses of a transformer to be determine. • determination of transformer losses and efficiency using test results. • relationship between transformer cooling and rating. • methods used for natural and forced cooling of transformers. • properties of transformer oil. • tests conducted on transformer oil. T4 Transformer voltage regulation and percent impedance encompassing: • voltage regulation as applicable to a transformer. • reasons for voltage variation in the output of a transformer. • determine the voltage regulation of a transformer from voltage and percentage impedance values. • percentage impedance as applied to transformers. • determine the percent impedance by using test results. • determine percent impedance of a transformer by calculation. T5 Parallel operation of transformers and transformer auxiliary equipment encompassing: • determine polarity markings for an unidentified single phase double wound transformer. • need for parallel operation of transformers. • conditions/restrictions required before two transformers can be connected in parallel. • connecting transformers in parallel to supply a single load (loading on transformers operating in parallel). • the consequences/effect of an incorrect connection.

Day 3	
Required Skills and Knowledge	T6 Auto-transformers and instrument transformers encompassing: • identification of auto-transformers, voltage transformers and current transformers from their winding diagrams. • determining voltage and current in the windings of an auto-transformer by calculation. • advantages and disadvantages of an auto-transformer. • AS/NZS3000 requirements with respect to transformers. • construction of voltage transformers. • ratings of voltage transformers. • construction of current transformers. • ratings of current transformers. • precautionary measures taken to connect and disconnect instrument transformers. • connection diagrams for instrument transformers. • applications for auto-transformers and instrument transformers.

Day 4	
Required Skills and Knowledge	Alternating current rotating machines T1 Operating Principles of three phase induction motors encompassing: • determining circuit operating characteristics by using the right hand (grip) rule for conductors

	and solenoids and Fleming's left and right hand rules. • characteristics of the magnetic field produced by a single, two and three-phase windings. • speed of rotation of a rotating magnetic field. • relationship between the rotor speed, slip and rotor frequency. • basic principle of operation of an induction motor. • reversing the direction of rotation of a three phase induction motor T2 Three phase induction motor construction encompassing: • basic component parts of a three-phase induction motor. • types of rotors used in three-phase induction motors. • connecting three-phase induction motor in both star and delta. • dismantling three-phase induction motors. • testing insulation resistance of a three-phase induction motor prior to connection to the supply. • testing winding resistance (ohmic value and continuity) of a three-phase induction motor prior to connection to the supply T3 Three phase induction motor characteristics encompassing: • relationship between torque, speed, and power and interpretation of speed/torque curves of induction motors. • squirrel cage motors operating characteristics conditions necessary for an induction motor to produce maximum torque. • operating characteristics of an induction motor from name plate information and by measurement. • induction motors efficiency and minimum energy performance standards (MEPS). • full load efficiency and power factor of induction motors.

Day 5	
Required Skills and Knowledge	T4 Single phase motors – split phase encompassing: • common types of single phase motor. • principles of operation of a split phase induction motor. • construction and basic characteristics of a split phase induction motor. • applications of split phase induction motors. • connecting, running and reversing a split phase induction motor. T5 Single phase motors – capacitor and shaded pole types encompassing: • identification of single phase induction motors including capacitor start, capacitor start/capacitor run, permanent split capacitor (PSC) and shaded pole • principles of operation of each motor type listed above. • operating characteristics and typical applications of each motor type listed above. • connection and running each type of motor listed. • reversing the direction of rotation of each of the capacitor type motors. T6 Single phase motors – universal encompassing: • principles of operation of a series universal motor. • identification and functions of each of the basic parts of a series universal motor. • operating characteristics and typical uses for a series universal motor. • connecting, running and reversing a series universal motor.

Day 6	
Required Skills and Knowledge	T7 Motor protection encompassing: • reasons why motor protection is required. • requirements of the AS/NZS3000 Wiring rules with regards to motor protection.

