Course outline: 121 DC Circuits E104A
UEENEEE104A - Solve problems in D.C. circuits

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: http://training.gov.au/Training/Details/UEENEEE104A
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	T1 Basic electrical concepts encompassing: • electrotechnology industry • static and current electricity • production of electricity by renewable and non renewable energy sources • transportation of electricity from the source to the load via the transmission and distribution systems • utilisation of electricity by the various loads • basic calculations involving quantity of electricity, velocity and speed with relationship to the generation and transportation of electricity. T2 Basic electrical circuit encompassing: • symbols used to represent an electrical energy source, a load, a switch and a circuit protection device in a circuit diagram • purpose of each component in the circuit • effects of an open-circuit, a closed-circuit and a short-circuit • multiple and sub-multiple units T3 Ohm’s Law encompassing: • basic d.c. single path circuit. • voltage and currents levels in a basic d.c. single path circuit. • effects of an open-circuit, a closed-circuit and a short-circuit on a basic d.c. single path

	relationship between voltage and current from measured values in a simple circuit • determining voltage, current and resistance in a circuit given any two of these quantities • graphical relationships of voltage, current and resistance • relationship between voltage, current and resistance

Day 2	
Required Skills and Knowledge	T4 Electrical power encompassing: • relationship between force, power, work and energy • power dissipated in circuit from voltage, current and resistance values • power ratings of devices • measurement electrical power in a d.c. circuit • effects of power rating of various resistors T5 Effects of electrical current encompassing: • physiological effects of current and the fundamental principles (listed in AS/NZS 3000) for protection against the this effect • basic principles by which electric current can result in the production of heat; the production of magnetic fields; a chemical reaction • typical uses of the effects of current • mechanisms by which metals corrode • fundamental principles (listed in AS/NZS3000) for protection against the damaging effects of current

Day 3	
Required Skills and Knowledge	T6 EMF sources energy sources and conversion electrical energy encompassing: • basic principles of producing a emf from the interaction of a moving conductor in a magnetic field. • basic principles of producing an emf from the heating of one junction of a thermocouple. • basic principles of producing a emf by the application of sun light falling on the surface of photovoltaic cells • basic principles of generating a emf when a mechanical force is applied to a crystal (piezo electric effect) • principles of producing a electrical current from primary, secondary and fuel cells • input, output, efficiency or losses of electrical systems and machines • effect of losses in electrical wiring and machines • principle of conservation of energy T7 Resistors encompassing: • features of fixed and variable resistor types and typical applications • identification of fixed and variable resistors • various types of fixed resistors used in the Electro technology Industry. e.g. wire-wound, carbon film, tapped resistors. • various types of variable resistors used in the Electro technology Industry e.g. adjustable resistors: potentiometer and rheostat; light dependent resistor (LDR); voltage dependent resistor (VDR) and temperature dependent resistor (NTC, PTC). • characteristics of temperature, voltage and light dependent resistors and typical applications of each • power ratings of a resistor. • power loss (heat) occurring in a conductor. • resistance of a colour coded resistor from colour code tables and confirm the value by measurement. • measurement of resistance of a range of variable’ resistors under varying conditions of light, voltage, temperature conditions.

	• specifying a resistor for a particular application.

Day 4	
Required Skills and Knowledge	T8 Series circuits encompassing: • circuit diagram of a single-source d.c. ‘series’ circuit. • Identification of the major components of a ‘series’ circuit: power supply; loads; connecting leads and switch • applications where ‘series’ circuits are used in the Electro technology industry. • characteristics of a ‘series’ circuit - connection of loads, current path, voltage drops, power dissipation and affects of an open circuit in a ‘series’ circuit. • the voltage, current, resistances or power dissipated from measured or given values of any two of these quantities • relationship between voltage drops and resistance in a simple voltage divider network. • setting up and connecting a single-source series dc circuit • measurement of resistance, voltage and current values in a single source series circuit • effect of an open-circuit on a series connected circuit T9 Parallel circuits encompassing: • schematic diagram of a single-source d.c. ‘parallel’ circuit. • major components of a ‘parallel’ circuit (power supply, loads, connecting leads and switch) • applications where ‘parallel’ circuits are used in the Electrotechnology industry. • characteristics of a ‘parallel’ circuit. (load connection, current paths, voltage drops, power dissipation, affects of an open circuit in a ‘parallel’ circuit). • relationship between currents entering a junction and currents leaving a junction • relationship between branch currents and resistances in a two branch current divider network. • calculation of the total resistance of a ‘parallel’ circuit. • calculation of the total current of a ‘parallel’ circuit. • Calculation of the total voltage and the individual voltage drops of a ‘parallel’ circuit. • setting up and connecting a single-source d.c. parallel circuit • resistance, voltage and current measurements in a single-source parallel circuit • voltage, current, resistance or power dissipated from measured values of any of these quantities • output current and voltage levels of connecting cells in parallel.