	• types of motor overload protection. • operating principles of micro therm devices, thermal and magnetic motor protection devices. • electrical features of motor protection HRC fuses. • effects of under voltage and over voltage on motors and motor circuits. • effects of repetitive starting and/or reversing on motors. • special requirements for motor protection, in high humidity or moist environments, high temperature areas and corrosive atmospheres. • operating principles of phase failure protection. • selecting suitable protective devices for a given motor and starter combination. T8 Three phase synchronous machines- operation principles and construction encompassing: • power transfer diagram of an a.c. synchronous machine. • need for the generation of a sinusoidal waveform. • principles of operation of a synchronous alternator. • principles of operation of a synchronous motor. • principles of operation of an asynchronous generator (induction generator). • identification of main parts of a synchronous alternator/motor. • methods used to provide the excitation of a synchronous alternator/motor. • block diagram of an alternator voltage regulator. • advantages gained by the parallel operation of alternators. • starting methods of synchronous motors.

Day 7	
Required Skills and Knowledge	T9 Alternators and generators encompassing: • effects on the generated voltage of variations in excitation. • effects on generated voltage of variations in load. • identification of characteristic curves of an alternator. • types of prime movers used with single and three phase portable/standby alternators. • manual operation of single and three phase portable/standby alternators. • ratings of single and three phase portable/standby alternators. • applications of single and three phase portable/standby alternators. • construction details of single and three phase portable/standby alternators. • common faults found in portable/standby alternators.

3. Elements and Performance Criteria

Elements and Performance Criteria require practice and demonstration in the work place.

Element		Performance Criteria	Work Performance
1:Prepare to solve single and three phase low voltage machines problems.	1.1	OHS procedures for a given work area are identified, obtained and understood.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	1.2	Established OHS risk control measures and procedures in preparation for the work are followed.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	1.3	Safety hazards, which have not previously been identified, are noted and established risk control measures are implemented.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	1.4	The nature of the machine (s) problem is obtained from documentation or from work supervisor to establish the scope of work to be undertaken.	☐ Satisfactory ☐ Needs improvement ☐ Not performed

	1.5	Advice is sought from the work supervisor to ensure the work is coordinated effectively with others.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	1.6	Sources of materials that may be required for the work are established in accordance with established procedures.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	1.7	Tools, equipment and testing devices needed to carry out the work are obtained and checked for correct operation and safety.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
2:Solve single and three phase low voltage machine problems.	2.1	OHS risk control measures and procedures for carrying out the work are followed.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	2.2	The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	2.3	Circuits/machines/plant are checked as being isolated where necessary in strict accordance OHS requirements and procedures.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	2.4	Established methods are used to solve machine problems from measure and calculated values as they apply to single and three-phase low voltage machines.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	2.5	Established methods for dealing with unexpected situations are discussed with appropriate person or persons and documented.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	2.6	Unexpected situations are dealt with safely and with the approval of an authorised person.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	2.7	Problems are solved without damage to machines, circuits, the surrounding environment or services and using sustainable energy practices.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
3: Complete work and document problem solving activities.	3.1	OHS work completion risk control measures and procedures are followed.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	3.2	Work site is cleaned and made safe in accordance with established procedures.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	3.3	Justification for solutions used to solve machine problems is documented.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	3.4	Work completion is documented and an appropriate person or persons notified in accordance with established procedures.	☐ Satisfactory ☐ Needs improvement ☐ Not performed

4. Assessments

Assessment	When	Satisfactory mark/outcome
Theory assessment 1	Day 3	70%
Theory assessment 2	Day 7	70%
Practical assessment 1	Day 2	100%

Practical assessment 2	Day 7	100%
Workplace Observation	After theory and practical assessments	Must be valid, sufficient, authentic and current
Employer Competency report		
Structured workplace experience interview		
Note: Once all theory, practical and on-site assessments are complete, competency assessment decisions can be made in conjunction with the learner, employer and registered training organisation.		

5. Version control

Version	Date of release	Author	Authorised by	Position	Rational for change
V1	5/10/2015	Ben Murphy	Ben Murphy	Proprietor	Initial release
V2	7/2/2017	Ben Murphy	Ben Murphy	Proprietor	Added Elements and Performance Criteria