Day 5	
Required Skills and Knowledge	T10 Series/parallel circuits encompassing: • schematic diagram of a single-source d.c. ‘series/parallel’ circuit. • major components of a ‘series/parallel’ circuit (power supply, loads, connecting leads and switch) • applications where ‘series/parallel’ circuits are used in the Electrotechnology industry. • characteristics of a ‘series/parallel’ circuit. (load connection, current paths, voltage drops, power dissipation, affects of an open circuit in a ‘series/parallel’ circuit). • relationship between voltages, currents and resistances in a bridge network. • calculation of the total resistance of a ‘series/parallel’ circuit. • calculation of the total current of a ‘series/parallel’ circuit. • calculation of the total voltage and the individual voltage drops of a ‘series/parallel’ circuit. • setting up and connecting a single-source d.c. series/ parallel circuit • resistance, voltage and current measurements in a single-source d.c. series / parallel circuit • the voltage, current, resistances or power dissipated from measured values of any two of these quantities T11 Factors affecting resistance encompassing: • four factors that affect the resistance of a conductor (type of material, length, cross-sectional

	area and temperature) • affect the change in the type of material (resistivity) has on the resistance of a conductor. • affect the change in 'length' has on the resistance of a conductor. • affect the change in 'cross-sectional area' has on the resistance of a conductor. • effects of temperature change on the resistance of various conducting materials • effects of resistance on the current-carrying capacity and voltage drop in cables. • calculation of the resistance of a conductor from factors such as conductor length, cross-sectional area, resistivity and changes in temperature • using digital and analogue ohmmeter to measure the change in resistance of different types of conductive materials (copper, aluminium, nichrome, tungsten) when those materials undergo a change in type of material length, cross-sectional area and temperature.

Day 6	
Required Skills and Knowledge	T12 Effects of meters in a circuit encompassing: • selecting an appropriate meter in terms of units to be measured, range, loading effect and accuracy for a given application. • measuring resistance using direct, volt-ammeter and bridge methods. • instruments used in the field to measure voltage, current, resistance and insulation resistance and the typical circumstances in which they are used. • hazards involved in using electrical instruments and the safety control measures that should be taken. • operating characteristics of analogue and digital meters. • correct techniques to read the scale of an analogue meters and how to reduce the 'parallax' error. • types of voltmeters used in the Electrotechnology industry – bench type, clamp meter, Multimeter, etc. • purpose and characteristics (internal resistance, range, loading effect and accuracy) of a voltmeter. • types of voltage indicator testers. e.g. LED, neon, solenoid, volt-stick, series tester, etc. and explain the purpose of each voltage indicator tester. • operation of various voltage indicator testers. • advantages and disadvantages of each voltage indicator tester. • various types of ammeters used in the Electrotechnology industry – bench, clamp meter, multimeter, etc. • purpose of an ammeter and the correct connection (series) of an ammeter into a circuit. • reasons why the internal resistance of an ammeter must be extremely low and the dangers and consequences of connecting an ammeter in parallel and/or wrong polarity. • selecting an appropriate meter in terms of units to be measured, range, loading effect and accuracy for a given application • connecting an analogue/digital voltmeter into a circuit ensuring the polarities are correct and take various voltage readings. • loading effect of various voltmeters when measuring voltage across various loads. • using voltage indicator testers to detect the presence of various voltage levels. • connecting analogue/digital ammeter into a circuit ensuring the polarities are correct and take various current readings.

Day 7	
Required Skills and Knowledge	T13 Resistance measurement encompassing: • Identification of instruments used in the field to measure resistance (including insulation resistance) and the typical circumstances in which they are used. • the purpose of an Insulation Resistance (IR) Tester. • the parts and functions of various analogue and digital IR Tester (selector range switch, zero ohms adjustment, battery check function, scale and connecting leads).

	• reasons why the supply must be isolated prior to using the IR tester. • where and why the continuity test would be used in an electrical installation. • where and why the insulation resistance test would be used in an electrical installation. • the voltage ranges of an IR tester and where each range may be used. e.g. 250 V d.c, 500 V d.c and 1000 V d.c • AS/NZS3000 Wiring Rules requirements – continuity test and insulation resistance (IR) test. • purpose of regular IR tester calibration. • the correct methods of storing the IR tester after use • carry out a calibration check on a IR Tester • measurement of low values of resistance using an IR tester continuity functions. • measurement of high values of resistance using an IR tester insulation resistance function. • volt-ammeter (short shunt and long shunt) methods of measuring resistance. • calculation of resistance values using voltmeter and ammeter reading (long and short shunt connections) • measurement of resistance using volt-ammeter methods

Day 8	
Required Skills and Knowledge	T14 Capacitors and Capacitance encompassing: • basic construction of standard capacitor, highlighting the: plates, dielectric and connecting leads • different types of dielectric material and each dielectric's relative permittivity. • identification of various types of capacitors commonly used in the Electrotechnology industry (fixed value capacitors -stacked plate, rolled, electrolytic, ceramic, mica and Variable value capacitors – tuning and trimmer) • circuit symbol of various types of capacitors: standard; variable, trimmer and polarised • terms: Capacitance (C), Electric charge (Q) and Energy (W) • unit of: Capacitance (Farad), Electric charge (Coulomb) and Energy (Joule) • factors affecting capacitance (the effective area of the plates, the distance between the plates and the type of dielectric) and explain how these factors are present in all circuits to some extent. • how a capacitor is charged in a d.c. circuit. • behaviour of a series d.c. circuit containing resistance and capacitance components. - charge and discharge curves • the term 'Time Constant' and its relationship to the charging and discharging of a capacitor. • calculation of quantities from given information: Capacitance (Q = VC); Energy (W =½CV2); Voltage (V = Q/C) • calculation one time constant as well as the time taken to fully charge and discharge a given capacitor. ($\tau = RC$) • connection of a series d.c. circuit containing capacitance and resistor to determine the time constant of the circuit

Day 9	
Required Skills and Knowledge	T15 Capacitors in Series and Parallel encompassing: • hazards involved in working with capacitance effects and the safety control measures that should be taken. • safe handling and the correct methods of discharging various size capacitors • dangers of a charged capacitor and the consequences of discharging a capacitor through a person • factors which determine the capacitance of a capacitor and explain how these factors are present in all circuits to some extent. • effects of capacitors connected in parallel by calculating their equivalent capacitance. • effects on the total capacitance of capacitors connected in series by calculating their equivalent capacitance.

	• Connecting capacitors in series and/or parallel configurations to achieve various capacitance values. • common faults in capacitors. • testing of capacitors to determine serviceability. • application of capacitors in the Electrotechnology industry.

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 work on DC electrical circuits	1.1	OHS procedures for a given work area are identified, obtained and understood.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	1.2	OHS risk control work preparation measures and procedures are followed.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	1.3	The nature of the circuit problem is obtained from documentation or from work supervisor to establish the scope of work to be undertaken.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	1.4	Advice is sought from the work supervisor to ensure the work is coordinated effectively with others.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	1.5	Sources of materials that may be required for the work are identified and accessed in accordance with established procedures.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	1.6	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 DC circuit problems	2.1	OHS risk control work measures and procedures 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 are checked as being isolated where necessary in strict accordance OHS requirements and procedures.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	2.4	Established methodological techniques are used to solve d.c. circuit problems from measure and calculated values as they apply to electrical circuit.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	2.5	Unexpected situations are dealt with safely and with the approval of an authorised person.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	2.6	Problems are solved without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practices.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
3:Complete work and	3.1	OHS work completion risk control measures and procedures are followed.	☐ Satisfactory ☐ Needs improvement

document problem solving activities			☐ 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 circuit problems is documented.	☐ Satisfactory ☐ Needs improvement ☐ Not performed
	3.4	Work completion is documented and appropriate person(s) notified in accordance with established procedures.	☐ Satisfactory ☐ Needs improvement ☐ Not performed

4. Assessments

Assessment	When	Satisfactory mark/outcome
Theory assessment 1	Day 4	70%
Theory assessment 2	Day 7	70%
Theory assessment 3	Day 9	70%
Practical assessment 1	Day 3	100%
Practical assessment 2	Day 5	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